Beneficials

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Beneficials

A major purpose of IPM strategies is to maintain and enhance beneficial organisms that attack insect pests. They are grouped into:

- predators
- parasites,
- spiders, and
- insect pathogens.

To find information for the beneficial organism you are looking for, click on the button on the left-hand side that best describes the group to which the beneficial is likely to belong.

Examples of beneficials

Predators

Predators

Each insect predator can attack a range of species and several life stages, such as nymphs and adults.
Generally, both immature and adult predators attack their prey, consuming a considerable number of prey to complete their life cycle.
Some of these predators, such as the water bug, live on the surface of the water in the rice field, preying on pest insects that fall from the crop. Other predators actively seek out their prey on the crop surface.

Lady beetles

Lady beetles

The following species of Lady beetles are important insect predators in rice:

Family: Coccinellidae
Harmonia octomaculata (Fabricius)
Menochilus sexmaculatus (Fabricius)
Micraspis crocea (Mulsant)

A typical coccinellid beetle (Micraspis sp.)

Scientific name: Harmonia octomaculata (Fabricius)

Common name: Lady beetle

Larva of lady beetle Harmonia octomaculata (Fabricius)

Ladybird beetle Harmonia octomaculata

Larva of Harmonia octomaculata feeding on brown planthopper nymph

Taxonomy	Class: Insecta Order: Coleoptera Family: Coccinellidae
Economic importance	Generalist predator.
Hosts	Leafhoppers, planthoppers, aphids, and leaffolders.
Description	Harmonia octomaculata is a black-spotted lady beetle. It is reddish brown. Each front wing or elytron has five black spots and the pronotum has one to two pairs of quadrate to sub-ovate black spots. It has black legs with reddish yellow tibiae and tarsi. The spotted lady beetle measures 6 to 7 mm long.
Biology and ecology	Harmonia octomaculata can produce 150 to 200 offspring. Development from egg to adult takes about 1 to 2 weeks. Pupation takes place on the leaf. The beetle larvae are more voracious than the adults. They can consume 5 to 10 prey a day and feed on all stages of the insect. They also catch slow-moving prey.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

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Yasumatsu K. 1981. An illustrated guide to some natural enemies of rice insect pests in Thailand. Part I. Japan International Cooperation Agency. 72 p.

Scientific name: Menochilus sexmaculatus (Fabricius)

Common name: Lady beetle

Lady beetle Menochilus sexmaculatus (Fabricius)

Taxonomy	Class: Insecta Order: Coleoptera Family: Coccinellidae
Economic importance	Generalist predator
Hosts	Planthoppers
Description	Menochilus sexmaculatus is a black-spotted lady beetle. The long and narrow black band at the pronotal base is connected to the transverse oval black discal spot by a short and narrow longitudinal constriction or line. Each elytron has two wavy black bands and a rounded black sub-apical spot and a narrow black band is present on both anterior edges of the elytron.
Biology and ecology	The lady beetles catch slow-moving prey. When disturbed, they fly off. Both the adults and larvae prey on small planthopper adults, nymphs, and eggs. They can consume 5 to 10 prey daily. Development from egg to adult takes 6 to 10 weeks. A single beetle can lay as many as 150 to 200 eggs.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

Shepard BM, Barrion AT, Litsinger JA. 1987. Helpful insects, spiders, and pathogens. Manila (Philippines): International Rice Research Institute. 127 p.

Scientific name: Micraspis crocea (Mulsant)

Common name: Lady beetle

A lady beetle, Micraspis crocea (Mulsant)

Dark larva of Micraspis crocea feeding on nymphs of planthopper

Taxonomy	Class: Insecta Order: Coleoptera Family: Coccinellidae
Economic importance	Generalist predator
Hosts	Leafhoppers, planthoppers, leaf-feeding insects, and aphids
Description	Micraspis crocea is an oval beetle. It is yellow with a pair of black spots on the head or pronotum. The elytra are devoid of any markings. The insect is 4 to 5 mm long.
Biology and ecology	Micraspis crocea is a very active beetle. In daytime, it stays in the upper half of the canopy in dryland and wetland habitats. Both the adults and larvae feed on small hoppers such as the brown planthopper. They also prey on small larvae and exposed eggs.

Selected references

Shepard BM, Barrion AT, Litsinger JA. 1987. Helpful insects, spiders, and pathogens. Manila (Philippines): International Rice Research Institute. 127 p.

Shepard BM, Rapusas HR. 1989. Life cycle of Micraspis sp. on brown planthopper (BPH) and rice pollen. Int. Rice Res. Newsl. 14(3):40.

Ground beetle

Ground beetle

Ophionea nigrofasciata, known as the ground beetle is a reddish brown insect with a bluish band on the elytra.

Reddish brown adult of Ophionea nigrofasciata (Schmidt-Goebel)

Scientific name: Ophionea nigrofasciata (Schmidt-Goebel)

Common name: Ground beetle

Reddish brown adult of Ophionea nigrofasciata (Schmidt-Goebel)

Taxonomy	Class: Insecta Order: Coleoptera Family: Carabidae
Economic importance	Generalist predator
Hosts	Leaffolder larvae and planthoppers.
Description	Ophionea nigrofasciata, known as the ground beetle is a reddish brown insect with a bluish band on the elytra. Two white spots are located on both ends of the bluish band. The beetle has a shiny black head.
Biology and ecology	The insect is always found within the folded leaf made by the leaffolder larvae. It can prey on 3 to 5 larvae per day. It also feeds on planthoppers. O. nigrofasciata is common in both wetland rice bunds and dryland fields where it also pupates.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. 779 p.

Shepard BM, Barrion AT, Litsinger JA. 1987. Helpful insects, spiders, and pathogens. Manila (Philippines): International Rice Research Institute. 127 p.

Crickets

Crickets

Two species of Crickets are common predators of rice insect pests:

Family: Gryllidae
Anaxipha longipennis (Serville) (Cricket)
Metioche vittaticollis (Stal) (Sword-tailed Cricket)

Scientific name: Anaxipha longipennis (Serville)

Common name: Crickets

Adult of Anaxipha longipennis (Serville)

Taxonomy	Class: Insecta Order: Orthoptera Family: Gryllidae
Economic importance	Generalist predator
Hosts	Leafhoppers, planthoppers, eggs of armyworm, whorl maggot, stem borers, and leaffolders.
Description	Anaxipha longipennis is a brown cricket. Its head, thorax, wings, and legs are yellow. The scape and pedicel of the antennae are pale yellow. The terminal segment of the maxillary palpi is triangular and has a broad truncated tip. Wing venations differ in both sexes. The male adult has a neat anal mirror or ringed pattern. The female has a feebly convex wing with 5 straight veins in the dorsal area.
Biology and ecology	These predators are found in wetland and dryland habitats. The females use their sword-like ovipositors to insert their eggs into the sheaths of rice and grasses. Both the adults and nymphs are important predators.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

Shepard BM, Barrion AT, Litsinger JA. 1987. Manila (Philippines): International Rice Research Institute. 127 p.

Scientific name: Metioche vittaticollis (Stal)

Common name: Crickets, sword-tailed crickets

Nymph of Metioche vittaticollis (Stal)

Adult of Metioche vittaticollis

Taxonomy	Class: Insecta Order: Orthoptera Family: Gryllidae
Economic importance	Generalist predator
Hosts	Bugs, hoppers, larvae of whorl maggot, leaffolder, stem borers, and armyworms.

Description	***Egg*** The egg is cylindrical and angled at the point where it attaches to the plant tissue. Freshly laid eggs are smooth, shiny, and transparent to translucent. They later turn white. Before egg hatching, eggs increase in size. ***Nymph*** The nymphs are whitish to gray with black hairs all over the body. Brownish stripes are present from the head to the abdomen. ***Adult*** Metioche vittaticollis adults are black. The dorsal part of the head has a light yellow to white mark. The scape and pedicel of the antennae are black as is the terminal segment of the maxillary palpi, which are also tinged with brown. The tips of the terminal maxillary palpi are moderately broad and truncated. Wing venations of both sexes are similar. The male cricket has a neat anal field mirror, whereas the female has false veins and 5 straight veins in the dorsal area of the feebly convex wing. The second tarsal segment of the leg is black.
Biology and ecology	The adults and nymphs of M. vittaticolis are predators of eggs, small larvae, and hoppers. The adult female has a sword-like ovipositor, which is used to insert eggs into the leaf sheaths of rice and grasses. Development from egg to adult takes 60-80 days and a female can produce as many as 40-80 nymphs. Laboratory studies show that egg incubation takes 7 to 15 days. Nymphs pass through four nymphal instars in 24 to 27 days. Both male and female adults live 15 to 37 days.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

Rubia EG. 1986. Biological and toxicological studies of the cricket, Metioche vittaticollis (Stal) (Orthoptera: Gryllidae), a predator of rice insect pests. Unpublished M.S. Thesis, University of the Philippines Los Baños, College, Laguna. 79 p.

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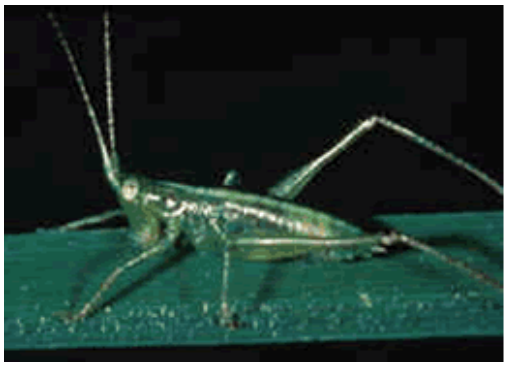
Meadow grasshopper

Meadow grasshopper

The green insect is distinguished from other grasshoppers by its long thread-like antennae.



Green nymph of Conocephaluslongipennis (de Haan) longipennis

Meadow grasshopper Conocephalus

Scientific name: Conocephalus longipennis (de Haan)

Common name: Meadow grasshopper

Green nymph of Conocephalus longipennis (de Haan)

Meadow grasshopper Conocephalus longipennis

Taxonomy	Class: Insecta Order: Orthoptera Family: Tettigoniidae
Economic importance	Generalist predator
Hosts	Eggs of rice bugs and stem borers and nymphs of leafhoppers and planthoppers.

Description	The green insect is distinguished from other grasshoppers by its long thread-like antennae. It is a large insect with slanted face. The thorax and abdomen are yellow. It has 4-segmented tarsi. The female adult has an elongated ovipositor. The nymphs are green and have no wings. The female nymphs lack the sword-like ovipositor.
Biology and ecology	The adult is active during the night and readily flies when disturbed. It is abundant in older fields. The meadow grasshopper has dual food habits. Aside from being a predator, it also feeds on rice leaves and panicles. As a predator, it can consume 3 to 4 yellow stem borer egg masses daily. The adult lives 3 to 4 months.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

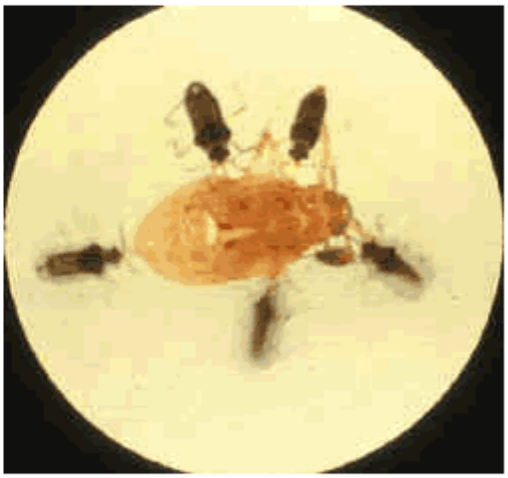
Reissig WH, Heinrichs EA, Litsinger JA, Moody K, Fiedler L, Mew TW, Barrion AT. 1986. Illustrated guide to integrated pest management in rice in tropical Asia. Manila (Philippines): International Rice Research Institute. 411 p.

Shepard BM, Barrion AT, Litsinger JA. 1987. Helpful insects, spiders, and pathogens. Manila (Philippines): International Rice Research Institute. 127 p.

Water Bug

Water Bug

Microvelia douglasi atrolineata is a short but broad small water bug.



Scientific name: Microvelia douglasi atrolineata Bergroth

Common name: Water bug

The broad-shouldered adults of water bug Microvelia douglasi atrolineata Bergroth

Nymph of Microvelia douglasi atrolineata

Water bugs feeding on hoppers on the water surface

Taxonomy	Class: Insecta Order: Hemiptera Family: Veliidae
Economic importance	Generalist predator
Hosts	Leafhoppers and planthoppers.
Description	Microvelia douglasi atrolineata is a short but broad small water bug. It is black with small gray areas. It exists in two forms, winged or wingless. The wingless adults have no black and white markings on the neck and front wings. These water bugs can be distinguished by their broad shoulder and 1-segmented front tarsus. Their claws are anteapical.
Biology and ecology	Both the adults and nymphs live on the water surface and attack insects that fall onto the surface. They are more successful as predators when they attack the host in groups. A single water bug feeds on small nymphs, whereas a group of Microvelia will attack larger prey. The water bugs use their mouth parts to inject a toxic solution to paralyze the prey. A single predator feeds on 4 to 7 hoppers daily. A female water bug can lay 20 to 30 eggs in rice stems above the water surface in her life span of 1 to 2 months. Microvelia douglasi atrolineata can survive for long periods even without food provided the field is saturated or flooded.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

Reissig WH, Heinrichs EA, Litsinger JA, Moody K, Fiedler L, Mew TW, Barrion AT. 1986. Illustrated guide to integrated pest management in rice in tropical Asia. Manila (Philippines): International Rice Research Institute. p 13-362.

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Water Strider

Water Strider

Limnogonus fossarum is a black and long-legged water strider.

Adult form of water strider Limnogonus fossarum (Fabricius)

Scientific name: Limnogonus fossarum (Fabricius)

Common name: Water strider

Adult form of water strider Limnogonus fossarum (Fabricius)

Taxonomy	Class: Insecta Order: Hemiptera Family: Gerridae
Economic importance	Generalist predator
Hosts	Leafhoppers, planthoppers, and moths.
Description	Limnogonus fossarum is a black and long-legged water strider. Its rear legs are long and slender, whereas its front legs are very short. Its hind femur extends beyond the abdominal tip. The mid coxae are closer to the hind coxae than the fore coxae. It is distinguished from other water striders by the longitudinal yellow line on the posterior of the pronotum.
Biology and ecology	Limnogonus fossarum adults and nymphs prey on 5 to 10 hosts a day. They lay as many as 10 to 30 eggs in the rice stem above the water surface. They also deposit their eggs on floating objects. They live for 1 to 1.5 months. In a greenhouse experiment in the Philippines, the life cycle of the insect was 57 to 66 days. A female adult can lay 87 eggs.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

Rubia EG, Heong KL. 1990. Life history of water strider Limnogonus fossarum (F.). Int. Rice Res. Newsl. 15(1):34-35.
Shepard BM, Barrion AT, Litsinger JA. 1987. Helpful insects, spiders, and pathogens. Manila (Philippines): International Rice Research Institute. 127 p.

Van Vreden G, Ahmadzabidi AL. 1986. Pests of rice and their natural enemies in peninsular Malaysia. Wageningen (Netherlands): Centre for Agricultural Publishing and Documentation (Pudoc). 230 p.

Water Treader

Water Treader

Mesovelia vittigera is pale green.

Wingless adult of water bug Mesovelia vittigera (Horvath)

Scientific name: Mesovelia vittigera (Horvath)

Common name: Water treader

Wingless adult of water bug Mesovelia vittigera (Horvath)

Taxonomy	Class: Insecta Order: Hemiptera Family: Gerridae
Economic importance	Generalist predator
Hosts	Stem borers, leafhoppers, and planthoppers.
Description	Mesovelia vittigera is pale green. It is larger than Microvelia douglasi atrolineata Bergroth. It appears in two morphs, the winged and unwinged adults. The head is longer than it is wide and is acute frontally. Its eyes are not convergent. The tarsi of the legs have a small basal segment. In winged species, the membrane on the hemelytron of the front wings has no closed cells and the corium has dark brown thickened veins forming three whitish cells.
Biology and ecology	Mesovelia vittigera is a solitary feeder. Both the adults and nymphs prey on stem borer larvae and hoppers that easily fall onto the water surface. Of the two morphs, the wingless adults are more common. The predators are usually found in rice fields and rice bunds.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

Shepard BM, Barrion AT, Litsinger JA. 1987. Helpful insects, spiders, and pathogens. Manila (Philippines): International Rice Research Institute. 127 p.

Plant Bug

Plant Bug

Cyrtorhinus lividipennis is a light green mirid bug with green membranous wings and black spotted thorax.

Green and black adult of plant bug Cyrtorhinus lividipennis Reuter

Nymph of plant bug Cyrtorhinus lividipennis

Scientific name: Cyrtorhinus lividipennis Reuter

Common name: Plant bug

Green and black adult of plant bug Cyrtorhinus lividipennis Reuter

Nymph of plant bug Cyrtorhinus lividipennis

Taxonomy	Class: Insecta Order: Hemiptera Family: Miridae
Economic importance	Generalist predator
Hosts	Leafhopper and planthopper eggs and nymphs.
Description	Cyrtorhinus lividipennis is a light green mirid bug with green membranous wings and black spotted thorax. It is elongate and oval. The second antennal segment is slightly longer than the width of the pronotal base. The tip of the first antennal segment is greenish yellow. It has green legs except for the yellowish tibiae.

Biology and ecology	Cyrtorhinus lividipennis is a plant-feeding insect. It is also predaceous on planthopper and leafhopper eggs and young nymphs. It lays its eggs inside plant tissue. A female mirid bug can produce 10 to 20 individuals. Development from egg to adult takes 2 to 3 weeks. Each predator preys on 7 to 10 eggs or 1 to 5 hoppers daily. Both the adults and nymphs suck the hopper eggs by inserting their mouth parts and collecting the egg liquid, causing the eggs to collapse.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

Reissig WH, Heinrichs EA, Litsinger JA, Moody K, Fiedler L, Mew TW, Barrion AT. 1986. Illustrated guide to integrated pest management in rice in tropical Asia. Manila (Philippines): International Rice Research Institute. 411 p.

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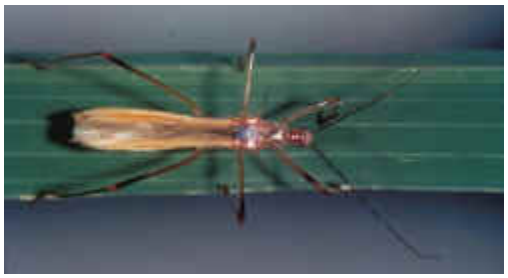
Van Vreden G, Ahmadzabidi AL. 1986. Pests of rice and their natural enemies in peninsular Malaysia. Wageningen (Netherlands): Centre for Agricultural Publishing and Documentation (Pudoc). 230 p.

Assassin Bug

Assassin Bug

Polytoxus fuscovittatus is easily distinguished by the three spines on the thorax.

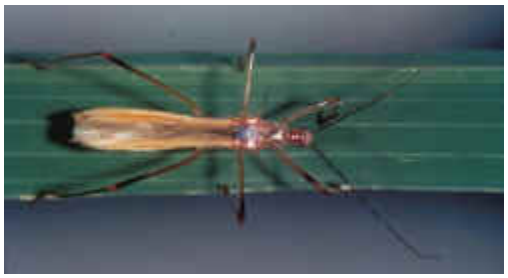


Brown adult of assassin bug Polytoxus fuscovittatus (Stal)

Lateral view of assassin bug Polytoxus fuscovittatus (Stal)

Scientific name: Polytoxus fuscovittatus (Stal)

Common name: Assassin bug



Brown adult of assassin bug Polytoxus fuscovittatus (Stal)

Lateral view of assassin bug Polytoxus fuscovittatus (Stal)

Taxonomy	Class: Insecta Order: Hemiptera Family: Reduviidae
Economic importance	Generalist predator
Hosts	Larvae of moths and butterflies.
Description	Polytoxus fuscovittatus is easily distinguished by the three spines on the thorax. The lateral spines on the apex of the pronotum are about half the length of its pronotum, whereas the apical spine on the scutellum is outwardly and upwardly curved. Its head is shorter than the pronotum and has a transverse suture near the eyes. The pronotum is brownish black medially and reddish at both margins; the beak is 3-segmented. The legs of the assassin bug are yellowish except for the brownish black apices of the femora that are also tinged with red-orange. The bases of the tibia are light red-orange and the tarsi have black apices.

Biology and ecology	Assassin bugs are solitary predators of lepidopterous larvae. They can attack prey larger than themselves by piercing its body with their needle- like mouth parts.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

Reissig WH, Heinrichs EA, Litsinger JA, Moody K, Fiedler L, Mew TW, Barrion AT. 1986. Illustrated guide to integrated pest management in rice in tropical Asia. Manila (Philippines): International Rice Research Institute. 411 p.

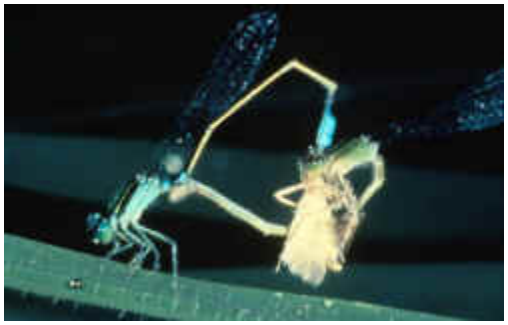
Shepard BM, Barrion AT, Litsinger JA. 1987. Helpful insects, spiders, and pathogens. Manila (Philippines): International Rice Research Institute. 127 p.

Damselflies

Damselflies

The narrow winged damselflies are weak fliers compared with their dragonfly cousins. The yellow-green and black adults have a long slender abdomen. They feed on flying moths, butterflies, and hoppers. The following are common in rice:

Family: Coenagrionidae
Agriocnemis femina femina (Brauer)
Agriocnemis pygmaea (Rambur)

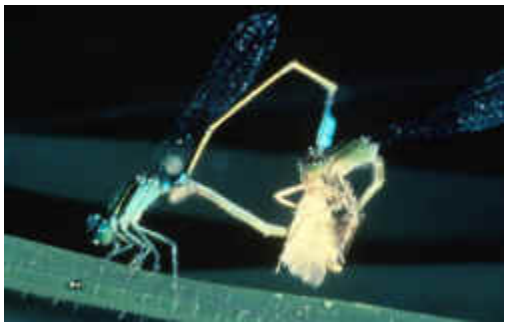


A mating pair of Agriocnemis femina femina (Brauer)

Adult damselfly, Agriocnemis pygmaea (Rambur)

Scientific name: Agriocnemis femina femina (Brauer)

Common name: Damselfly



A mating pair of Agriocnemis femina femina (Brauer)

Taxonomy	Class: Insecta Order: Othoptera Family: Coenagrionidae
Economic importance	Generalist predator
Hosts	Leafhoppers, planthoppers, moths, and butterflies.
Description	Agriocnemis femina femina is 16 to 18 mm in length. The male species has an orange and black body with blue-green abdominal tip. The sides of the thorax are also blue-green. Older species are whitish. The female damselfly is deep reddish. With age, it changes to dark green.
Biology and ecology	The immatures called naiads are aquatic. They feed on hopper nymphs by climbing up rice stems. The adult damselflies may prey on flying insects such as moths and butterflies. They also feed on leafhoppers and planthoppers.

Selected references

Shepard BM, Barrion AT, Litsinger JA. 1987. Helpful insects, spiders, and pathogens. Manila (Philippines): International Rice Research Institute. 127 p.

Yasumatsu K. 1981. An Illustarted guide to some natural enemies of rice insect pests in Thailand. Part I. Japan International Cooperation Agency. 71 p.

Scientific name: Agriocnemis pygmaea (Rambur)

Common name: Damselfly

Adult damselfly, Agriocnemis pygmaea (Rambur)

Taxonomy	Class: Insecta Order: Odonata Family: Coenagrionidae
Economic importance	Generalist predator
Hosts	Leafhoppers and planthoppers.
Description	The narrow winged damselfly adult is yellow-green and black. It has a long slender abdomen. The male adult is more colorful with an orange abdominal tip.
Biology and ecology	The adult damselfly preys on hoppers. Its nymphs are aquatic and can climb up the rice stems in search of prey. Adults are also predators.

Selected reference

Shepard BM, Barrion AT, Litsinger JA. 1987. Helpful insects, spiders, and pathogens. Manila (Philippines): International Rice Research Institute. 127 p.

Earwig

Earwig

Euborellia stali is a shiny black earwig with sclerotized tegmina.

Adult earwig Euborellia stali (Dohrn)

Scientific name: Euborellia stali (Dohrn)

Common name: Earwig

Adult earwig Euborellia stali (Dohrn)

Taxonomy	Class: Insecta Order: Dermaptera Family: Carcinophoridae
Economic importance	Generalist predator
Hosts	Leaffolder and stem borer larvae.
Description	Euborellia stali is a shiny black earwig with sclerotized tegmina. It has white bands between the abdominal segments. Two antennal segments located near the tip are white. Earwigs have a hind pair of forceps-like cerci. These are used more for defense than for capturing prey.
Biology and ecology	Earwigs are common in dryland habitats. They rest in the soil at the base of rice hills and are nocturnal. A female earwig can lay 200-350 eggs in 3-5 months. It preys on stem borer larvae by entering the borer tunnel and climbs the rice plant to prey on leaffolder larvae. It can consume 20-30 prey daily.

Selected reference

Shepard BM, Barrion AT, Litsinger JA. 1987. Helpful insects, spiders, and pathogens. Manila (Philippines): International Rice Research Institute. 127 p.

Ants

Ants

Solenopsis is reddish to brown and has 10-segmented antennae with 2-segmented clubs.

Solenopsis geminata (Fabricius) feeding on eggs of black bug

Solenopsis geminata also preys on adult black bug

Scientific name: Solenopsis geminata (Fabricius)

Common name: Red ant, red fire ant

Solenopsis geminata (Fabricius) feeding on eggs of black bug

Solenopsis geminata also preys on adult black bug

Taxonomy	Class: Insecta Order: Hymenoptera Family: Formicidae
Economic importance	Generalist predator
Hosts	Leafhoppers, planthoppers, bugs, and moths.

Description	Solenopsis is reddish to brown and has 10-segmented antennae with 2-segmented clubs. Its eyes are relatively larger than those of other species of ants.
Biology and ecology	Red ants make nests below the soil surface in upland fields and in bunds or levees in wetland rice fields. The nests they make are for workers and soldiers. They colonize newly established fields and prey on different kinds of insects and small animals, including adult black bugs. Solenopsis hunts by day near the nest and prefers dry land habitats. Red ants are common in upland environments and in dry-seeded rice fields in rainy wetlands.

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Spiders

Spiders

Like their insect counterparts, spiders are generally predators. The hunting spiders, including the wolf and jumping spider, are the most important predators in tropical rice. Web spiders spin a web in the crop to catch their prey.

Wolf spider

Wolf spider

The following Pardosa pseudoannulata are found in rice:

Scientific name: Pardosa pseudoannulata (Boesenberg & Strand)

Common name: Wolf spider

Pardosa pseudoannulata (Boes. & Strand) feeding on a stem borer adult

Spiderling of Pardosa pseudoannulata preying on a brown planthopper nymph

Female Pardosa pseudoannulata spider

Ventral view of Pardosa pseudoannulata feeding on green leafhopper

Taxonomy	Class: Arachnida Order: Araneae Family: Lycosidae
Economic importance	Generalist predator
Hosts	Leafhoppers, planthoppers, moths, and butterflies.
Description	Pardosa pseudoannulata has a forked or Y-shaped median light band on the carapace. Its sub-lateral margins have a longitudinal white band. The male spider has 4 to 5 transverse light bands on the dorsal side of the abdomen, whereas the female has 3 elongate-ovate light bands and a pair of globular spots. In addition, the male has enlarged palps.

Biology and ecology	Pardosa pseudoannulata is a very active spider. It hunts for its prey. The adults are usually found near the base of the plants. They prefer leafhoppers and planthoppers as prey. They feed on 5 to 15 prey daily. At high population density, they also eat each other. The female spider lays as many as 200 to 400 eggs in a sac. From this sac, about 60 to 80 spiderlings hatch. Newly hatched spiderlings remain attached to the female for several days. The female lives 3 to 4 months. In greenhouse experiments, the wolf spider was observed to have an underwater hiding behavior. It can hide under water with silver bubbles covering the body. It breaths through air films trapped by the hairs of the body. Wolf spiders are found in newly prepared wetland or dryland rice fields.

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Lynx spider

Lynx spider

There are two main species of Lynx spiders found in rice:

Family: Oxyopidae
Oxyopes javanus Thorell
Oxyopes lineatipes (C.L. Koch)

Scientific name: Oxyopes javanus Thorell

Common name: Lynx spider

Female Oxyopes javanus Thorell, a lynx spider with two pairs of diagonal white bands on the sides of the abdomen

Male Oxyopes javanus showing its enlarged palps

Taxonomy	Class: Arachnida Order: Araneae Family: Oxyopidae
Economic importance	Generalist predator
Hosts	Moths and butterflies.

Description	Oxyopes javanus measures 7 to 10 mm long. Its eyes are arranged in three distinct rows. It has diagonal or longitudinal bands on the long and elongated abdomen. Its legs are brown, long, slender, and spinous. It has a three-clawed tarsus. Oxyopes females have two pairs of diagonal white bands on the sides of the abdomen. Oxyopes males have enlarged palps.
Biology and ecology	Lynx spiders are direct hunters. They do not build webs. A female spider can produce as many as 200 to 350 spiderlings in her lifetime of 3 to 5 months. The spider prefers drier habitats and colonizes rice fields after canopy development. It can prey on 2 to 3 moths a day and it has the habit of hiding from its prey until within striking distance.

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Yasumatsu K. 1981. An illustrated to some natural enemies of rice insect pests in Thailand. Japan International Cooperation Agency. 72 p.

Scientific name: Oxyopes lineatipes (C.L. Koch)

Common name: Lynx spider

Oxyopes lineatipes (C.L. Koch) is another lynx spider with two reddish brown and two white stripes running along its abdomen

Taxonomy	Class: Arachnida Order: Araneae Family: Oxyopidae
Economic importance	Predator.
Hosts	Moths and butterflies.
Description	O. lineatipes has a yellowish orange cephalothorax and abdomen. Two reddish brown and two white stripes run along the entire length of the body. The legs are spinous.
Biology and ecology	This predator is commonly known as the lynx spider. It lives within the rice canopy, hunts for its prey, and does not build any web. It has the same hunting habit as Oxyopes javanus Thorell. It can kill 2 to 3 moths a day. The O. lineatipes female lays 200 to 350 eggs in her life span of 3 to 5 months.

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Barrion AT, Litsinger JA. 1995. Riceland spiders of south and southeast Asia. Manila (Philippines): International Rice Research Institute. 700 p.

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Jumping spider

Jumping spider

Phidippus sp. is a brown jumping spider.

A jumping spider Phidippus sp.

Scientific name: Phidippus sp.

Common name: Jumping spider

A jumping spider Phidippus sp.

Taxonomy	Class: Arachnida Order: Araneae Family: Salticidae
Economic importance	Generalist predator.
Hosts	Leafhoppers.
Description	Phidippus sp. is a brown jumping spider. It has two bulging eyes and these are arranged in three distinct rows. It has a broadly or partly ovoid abdomen. The abdomen has a light transverse basal band. Brown hairs cover the body. The male jumping spider has normal chelicerae. It has eyebrows in the eye region.
Biology and ecology	A female spider produces 60 to 90 spiderlings in her lifetime of 2 to 4 months. The elongated eggs are laid in a mass. They are covered with silk within a folded leaf. The female guards the egg mass. The jumping spider is common in dryland habitats. It stays in the rice foliage and hunts for its prey. It also waits for its prey by hiding in a small retreat web in a folded leaf. It also feeds on other small insects.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

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Dwarf spider

Dwarf spider

Dwarf spiders are very small and are often confused with spiderlings of other species.

Scientific name: Atypena (= Callitrichia) formosana (Oi)

Common name: Dwarf spider

A dwarf spider Atypena formosana (Oi)

A close-up of a dwarf spider (Atypena formosana)

Dwarf spider Atypena formosana

Taxonomy	Class: Arachnida Order: Araneae Family: Linyphiidae
Economic importance	Generalist predator.
Hosts	Leafhoppers and planthoppers.
Description	Dwarf spiders are very small and are often confused with spiderlings of other species. They measure 1 to 5 mm in dimension. Their eyes are arranged in two distinct rows. The adults have three pairs of spots or gray markings on the dorsal part of the spherical abdomen. Their tarsi are three-clawed. The males have normal chelicerae. The eggs of A. formosana are globular.
Biology and ecology	Dwarf spiders are found in groups of 30 to 40 at the base of the rice plant. A female produces 80 to 100 spiderlings in her life span of 45 to 60 days. The eggs, covered with a thin layer of silk, are laid in masses on dried leaf sheaths. They do not receive any maternal care. A. formosana prefers wetland habitats. It builds webs within the base of rice tillers above the water line and catches most of its prey in webs. It can also hunt directly and feed on 4 to 5 leafhopper and planthopper nymphs a day.

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Orb spider

Orb spider

The following two species of Orb spiders are common predators of rice insect pests:
Family: Araneidae
Araneus inustus (L. Koch)
Argiope catenulata (Doleschall)

Scientific name: Araneus inustus (L. Koch)

Common name: Orb Spider

An orb spider Araneus inustus (L. Koch)

Another species of orb spider (Araneus sp.)

Taxonomy	Class: Arachnida Order: Araneae Family: Araneidae
Economic importance	Generalist predator.
Hosts	Leafhoppers, planthoppers, and flies.
Description	Araneus inustus is smaller than Argiope catenulata (Doleschall). The male's body is 4 to 5 mm long, whereas the female is bigger, 5 to 8 mm long. The legs of both sexes are yellow. They have a brown cephalothorax. Their abdomen is yellowish with a blackish ovoid band on the lateral margins of the dorsal part. Thin hairs cover the abdomen.

Biology and ecology	Araneus inustus builds a web to catch its prey. The web is an irregular pattern located between the leaves. The female lays its eggs within folded leaves and covers its eggs by secreting a white silken thread.

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Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p.13-362.

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Yasumatsu, K. (1981). An illustrated guide to some natural enemies of rice insect pests in Thailand. Japan International Cooperation Agency. 72 p.

Scientific name: Argiope catenulata (Doleschall)

Common name: Orb spider

Taxonomy	Class: Arachnida Order: Araneae Family: Araneidae
Economic importance	Generalist predator.
Hosts	Leafhoppers, planthoppers, and flies.
Description	Argiope catenulata is a colorful spider. The female's cephalothorax is yellow with black eye margins. Its abdomen is oblong with a black and silvery-whitish yellow dorsal pattern. Brown patches of irregular shapes are present from the median of the abdomen to the posterior side. The legs are black with thin white rings. The male is smaller than the female. It has a brownish red to yellowish brown cephalothorax with black eye margins. Its abdomen is yellowish with a dorsal pattern as in the female. The legs are yellowish brown.
Biology and ecology	Argiope catenulata builds webs to catch its prey. The circular webs have zigzag webbing known as white stabilimenta making them sticky. They are common in all rice environments. They are late colonizers of rice fields and are found with their heads hanging down in their webs. The female spider lays 600 to 800 eggs in her life span of 2 to 3 months. The eggs of A. catenulata are contained in a light brown cocoon. It hangs on the web.

Selected references

Barrion AT, Litsinger JA. 1995. Riceland spiders of south and southeast Asia. Manila (Philippines): International Rice Research Institute. 700 p.

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Long-jawed spider

Long-jawed spider

Tetragnatha maxillosa is commonly known as the long-jawed spider.

Scientific name: Tetragnatha maxillosa Thorell

Common name: Long-jawed spider

Long-jawed spider Tetragnatha maxillosa Thorell

Male Tetragnatha maxillosa characterized by its enlarged jaws

A long-jawed spider preying on green leafhopper adult

Taxonomy	Class: Arachnida Order: Araneae Family: Tetragnathidae
Economic importance	Generalist predator.

Hosts	Leafhoppers, stem borers, and flies.
Description	Tetragnatha maxillosa is commonly known as the long-jawed spider. It has long legs and body, measuring 6 to 10 mm in length. Its eyes are arranged in two distinct rows. Its abdomen is brownish yellow, with or without markings and usually four or more times longer than it is wide. It has a 3-segmented tarsus. The male long-jawed spider has large chelicerae, which are as long as or longer than the carapace.
Biology and ecology	The female tetragnathid can lay as many as 100 to 200 eggs in her life span of 1 to 3 months. The eggs, which are covered in cottony silk, are laid in masses in the upper half of the rice plant. Tetragnathid prefers a wetland environment. It builds a ring-shaped web where it waits for its prey. It wraps its prey in a silk once trapped in the web. A single tetragnathid feeds on 2 to 3 prey a day.

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Barrion AT, Litsinger JA. 1995. Riceland spiders of south and southeast Asia. Manila (Philippines): International Rice Research Institute. 700 p.

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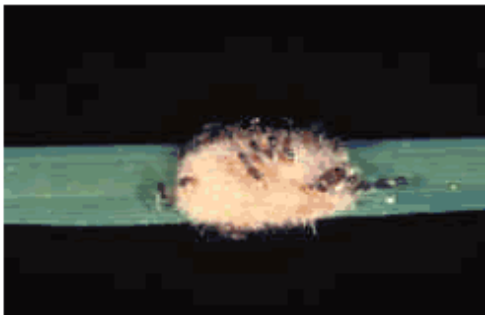
Parasitoids

Parasitoids

Insect parasites are mostly specialists. They prey on one or very few species and then usually only attack one life stage, for instance the egg or larval stage. Insect parasites, which are mostly wasps and flies, generally destroy their prey.

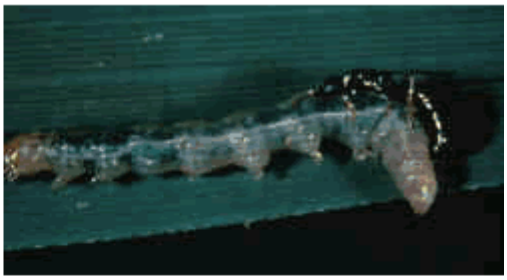
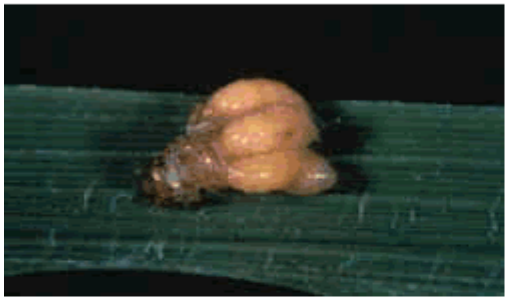


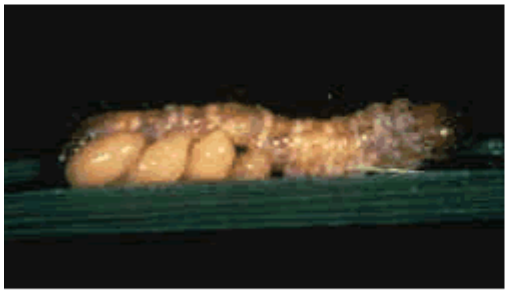
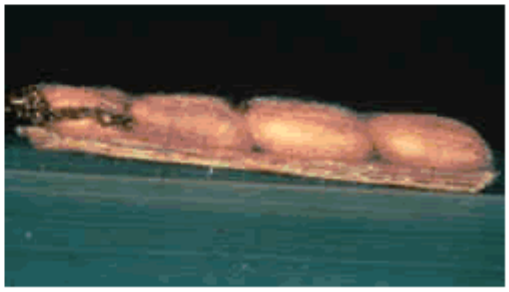
Bethylid Wasp

Bethylid Wasp

This black bethylid wasp is ant-like in appearance.

Dicondylus indianus Olmi
Haplogonatopus apicalis Perkins
Pseudogonatopus nudus Perkins

Scientific name: Goniozus nr. triangulifer Kieffer

Common name: Bethylid wasp

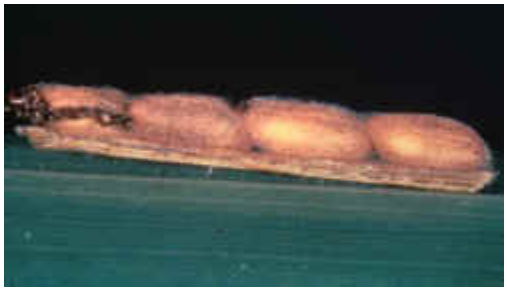
A small ant-like bethylid wasp Goniozus nr. triangulifer Kieffer

A bethylid wasp paralyzing a leaffolder larva before laying its eggs

Early stage parasite larvae of bethylid wasps are globular and yellow

Pupation occurs beside the leaffolder larva

Ovoid parasite larvae of bethylid wasps



Reddish brown cocoons of bethylid wasps

Taxonomy	Class: Insecta Order: Hymenoptera Family: Bethylidae
Economic importance	Parasitoid.
Hosts	Leaffolder larvae.
Description	This black bethylid wasp is ant-like in appearance. It has a flat body with transparent wings and 13-segmented antennae. The early stage parasitoid larva is globular and yellow.
Biology and ecology	The parasitoid enters the folded leaf to parasitize the host larva. It lays 3 to 8 eggs outside the host body. Upon hatching, the parasitoid larvae feed externally on the leaffolder larva. By the fourth day, the infested larva becomes ovoid and is eventually killed by the parasitoid's feeding. Reddish brown cocoons are formed on the fifth day beside the leaffolder body. The development of the parasite from egg to adult takes 10 to 14 days. The female wasp lives for 2 to 3 weeks.

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Bi-Headed Flies

Bi-Headed Flies

The following Big-headed flies are commonly found to parasitize insect pests of rice:
Family: Pipunculidae

Pipunculus javanensis de Meijere
Pipunculus mutillatus (Loew)
Tomosvaryella oryzaetora (Koizumi)
Tomosvaryella subvirescens (Loew)

Scientific name: Pipunculus javanensis de Meijere

Common name: Big-headed fly

A big-headed fly Pipunculus javanensis de Meijere on a leafhopper

Taxonomy	Class: Insecta Order: Diptera Family: Pipunculidae
Economic importance	Parasitoid.
Hosts	Leafhopper and planthopper nymphs and adults.
Description	The parasitoid is a black fly with a large head occupied mainly by its compound eyes. Its third antennal segment is dark brown. It has a row of hairs and a distinct brown spot on the front wings. The legs are black except for the yellow patches along the tibiae and tarsi. The tip of the fly's abdomen is indented at the center. Its body length is 3 mm. The male fly has the genitalia notched on the dorsal part of the tip or apex, whereas the female fly has the tip of the ovipositor curved toward the posterior margin of the fifth abdominal segment.
Biology and ecology	The big-headed fly deposits eggs into the host's abdomen. A single fly develops from each host. Before pupation, the larva moves out from the host's body to pupate in the soil or at the base of the plant. Development from egg to adult is completed in 30-40 days. The female fly parasitizes 2-3 hoppers daily in its life span of 4 days.

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Yasumatsu K. 1981. An illustrated guide to some natural enemies of rice insect pests in Thailand. Japan International Cooperation Agency. 72 p.

Scientific name: Pipunculus mutillatus (Loew)

Common name: Big-headed fly

Taxonomy	Class: Insecta Order: Diptera Family: Pipunculidae
Economic importance	Parasitoid.
Hosts	Leafhopper.
Description	This small black fly has prominent setae on the lateral basal half of its abdominal tergum. Its legs are yellowish brown except for its femora and distal end of the tarsi. A distinct brown spot is present on the marginal vein of the front wings. The right side of the male genitalia has a narrow oblique cleft. The ovipositor of the female is curved toward the basal three abdominal segments.
Biology and ecology	The parasitoid deposits its eggs into the host's abdomen. The host insect develops normally and later dies as soon as the parasite larva emerges. The larva pupates in the soil or near the base of the plant. A single fly develops from each host. The adult fly lives about 4 days and parasitizes 2-3 hoppers a day.

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Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

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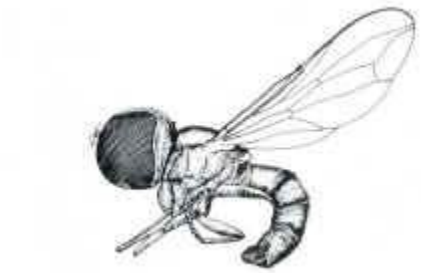
Scientific name: Tomosvaryella oryzaetora (Koizumi)

Common name: Big-headed fly

Adults of Tomosvaryella oryzaetora (Koizumi)



Close-up of a big-headed fly

Taxonomy	Class: Insecta Order: Diptera Family: Pipunculidae
Economic importance	Parasitoid.
Hosts	Nephotettix spp.

Description	Tomosvaryella oryzaetora is a small black fly with large and round head covered entirely by its compound eyes. Its compound eyes do not meet at the middle on the front. A narrow convergence point on the anterior of the ocelli is evident. It has black or gray shoulders or humeri. Its wings are tinged with brown. Its hind femora are devoid of hairs. Both sexes have elongate and sub-cylindrical abdomens. All the segments are shining black and gray. The first segment is the smallest and the shortest, whereas the fifth segment is the longest. The antero-lateral portion of the first abdominal segment has a row of 5 to 6 long bristles located on the anterior and lateral portion. The genitalia of the male are short compared with its abdomen. The ovipositor of the female has a sub-globular base.
Biology and ecology	The adult lays eggs inside the host's body and the host dies soon after the larva emerges. It pupates in the soil or at the base of the plant. A single fly develops from each host. The egg develops to adulthood in 30-40 days; the adult has a life span of 4 days. It can parasitize 2-3 hoppers a day.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

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Scientific name: Tomosvaryella (= Pipunculus) subvirescens (Loew)

Common name: Big-headed fly

A big-headed fly, Tomosvaryella subvirescens (Loew)

Taxonomy	Class: Insecta Order: Diptera Family: Pipunculidae
Economic importance	Parasitoid.
Hosts	Nephotettix spp.
Description	Tomosvaryella subvirescens is a small black fly with large rounded head formed entirely by its compound eyes. Its shoulders or humeri are yellow. It has hyaline wings. Its hind trochanters are trapezoidal. A hairy ridge on each femur is visible. The abdomen of the male is stout and brownish black. It is clothed with short pubescence. Its posterior abdominal end is slightly twisted on the right side. The female has a straight ovipositor.
Biology and ecology	The fly deposits its eggs inside the host's body. The parasitized host is alive but dies as soon as the mature parasite larvae emerge. A single fly develops from each host. The larva pupates in the soil or at the base of the plant. Development from egg to adult takes 30-40 days and the adult lives for 4 days. It can parasitize 2-3 hoppers a day.

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Braconid Wasps

Braconid Wasps

There is great diversity in the Braconid wasps that are found in rice:

Family: Braconidae
Cardiochiles philippinensis Ashmead
Cotesia angustibasis (Gahan)
Cotesia flavipes Cameron
Macrocentrus philippinensis Ashmead
Myosoma chinensis (Szepligeti)
Opius barrioni Fisher
Phanerotoma sp.
Rogas sp.
Snellenius manilae (Ashmead)
Stenobracon nicevillei (Bingham)

An adult braconid wasp (Rogas sp.)

Parasitic larvae of a braconid wasp (Cotesia sp.) developing on their host larvae

Scientific name: Cardiochiles philippinensis Ashmead

Common name: Braconid wasp

A medium-sized stout wasp of Cardiochiles philippinensis Ashmead

Taxonomy	Class: Insecta Order: Hymenoptera Family: Braconidae
Economic importance	Parasitoid.
Hosts	Leaffolder larvae.
Description	Cardiochiles philippinensis is a black parasitoid of medium size. It has hairy eyes and black legs with white hairs. The brown front wings have infuscation after the stigmal vein. The hindwings are also brown with infuscation along the costal area, basal one-fourth, and apical one-fourth. The tips of both wings are dark. The immatures, particularly the larvae of C. philippinensis, are creamy white.
Biology and ecology	The parasitoid wasp is common in dryland and wetland rice environments. The female deposits a single egg on its host by entering the folded leaves. The developing parasitoid larvae also feed externally on the host. Laboratory studies show that C. philippinensis can parasitize as many as 17 leaffolder larvae and live 22.7 days.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

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Shepard BM, Barrion AT, Litsinger JA. 1987. Helpful insects, spiders, and pathogens. Manila (Philippines): International Rice Research Institute. 127 p.

Scientific name: Cotesia (= Apanteles) angustibasis (Gahan)

Common name: Braconid wasp

Dead leaffolder larva with white cocoons of a braconid wasp, Cotesia angustibasis (Gahan)

Newly emerged wasps of Cotesia angustibasis

Taxonomy	Class: Insecta Order: Hymenoptera Family: Braconidae
Economic importance	Parasitoid.
Hosts	Leaffolder larvae.
Description	These black braconid wasps are small and stout. Their head, and particularly their vertex, frons, and temples are very smooth and impunctate. They have very clear wings. The anterior of their mesoscutums has distinct punctures. Their coxae and femora of the legs are all black. The apical half of the hind tibia and the base of the hind tarsus are brownish black. Cotesia angustibasis can also be distinguished from related species by its waist-like first abdominal segment, which is three times longer than its width. Its mid-portion is black, long, and slender.

Biology and ecology	The female adult lays more than 10 eggs inside a larval host of leaffolders. During development, the parasitoid larvae feed internally and eventually kill the larval host. Several parasitic larvae develop inside the host's body. Upon pupation, the mature larvae leave the host and spin white cocoons next to it. The masses of white cocoons are found in the upper portion of the leaves outside the folded leaf. This parasitic wasp lives for 4 to 10 days.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

Borror DJ, Delong DM, Triplehorn CA. 1976. An introduction to the study of insects. New York (USA): Holt, Rinehart and Winston. 852 p.
Reissig WH, Heinrichs EA, Litsinger JA, Moody K, Fiedler L, Mew TW, Barrion AT. 1986. Illustrated guide to integrated pest management in rice in tropical Asia. Manila (Philippines): International Rice Research Institute. 411 p.

Shepard BM, Barrion AT, Litsinger JA. 1987. Helpful insects, spiders, and pathogens. Manila (Philippines): International Rice Research Institute. 127 p.

Scientific name: Cotesia (= Apanteles) flavipes Cameron

Common name: Braconid wasp

Overlapping cocoons of Cotesia flavipes Cameron with a dead host

Taxonomy	Class: Insecta Order: Hymenoptera Family: Braconidae
Economic importance	Parasitoid.
Hosts	Stem borer and semilooper larvae.
Description	Cotesia flavipes is a black wasp. Its legs and short antennae are red except for the spotted brownish yellow to red basal part of the hind legs. The tegulae, stigma, and costal veins of the wings are reddish brown. The first abdominal segment is widened behind and the apicolateral corners are weak and roundly constricted. The ovipositor sheath of the female adult is short.
Biology and ecology	The female adult deposits as many as 20 eggs inside the host larva and it can accommodate the development of several parasitoids. The immatures feed inside the host and emerge from the midlateral sides of the dead host. Before pupation, they spin protective white silk cocoons. The adult parasitic wasps live for 5 to 7 days.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

Borror DJ, Delong DM, Triplehorn CA. 1976. An introduction to the study of insects. New York (USA): Holt, Rinehart and Winston. 852 p.

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Shepard BM, Barrion AT, Litsinger JA. 1987. Helpful insects, spiders, and pathogens. Manila (Philippines): International Rice Research Institute. 127 p.

Scientific name: Macrocentrus philippinensis Ashmead

Common name: Braconid wasp

A female parasite of leaffolder larvae, Macrocentrus philippinensis Ashmead, showing its long ovipositor

A male adult of Macrocentrus philippinensis lacks ovipositor

Taxonomy	Class: Insecta Order: Hymenoptera Family: Braconidae
Economic importance	Parasitoid.
Hosts	Leaffolder larvae.
Description	Macrocentrus philippinensis is a medium-sized braconid wasp. It is thin-bodied and orange or dark yellow. It has a slender abdomen, which is brownish black dorsally with longitudinal striae and yellowish brown edges. The basal two abdominal segments are very slender and flattened. The hind coxae are swollen with a brown patch on the dorsal surface of the apex. The female wasp's ovipositor is almost twice as long as its abdomen and nearly as long as its antennae. The male is similar in size and color.

Biology and ecology	The parasitoid is common in all rice environments. It lays a single egg inside the host's larval body. The egg develops into a single larval parasite. Before pupation, it produces a brown cocoon within the folded leaf. Laboratory studies show that the development of M. philippinensis is completed in 29.4 days. It can consume 20 leaffolder larvae.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

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Yu-jie G, Heong KL, Basilio RP. 1991. Life history of two braconid parasitoids of rice leaffolder (LF) in the laboratory. Int. Rice Res. Newsl. 16(2):22-23.

Scientific name: Opius barrioni Fisher

Common name: Braconid wasp

The braconid wasp Opius is a parasite of whorl maggot larvae

Taxonomy	Class: Insecta Order: Hymenoptera Family: Braconidae
Economic importance	Parasitoid.
Hosts	Whorl maggot larvae.
Description	Opius barrioni is a small, orange-brown braconid wasp. Its antennae are long or as long as the body. The third radial longitudinal vein of the front wing is four-sided. The first abdominal segment is black and slightly triangular on top, whereas the last segment is finely spotted.
Biology and ecology	Opius barrioni parasitizes whorl maggot larvae and each larval host accommodates development of one larval parasite. Parasite development takes 7 to 9 days. The parasite lives for 3 to 4 days. The larva of Opius barrioni is also parasitized by Tetrastichus sp., a small black wasp that also emerges from the whorl maggot pupa.

Selected references

Borror DJ, Delong DM, Triplehorn CA. 1976. An introduction to the study of insects. New York (USA): Holt, Rinehart and Winston. 852 p.

Shepard BM, Barrion AT, Litsinger JA. 1987. Helpful insects, spiders, and pathogens. Manila (Philippines): International Rice Research Institute. 127 p.

Scientific name: Phanerotoma sp.

Common name: Braconid wasp

A small and light brown wasp Phanerotoma sp.

Taxonomy	Class: Insecta Order: Hymenoptera Family: Braconidae
Economic importance	Parasitoid.
Hosts	Stem borer larvae.
Description	Phanerotoma sp. is a small braconid wasp. It is light brown. Its short abdomen is broad and slightly compressed. It has three visible abdominal segments. Another distinguishing characteristic of the wasp is its small terminal antennal segments.
Biology and ecology	The female wasp of Phanerotoma sp. lays a single egg in each larval host. It develops inside the host until the larval host pupates. Development from egg to adult takes 2 to 6 days. The parasite lives from 3 to 6 days.

Selected references

Borror DJ, Delong DM, Triplehorn CA. 1976. An introduction to the study of insects. New York (USA): Holt, Rinehart and Winston. 852 p.

Shepard BM, Barrion AT, Litsinger JA. 1987. Helpful insects, and pathogens. Manila (Philippines): International Rice Research Institute. 127 p.

Scientific name: Snellenius (= Microplitis) manilae (Ashmead)

Common name: Braconid wasp

Parasitized cutworm larva with a single cocoon of Snellenius manilae (Ashmead)

Taxonomy	Class: Insecta Order: Hymenoptera Family: Braconidae
Economic importance	Parasitoid.
Hosts	Cutworm larvae.
Description	Snellenius manilae is a small braconid wasp and is often confused with Cotesia spp. They resemble each other except that S. manilae has a small triangular closed cell on its front wings. It has hairy eyes.
Biology and ecology	Snellenius manilae is host-specific. It parasitizes cutworm larvae. A female wasp oviposits 3 to 5 eggs in the larval host's body. The larval parasite uses the body fluids of its larval host for development. After larval development, cocoons are formed next to the larval host's body. Development to adulthood takes 4 to 8 days. The wasp lives for 6 to 8 days. The larval parasite is host to chalcid wasps Brachymeria spp. Snellenius manilae prefers dryland habitats.

Selected references

Borror DJ, Delong DM, Triplehorn CA. 1976. An introduction to the study of insects. New York (USA): Holt, Rinehart and Winston. 852 p.

Shepard BM, Barrion AT, Litsinger JA. 1987. Helpful insects, spiders, and pathogens. Manila (Philippines): International Rice Research Institute. 127 p.

Scientific name: Stenobracon nicevillei (Bingham)

Common name: Braconid wasp

Adult wasp of Stenobracon nicevillei (Bingham)

Taxonomy	Class: Insecta Order: Hymenoptera Family: Braconidae
Economic importance	Parasitoid.
Hosts	Stem borer larvae.
Description	Stenobracon nicevillei is a large braconid wasp measuring 9 to 13 mm long. Its wings are yellowish with three blackish markings on the front wings. It has an elongated reddish yellow or orange-brown abdomen with the second segment elevated, smooth, and strongly defined. Its sixth abdominal segment is black. The female wasp has an ovipositor twice as long as its body.
Biology and ecology	A female parasitoid inserts its long ovipositor inside the stem borer larva to lay a single egg. Each larval host allows development of a single larval parasitoid. Stenobracon nicevillei is found in dryland environments.

Selected references

Borror DJ, Delong DM, Triplehorn CA. 1976. An introduction to the study of insects. New York (USA): Holt, Rinehart, and Winston. 852 p.

Shepard BM, Barrion AT, Litsinger JA. 1987. Helpful insects, spiders, and pathogens. Manila (Philippines): International Rice Research Institute. 127 p.

Chalcidid Wasps

Chalcidid Wasps

Two species of Brachymeria, from the Chalcidid family of wasps, are beneficials in rice:

Family: Chalcididae
Brachymeria excarinata Gahan
Brachymeria lasus (Walker)

The chalcid wasp Brachymeria excarinata Gahan

A chalcidid wasp Brachymeria lasus (Walker)

Scientific name: Brachymeria excarinata Gahan

Common name: Chalcid wasps

The chalcid wasp Brachymeria excarinata Gahan

Taxonomy	Class: Insecta Order: Hymenoptera Family: Chalcididae
Economic importance	Parasitoid.
Hosts	Leaffolder, skipper, and satyrid larvae.
Description	This parasitoid is black. Its cheek is not triangular, unlike the other species of Brachymeria. Its first abdominal segment is longer than the rest. The dorsal surface of the second abdominal segment has dense minute punctures. Its hind tibiae are mostly black and slightly reddish basally. A yellow spot is located on the sub-basal and apical parts of the hind tibia. It is also recognized by its enlarged femora with teeth in the ventral edge. The hind femora are black except for the apical yellow spot. They contain 10 to 12 teeth on the outer margin.
Biology and ecology	Brachymeria excarinata parasitizes older larvae of leaffolders, skippers, and satyrids. The female lays a single egg inside the larval body or pupal host. Development until pupation takes place inside the host's body. The adult wasp emerges from the head portion of the pupa and its lifespan is 3-5 days.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

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Shepard BM, Barrion AT, Litsinger JA. 1987. Helpful insects, spiders, and pathogens. Manila (Philippines): International Rice Research Institute. 127 p.

Scientific name: Brachymeria lasus (Walker)

Common name: Chalcidid wasp

A chalcidid wasp Brachymeria lasus (Walker)

Taxonomy	Class: Insecta Order: Hymenoptera Family: Chalcididae
Economic importance	Parasitoid.
Hosts	Leaffolder, satyrid, and skipper larvae.
Description	Brachymeria lasus is a black chalcid wasp. Unlike B. excarinata, it has a triangular cheek. It has a short ovoid abdomen with the first tergite very smooth. The hind femur of B. lasus is shiny black with a clear yellow apical part. Its hind tibia is creamy yellow with the entire inner half reddish black.
Biology and ecology	The parasitoid parasitizes older larvae of leaffolder, skippers, and satyrids. The female lays a single egg in the host's body, which is either larva or pupa. Development of the parasitoid until pupation takes place inside the host. After emergence, the parasitoid lives for 3-5 days.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

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Dryinid Wasps

Dryinid Wasps

The following Dryinid wasps parasitize insect pests in rice:

Family: Dryinidae
Dicondylus indianus Olmi
Haplogonatopus apicalis Prekins
Pseudogonatopus nudus Prekins

A parasite larva of Pseudogonatopus sp. protrudes from the abdomen of a young hopper

A whitish oval silk cocoon of a dryinid wasp covering its pupa

Scientific name: Dicondylus indianus Olmi

Synonym: Pseudogonatopus flavifemur Esaki and Hashimoto
Common name: Dryinid wasp

Taxonomy	Class: Insecta Order: Hymenoptera Family: Dryinidae
Economic importance	Parasitoid and predator.
Hosts	Planthopper eggs.
Description	Dicondylus indianus is black except for its brown head. It is ant-like in appearance. Its metathorax and propodeum or first abdominal segment are dull and granulated. It has a pair of pincher claws to grasp the prey. Its enlarged claws have a sub-apical tooth and 5 lamellae. The males have wings and the females are wingless.
Biology and ecology	Dicondylus indianus has dual food habits. It is predacious on planthoppers and feeds on several hoppers a day. Each female lays its eggs inside the host's body. A maximum of 10 leafhopper nymphs may be parasitized per day. Egg incubation is 1 to 2 days. The developing larva feeds on the body fluids of its host. During larval development, a black to grayish sac covers the larva as it protrudes from the host's abdomen. After 7 to 10 days, the whitish larva emerges from the sac. During pupation, a whitish oval silk is secreted to cover the pupa. Before adult emergence, the flat cocoon turns reddish brown. The adult lives for 6 to 7 days. The parasitoid is common in wetland rice fields.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects in tropical asia. Manila (Philippines): International Rice Research Institute. p 13-362.

Borror DJ, Delong DM, Triplehorn CA. 1976. An Introduction to the study of insects. New York (USA): Holt, Rinehart and Winston. 852 p.

Reissig WH, Heinrichs EA, Litsinger JA, Moody K, Fiedler L, Mew TW, Barrion AT. 1986. Illustrated guide to integrated pest management in rice in tropical asia. 411 p.

Shepard BM, Barrion AT, Litsinger JA. 1987. Helpful insects, spiders, and pathogens. Manila (Philippines): International Rice Research Institute. 127 p.

Scientific name: Haplogonatopus apicalis Perkins

Common name: Dryinid wasp

A dryinid wasp Haplogonatopus apicalis Perkins attacks leafhopper

Taxonomy	Class: Insecta Order: Hymenoptera Family: Dryinidae
Economic importance	Parasitoid and predator.
Hosts	Leafhoppers.
Description	This ant-like parasitoid is a light brown dryinid wasp. The female is wingless and has a pair of pincher-like front claws for grasping prey. The male is winged.
Biology and ecology	A female dryinid wasp lives for 6 to 7 days. It can eat 2 to 4 hoppers a day. Likewise, it can also parasitize 4 to 6 hosts a day. It lays one or two eggs inside the hopper host and egg incubation is 1-2 days. During larval development, it feeds on the host's body fluid. It protrudes from the abdomen of its host as a black to grayish sac. After 7 to 10 days, the larval sac splits to expose a whitish larva. Pupation occurs outside the host's body. It secretes a whitish oval silk cocoon to cover the pupa. Before to adult emergence, the flat cocoon turns reddish brown.

Selected references

Barrion AT, Litsinger JA. 1994 Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

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Scientific name: Pseudogonatopus nudus Perkins

Common name: Dryinid wasp

Pseudogonatopus nudus Perkins attacking a planthopper

Taxonomy	Class: Insecta Order: Hymenoptera Family: Dryinidae
Economic importance	Parasitoid and predator.
Hosts	Planthopper nymphs.
Description	Pseudogonatopus nudus is a reddish brown wasp except for its black petiole. Its appearance is ant- like. The sides of its metanotum are protruding. Its metathorax and propodeum are without median furrows. It has enlarged claws with a sub-apical tooth and six lamellae. The male adults of P. nudus are winged, whereas the females are wingless.
Biology and ecology	The female wasp lives for 6 to 7 days. It can parasitize as many as 4 to 10 nymphs per day. A single host can accommodate 1 to 2 eggs of the parasite. After 1 to 2 days, eggs hatch into larvae. The larva uses the host's body fluids for its development. During larval growth, a black to gray sac covers the larva and protrudes from the host's abdomen. The sac tears in 7 to 10 days and the whitish larva wiggles free. During pupation, it secretes a whitish oval silk cocoon to cover the pupa on the plant. The flat cocoon turns reddish brown with age. Pseudogonatopus nudus is also predaceous on planthoppers.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

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Elasmid Wasp

Elasmid Wasp

Elasmus sp. is black and elongate.

Adult wasp of Elasmus sp.

Scientific name: Elasmus sp.

Common name: Elasmid wasp

Adult wasp of Elasmus sp.

Taxonomy	Class: Insecta Order: Hymenoptera Family: Braconidae
Economic importance	Parasitoid.
Hosts	Stem borer larvae.
Description	Stenobracon nicevillei is a large braconid wasp measuring 9 to 13 mm long. Its wings are yellowish with three blackish markings on the front wings. It has an elongated reddish yellow or orange-brown abdomen with the second segment elevated, smooth, and strongly defined. Its sixth abdominal segment is black. The female wasp has an ovipositor twice as long as its body.
Biology and ecology	A female parasitoid inserts its long ovipositor inside the stem borer larva to lay a single egg. Each larval host allows development of a single larval parasitoid. Stenobracon nicevillei is found in dryland environments.

Selected references

Borror DJ, Delong DM, Tripplehorn CA. 1976. An introduction to the study of insects. New York (USA): Holt, Rinehart, and Winston. 852 p.

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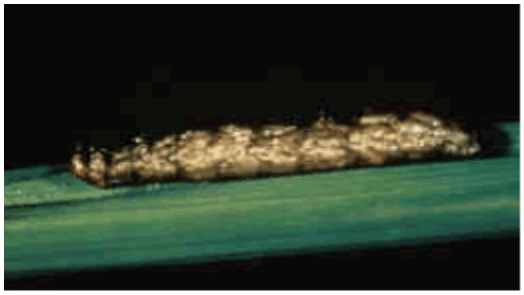
Encyrtid Wasp

Encyrtid Wasp

Copidosomopsis is a gray to black small wasp.



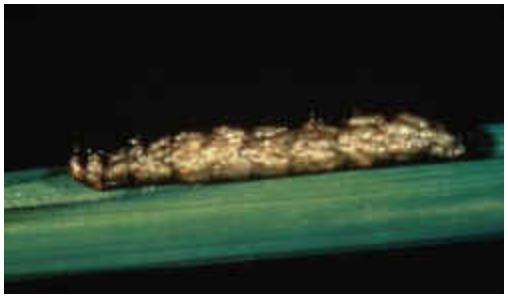
Small encyrtid wasps
Copidosomopsis nacoleiae (Eady)

Parasitized leaffolder with distinct wasp pupae of Copidosomopsis nacoleiae

Scientific name: Copidosomopsis nacoleiae (Eady)

Common name: Encyrtid wasp

Small encyrtid wasps Copidosomopsis nacoleiae (Eady)



Parasitized leaffolder with distinct wasp pupae of Copidosomopsis nacoleiae

Taxonomy	Class: Insecta Order: Hymenoptera Family: Encyrtidae
Economic importance	Parasitoid.
Hosts	Leaffolder eggs.
Description	Copidosomopsis is a gray to black small wasp. It has 8 antennal segments. The middle legs are enlarged and are used for jumping. The basal one-third of the front wing has few hairs; however, the wings are covered entirely with short hairs. The legs have 4-segmented tarsi.
Biology and ecology	The female parasitoid lays eggs inside leaffolder eggs. A single host egg can house numerous parasitoids and they pupate inside the host larvae. The adults live for 2 to 3 days.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

Borror DJ, Delong DM, Triplehorn CA. 1976. An introduction to the study of insects. New York (USA): Holt, Rinehart, and Winston. 852 p.

Reissig WH, Heinrichs EA, Litsinger JA, Moody K, Fiedler L, Mew TW, Barrion AT. 1986. Illustrated guide to integrated pest management in rice in tropical Asia. Manila (Philippines): International Rice Research Institute. 411 p.

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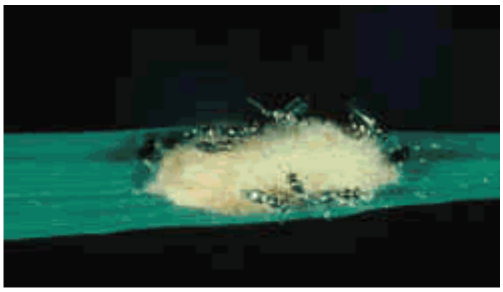
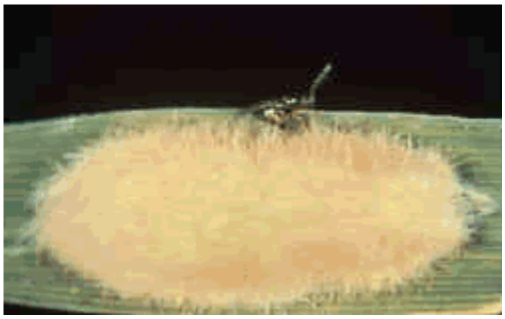
Eulophid Wasp

Eulophid Wasp

Tetrastichus schoenobii is a metallic blue-green or shining green with bluish luster insect.





Scientific name: Tetrastichus schoenobii Ferriere

Common name: Eulophid wasp

Adults of Tetrastichus schoenobii Ferriere parasitizing an egg mass of stem borer

Prior to oviposition, the female Tetrastichus schoenobii examines the egg mass

Once the eggs are located, Tetrastichus schoenobii's ovipositor is inserted into its target site for oviposition

Taxonomy	Class: Insecta Order: Hymenoptera Family: Eulophidae
Economic importance	Parasitoid.

Hosts	Stem borer eggs and pupae.
Description	Tetrastichus schoenobii is a metallic blue-green or shining green with bluish luster insect. It has an 8-segmented brown antenna except for the yellow scape. The hairs clothing the wings are not in rows. The thorax is smooth and shining and the abdomen is elongated and pointed. The legs are yellow except for the greenish coxae I and III. The tarsi are 4-segmented in all the legs.
Biology and ecology	Tetrastichus schoenobii parasitizes stem borer eggs and pupae. Several wasps may parasitize an egg mass of stem borers. Before oviposition, the female examines the egg mass for where to probe through the hair mat. 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. Each larval parasite needs three eggs for its development. Adulthood is observed after 1 to 2 days. This parasitoid is common in wetland and dryland rice fields.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

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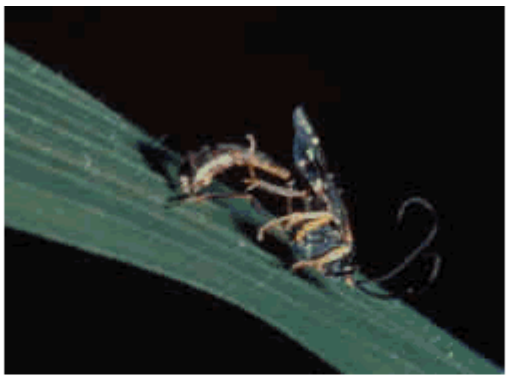
Shepard BM, Barrion AT, Litsinger JA. 1987. Helpful insects, spiders, and pathogens. Manila (Philippines): International Rice Research Institute. 127 p.

Ichneumonid Wasps

The following are six species of Ichneumonid wasps that are commonly found in rice:

Family: Ichneumonidae
Amauromorpha metathoracica (Ashmead)
Charops brachypterum Gupta and Maheswary
Itoplectis narangae (Ashmead)
Temelucha philippinensis (Ashmead)
Trichomma cnaphalocrosis Uchida
Xanthopimpla flavolineata Cameron



Scientific name: Amauromorpha accepta metathoracica (Ashmead)

Common name: Ichneumon

Adult of Amauromorpha accepta metathoracica (Ashmead)

Taxonomy	Class: Insecta Order: Hymenoptera Family: Ichneumonidae
Economic importance	Larval parasitoid.
Hosts	Yellow and white stem borer larvae.
Description	This larval parasitoid is a medium-sized ichneumon, red and black. Its abdominal segment I is black and reddish apico-laterally, whereas abdominal segments II to III are entirely black. Abdominal segment VII has a white apico-median transverse band. The front margin of the front wing is solid. Two cross veins or recurrent veins in the front wings and an elongated median cell reaching the base of the marginal vein in the hind wings are evident.
Biology and ecology	This larval parasitoid lays a single egg into the larval host. The parasitoid larva emerges from the dead host and pupates inside the tunnel.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p. 13-362.

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Shepard BM, Barrion AT, Litsinger JA. 1987. Helpful insects, spiders, and pathogens. Manila (Philippines): International Rice Research Institute. 127 p.

Scientific name: Charops brachypterum Gupta and Maheswary

Common name: Ichneumon

Charops brachypterum Gupta and Maheswary

A characteristically marked black and white cocoon of Charops brachypterum

Taxonomy	Class: Insecta Order: Hymenoptera Family: Ichneumonidae
Economic importance	Parasitoid.
Hosts	Leaffolder, green semilooper, and yellow stem borer larvae.
Description	Charops brachypterum is a large ichneumonid wasp. It has a black body and yellow-orange markings on the bases of the abdomen, legs, and antennae. The reddish brown abdomen is greatly enlarged at the end. Its hind legs are black except for the yellow trochanter, base of the tibia, and ends of the femora. The tarsal claws have 5 teeth. The larvae of C. brachypterum are legless.

Biology and ecology	The female parasitizes the host larva by piercing the plant stem with its ovipositor. It lays an egg near the host larva. The newly hatched parasite larva feeds externally on the body fluids of the larval host, causing its death. Upon pupation, the wasp larva leaves the stem and hangs itself from the leaf on a brown silk thread to spin a black and white cocoon. The adult parasitoid lives from 3 to 5 days.

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Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

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Scientific name: Itoplectis narangae (Ashmead)

Common name: Ichneumon

A medium-sized ichneumonid wasp Itoplectis narangae (Ashmead)

Taxonomy	Class: Insecta Order: Hymenoptera Family: Ichneumonidae
Economic importance	Parasitoid.
Hosts	Leaffolder, green semilooper, hairy caterpillar, and striped and pink stem borer larvae.
Description	Itoplectis narangae is a medium-sized ichneumonid wasp. It has a black head and thorax, orange legs, and a black abdominal tip. Its eyes are angular with strong emargination opposite the antennae. The pedicel and flagella of the antennae are reddish brown. The first to fourth or first to fifth abdominal segments are orange-red. These parasitoids have red mid- and hind femora with a black tip. The trochanters, hind tibia, and hind tarsus are yellowish white with bases and apices of the tibia and apices of the tarsal segment blackish brown.
Biology and ecology	The parasitoid is a solitary hunter and can easily detect larvae inside the rice stem using its antennae. It parasitizes the larvae of the leaffolder, green semilooper, hairy caterpillar, and striped and pink stem borer. The wasp can lay as many as 200-400 eggs in 2-3 weeks. Even if several wasps parasitize the larval host, a single female wasp can also emerge from the larval host. Several eggs may be laid in a single pupa. However, only one larva survives to adulthood.

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Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

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Scientific name: Temelucha philippinensis (Ashmead)

Common name: Ichneumon

A medium-sized wasp Temelucha philippinensis (Ashmead)

Taxonomy	Class: Insecta Order: Hymenoptera Family: Ichneumonidae
Economic importance	Parasitoid.
Hosts	Stem borer and leaffolder larvae.
Description	Temelucha philippinensis is a yellowish orange ichneumonid wasp. It is medium-sized and looks like Macrocentrus philippinensis Ashmead except for the former's flattened abdomen and shorter antennae. Its front wing has a blunt tip of the second rectangular or discoidal cell. Abdominal segments 3 to 6 are alternately black and reddish brown. The middle tibiae are blackish brown.
Biology and ecology	Temelucha philippinensis hunts for stem borer and leaffolder larvae. These active parasites are able to parasitize their hosts before the hosts are able to reenter the rice stem. Larval development occurs within the body of the host. The mature larva leaves its host to pupate outside. Before pupation, the parasitoid larva makes a light brown cocoon in the tunnel to pupate. The parasitoids are found in all rice environments.

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Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

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Scientific name: Trichomma cnaphalocrosis Uchida

Common name: Ichneumon

A large slender ichneumonid wasp Trichomma cnaphalocrosis Uchidad

Taxonomy	Class: Insecta Order: Hymenoptera Family: Ichneumonidae
Economic importance	Parasitoid.
Hosts	Leaffolder larvae.
Description	Trichomma cnaphalocrosis is a large, slender ichneumonid wasp. It is black and yellow. Its face is yellow with a black frons and ocellar area. Its eyes are strongly emarginate with the inner margins meeting in front. Long hairs are visible on the eyes. Yellow patches are prominent on the wing base. The abdomen of the wasp is orange-brown. The first two segments are long and slender. The propodeum or the segment connected to the petiole is pointed. The female parasitoid has a long ovipositor that is half the length of the abdomen.
Biology and ecology	Trichomma cnaphalocrosis prefers older leaffolder larvae. Each female enters the folded leaves to lay its single egg in each larval host. Larval and pupal development of the parasite is completed inside the host. The parasitoid can be parasitized by Brachymeria spp.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

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Scientific name: Xanthopimpla flavolineata Cameron

Common name: Ichneumon

A yellowish adult of Xanthopimpla flavolineata Cameron

Taxonomy	Class: Insecta Order: Hymenoptera Family: Ichneumonidae
Economic importance	Parasitoid.
Hosts	Stem borer pupae.
Description	Xanthopimpla flavolineata is a medium-sized ichneumonid wasp. It is yellow-orange. Black markings are evident on each abdominal segment, but the top lacks black spots. The female parasitoid has a black ovipositor.
Biology and ecology	The female parasitoid uses its antennae to search for its pupal host in the rice stem. After locating the host, the ovipositor penetrates the stem to lay a single egg. Development of the larval parasite from egg to pupa takes place within the host. After pupation, the adult parasitoid emerges from the pupal host. It can lay as many as 5 to 14 eggs daily and lives for 4 to 9 days. The ichneumonid wasp is commonly found in dryland and wetland rice environments.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362. Borror DJ, Delong DM, Triplehorn CA. 1976. An introduction to the study of insects. New York (USA): Holt, Rinehart, and Winston. 852 p.

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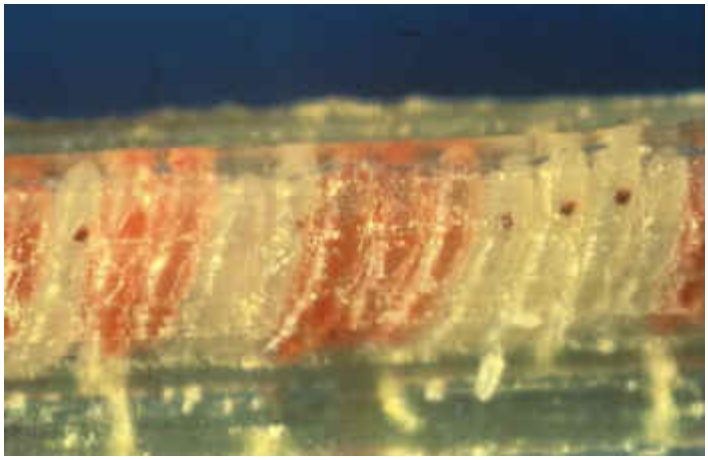
Mymarid Wasps

Mymarid Wasps

The main Mymarid wasps found in rice crops are:
Family: Mymaridae
Anagrus nr. flaveolus Waterhouse
Anagrus optabilis (Perkins)
Gonatocerus spp.



Hopper eggs parasitised by Anagrus spp. turn deep orange red

Scientific name: Anagrus nr. flaveolus Waterhouse

Common name: Fairyflies

Taxonomy	Class: Insecta Order: Hymenoptera Family: Mymaridae
Economic importance	Egg parasitoid.
Hosts	Leafhopper and planthopper eggs.
Description	This parasitoid is tiny and has a slender and elongated shape. It has an orange-red to red coloration. The third antennal segment is very short, unlike the other funicular segments. There are 3-4 irregular rows of hairs on the front wings and the marginal vein has 2 long setae. The distal end of its forewing disc is dilated. Its ovipositor is moderately exserted. The male parasitoid has 13 antennal segments, whereas the female has 9-segmented antennae. Their legs have 4-segmented tarsi.
Biology and ecology	This parasitoid is parthenogenetic and can reproduce without mating. During oviposition, it locates its host eggs using its antennae. Once the host egg is located, the female parasitoid makes rapid antennal palpations and inserts its ovipositor into the host egg. Parasitized eggs turn reddish orange, whereas unparasitized eggs remain creamy white. The total developmental period from egg to adult takes about 11-14 days and the female can parasitize 15-30 eggs a day. Adults live for 2-6 days.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasitoids and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

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Reissig WH, Heinrichs EA, Litsinger JA, Moody K, Fiedler L, Mew TW, Barrion AT. 1986. Illustrated guide to integrated pest management in rice in tropical asia. Manila (Philippines): International Rice Research Institute. 411 p.

Shepard BM, Barrion AT, Litsinger JA. 1987. Helpful insects, spiders, and pathogens. International Rice Research Institute. 127 p.

Scientific name: Anagrus optabilis (Perkins)

Common name: Fairyflies

Taxonomy	Class: Insecta Order: Hymenoptera Family: Mymaridae
Economic importance	Egg parasitoid.
Hosts	Leafhopper and planthopper eggs.
Description	Anagrus optabilis is a tiny mymarid wasp, reddish orange to red. It has long and narrow antennae with the third antennal segment longer than the rest. The disc of its front wing is narrow and parallel-sided. The front wings have rows of hairs in the basal two-thirds and 2 rows in the apical one-third. The ovipositor is almost at the tip of its abdomen. Male parasitoids have 13 antennal segments, whereas females have 9- segmented antennae. Anagrus optabilis has 4-segmented tarsi in its legs.
Biology and ecology	Anagrus optabilis is an egg parasitoid of leafhoppers and planthoppers. It is parthenogenetic and can reproduce without mating. After locating the host eggs using its antennae, the female wasp makes rapid antennal palpations and inserts the ovipositor into the egg mass. Parasitized eggs are deep orange-red, whereas normal eggs remain creamy white. The parasitoid develops from egg to adult in 11-13 days; the adults live for 2-6 days. A female can parasitize as many as 15-30 eggs a day.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

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Shepard BM, Barrion AT, Litsinger JA. 1987. Helpful insects, spiders, and pathogens. Manila (Philippines): International Rice Research Institute. 127 p.

Scientific name: Gonatocerus spp.

Common name: Fairyflies

A mymarid wasp, Gonatocerus sp., is known to parasitize hopper eggs

Frontal view of a mymarid wasp

Taxonomy	Class: Insecta Order: Hymenoptera Family: Mymaridae
Economic importance	Parasitoid.
Hosts	Eggs of leafhoppers and planthoppers.
Description	Gonatocerus spp. are tiny mymarid wasps measuring 1.8 mm in length. They have oar-shaped wings with long hairs on the margins. The marginal vein of the front wing is not elongated and the venation does not reach the basal one-third of the wing. The adults are brown to dark yellow brown with short waists or petioles. Their abdomens are arched. The male wasps have 13 antennal segments, the females have 11. Both have 5-segmented tarsi.

Biology and ecology	The female is parthenogenetic. It can parasitize as many as 15 leafhopper eggs per day. Parasitized eggs are brownish yellow to reddish yellow. Normal eggs are white. Development from egg to adult takes about 11-17 days.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

Pteromalid Wasps

Pteromalid Wasps

There are two main species of Pteromalid wasp to be found in rice:

Family: Pteromalidae
Panstenon nr. collaris Boucek
Trichomalopsis apanteloctena (Crawford)

Scientific name: Panstenon nr. collaris Boucek

Common name: Pteromalid wasp

A pteromalid wasp, Panstenon nr. collaris Boucek

Taxonomy	Class: Insecta Order: Hymenoptera Family: Pteromalidae
Economic importance	Parasitoid.
Hosts	Leafhopper and planthopper eggs.
Description	Panstenon nr. collaris is a small wasp. It is metallic blue-green. It has 13 antennal segments. The middle segment of the thorax is very coarse. Its front wings are relatively longer than the hindwings. Its abdomen is slender and tapers at the end. It has 5-segmented tarsi in all its legs.
Biology and ecology	A single female lays 1 or 2 eggs in a rice tiller. After egg hatching, the small C-shaped larval parasite preys on 4 to 8 eggs of planthoppers or leafhoppers daily. Pupation takes place within the tiller. The pupa is yellowish and naked. Development from egg to adult is completed in 4 to 6 days.

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Borror DJ, Delong DM, Triplehorn CA. 1976. An introduction to the study of insects. New York (USA): Holt, Rinehart and Winston. 852 p.

Shepard BM, Barrion AT, Litsinger JA. 1987. Helpful insects, spiders, and pathogens. Manila (Philippines): International Rice Research Institute. 127 p.

Scientific name: Trichomalopsis apanteloctena (Crawford)

Common name: Pteromalid wasp

A metallic pteromalid wasp Trichomalopsis apanteloctena (Crawford)

Taxonomy	Class: Insecta Order: Hymenoptera Family: Dryinidae
Economic importance	Parasitoid and predator.
Hosts	Planthopper nymphs.
Description	Pseudogonatopus nudus is a reddish brown wasp except for its black petiole. Its appearance is ant- like. The sides of its metanotum are protruding. Its metathorax and propodeum are without median furrows. It has enlarged claws with a sub-apical tooth and six lamellae. The male adults of P. nudus are winged, whereas the females are wingless.
Biology and ecology	The female wasp lives for 6 to 7 days. It can parasitize as many as 4 to 10 nymphs per day. A single host can accommodate 1 to 2 eggs of the parasite. After 1 to 2 days, eggs hatch into larvae. The larva uses the host's body fluids for its development. During larval growth, a black to gray sac covers the larva and protrudes from the host's abdomen. The sac tears in 7 to 10 days and the whitish larva wiggles free. During pupation, it secretes a whitish oval silk cocoon to cover the pupa on the plant. The flat cocoon turns reddish brown with age. Pseudogonatopus nudus is also predaceous on planthoppers.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

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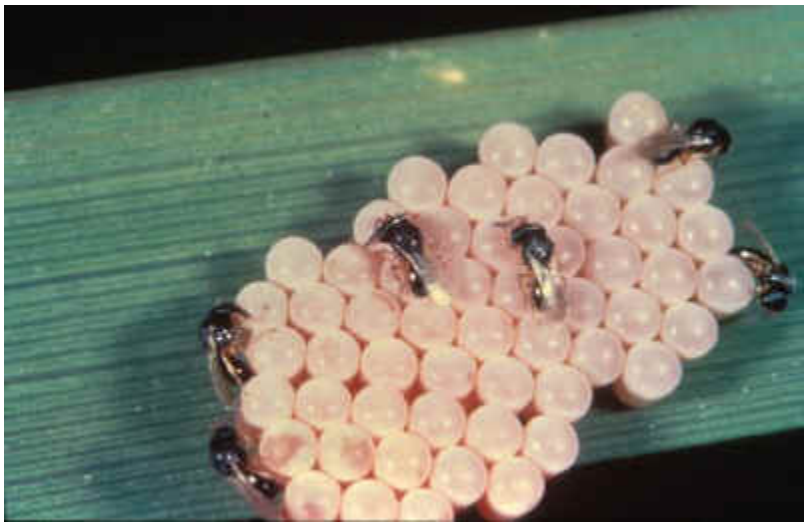
Scelionid Wasps

Scelionid Wasps

The following species of Scelonid wasps are found in rice:
Family: Scelionidae
Psix lacunatus Johnson and Masner
Telenomus cyrus (Nixon)
Telenomus rowani (Gaham)

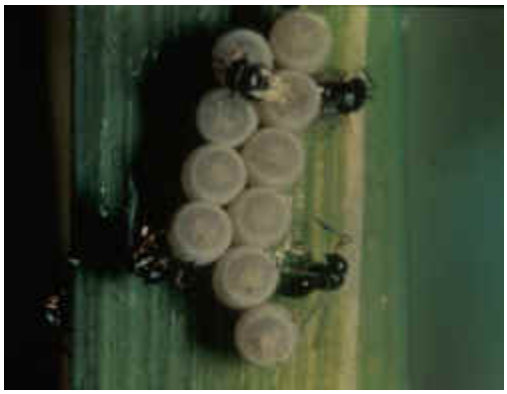


Scelionid wasps with white, unparasitised eggs of black bugs

Parasitised eggs of black bugs turn black

Scientific name: Psix lacunatus Johnson and Masner

Common name: Scelionid wasp



Scelionid wasps, Psix lacunatus Johnson & Masner

Taxonomy	Class: Insecta Order: Hymenoptera Family: Scelionidae
Economic importance	Parasitoid.
Hosts	Eggs of moths and bugs.
Description	Psix lacunatus is a small and black scelionid wasp. Its head has fan-like carinae starting from the mandibular base to the frons and cheeks. It has hairless eyes. Its antennae have yellow scape. It has reduced wing venation. The lateral sides of the thorax are strongly pitted. It has a broad second abdominal segment.
Biology and ecology	Psix lacunatus is an egg parasite of moths and black bugs. It oviposits on the eggs and leaves a scent preventing other parasitoids from parasitizing the same eggs. Parasitized eggs are grayish with exit holes, whereas unparasitized eggs are white with firm egg covers.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

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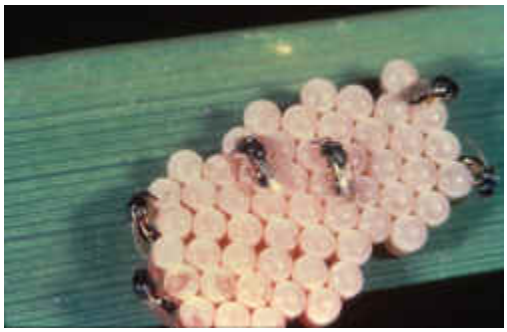
Scientific name: Telenomus cyrus (Nixon)

Common name: Scelionid wasp



Adult parasitoids of Telenomus cyrus (Nixon) on black bug eggs

Taxonomy	Class: Insecta Order: Hymenoptera Family: Scelionidae
Economic importance	Parasitoid.
Hosts	Eggs of moths and bugs.
Description	Telenomus cyrus is a black and moderate species that measures 1.05 mm in length. It has short hairs on the eyes. Its dark brown antennae are slender and without a distinct club. The first funicular segment of its antenna is as long as the pedicel; the second and third segments are elongate. The stigmalis of the front wings is long. Its abdomen is longer than it is wide with the first segment striated. It has yellow legs except for the black mid and hind coxae and infuscated femur.
Biology and ecology	Telenomus cyrus is an egg parasitoid of the black bug Scotinophara coarctata (Fabricius). It parasitizes the eggs even when they are guarded by the female bug. Parasitized eggs are grayish to black. Exit holes on parasitized eggs for adult parasitoid emergence are evident. Unparasitized eggs are pinkish white.

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Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

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Scientific name: Telenomus rowani (Gahan)

Common name: Scelionid wasp

Adults of Telenomus rowani (Gahan) parasitizing an egg mass of stem borer

Shot holes as entrance holes for wasp emergence

Taxonomy	Class: Insecta Order: Hymenoptera Family: Scelionidae
Economic importance	Parasitoid.
Hosts	Stem borer eggs.
Description	Telenomus rowani is a small and black scelionid wasp with a 0.5 to 1.1 mm body length. It has a pointed abdomen with rib-like structures on the basal segment. The lower midhalf of the abdomen is flat and tapers toward the apex. The tarsus is 5-segmented in all the legs. The male wasp has a yellow antenna except for the apical 3 to 4 segments. The antenna's funicular segments 4 to 9 are sub-globular and bead-like. The male is smaller and measures 0.5-0.6 mm long. The female adult has a 4-segmented antennal club. Each segment of the club is slightly longer than it is broad. The female has a body 0.8 to 0.85 mm long.

Biology and ecology	Telonomus rowani is a parasite of stem borer eggs. It oviposits eggs in a single host and only a single parasite develops in a single egg. Development from egg to adult takes 14 days. The adults emerge by making holes in the hair mat of stem borer eggs. Soon after emergence, the female parasitoid clings to the stem borer moth. It detaches from the moth after the moth has laid eggs. It then starts to parasitize the newly laid egg mass. The wasp can parasitize as many as 20 to 40 eggs in its lifespan of 2 to 4 days.

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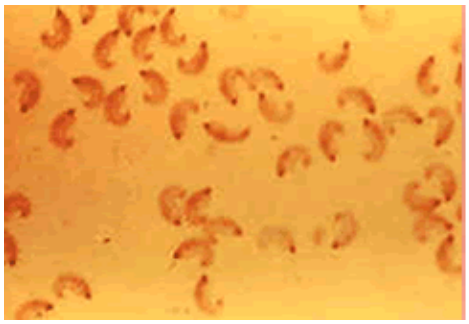
Strepsipteran Parasitoids

Strepsipteran Parasitoids

The following Strepsipteran parasites are found in rice:
Family: Elenchidae
Elenchus yasumatsui Kifune and Hirashima
Halictophagus spectrus Yang



Scientific name: Elenchus yasumatsui Kifune and Hirashima

Common name: Twisted-winged parasite

Triungulids of Elenchus yasumatsui Kifune and Hirashima

Taxonomy	Class: Insecta Order: Strepsiptera Family: Elenchidae
Economic importance	Parasitoid.
Hosts	Planthoppers.
Description	Elenchus yasumatsui is a minute twisted-winged parasite. The female parasites are wingless and remain inside the host's abdomen with their heads visible outside. The male parasites are winged. Their front wings are clubbed and their hind wings are transparent with few veins. They have 4-segmented antennae. Their tarsi are 2-segmented. The immatures or the triungulins are minute and C-shaped. They have a black head and pale brown body.
Biology and ecology	The male mates with the immobile female. A fertilized female produces 500 to 2,000 triungulins. The larvae or triungulins locate the host and bore inside the body. Development occurs inside the body of the host. The female parasitoid remains inside while the male emerges as an adult. The male parasite has a life span of 1 to 2 days. The female lives 1 to 2 months.

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Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

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Scientific name: Halictophagus spectrus Yang

Common name: Twisted-winged parasite

Male adult of Halictophagus spectrus Yang is black and is winged

Taxonomy	Class: Insecta Order: Hymenoptera Family: Dryinidae
Economic importance	Parasitoid and predator.
Hosts	Planthopper nymphs.
Description	Pseudogonatopus nudus is a reddish brown wasp except for its black petiole. Its appearance is ant- like. The sides of its metanotum are protruding. Its metathorax and propodeum are without median furrows. It has enlarged claws with a sub-apical tooth and six lamellae. The male adults of P. nudus are winged, whereas the females are wingless.
Biology and ecology	The female wasp lives for 6 to 7 days. It can parasitize as many as 4 to 10 nymphs per day. A single host can accommodate 1 to 2 eggs of the parasite. After 1 to 2 days, eggs hatch into larvae. The larva uses the host's body fluids for its development. During larval growth, a black to gray sac covers the larva and protrudes from the host's abdomen. The sac tears in 7 to 10 days and the whitish larva wiggles free. During pupation, it secretes a whitish oval silk cocoon to cover the pupa on the plant. The flat cocoon turns reddish brown with age. Pseudogonatopus nudus is also predaceous on planthoppers.

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Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

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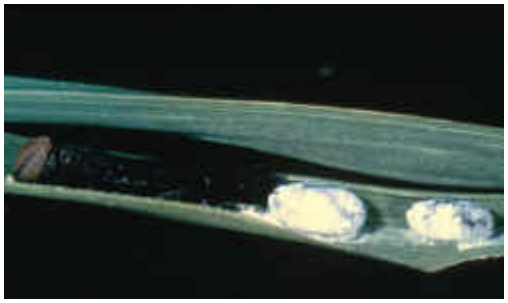
Tachinid Fly

Tachinid Fly

Argyrophylax nigrotibialis is a spiny fly that is slightly bigger than a housefly.

Argyrophylax nigrotibialis (Baranov), a tachinid parasite of skipper larvae

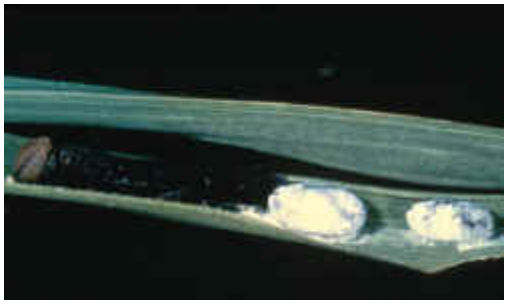


Puparia of Argyrophylax nigrotibialis near a dead host

Scientific name: Argyrophylax nigrotibialis (Baranov)

Common name: Tachinid fly

Argyrophylax nigrotibialis (Baranov), a tachinid parasite of skipper larvae



Puparia of Argyrophylax nigrotibialis near a dead host

Taxonomy	Class: Insecta Order: Diptera Family: Tachinidae
Economic importance	Parasitoid.
Hosts	Skipper larvae.
Description	Argyrophylax nigrotibialis is a spiny fly that is slightly bigger than a housefly. It is gray or black. The head is generally dark to blackish red except for the silvery white tinge along the face. The thorax and abdomen are covered with many long hairs.
Biology and ecology	Argyrophylax nigrotibialis is found in wetland and dryland rice fields. Once the female locates a larval host, it lays 2 to 4 eggs on its body. Upon hatching, the maggot enters the host's body to develop. Before pupation, the mature maggot produces a hard cocoon. Fresh cocoons are light yellow and turn dark red with age. Pupation takes about four days. Adult flies live for about 3 days. Mating occurs

immediately after adult emergence.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of Rice Insect Pests and Their Arthropod Parasites and Predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13- 362.

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Trichogrammatid Wasps

Trichogrammatid Wasps

The two most important beneficial Trichogrammatid wasps found in rice crops are:
Family: Trichogrammatidae
Oligosita aesopi Girault
Oligosita naias Girault

Scientific name: Oligosita aesopi Girault

Common name: Trichogrammatid wasp

Oligosita aesopi Girault is another trichogrammatid wasp parasitizing hopper eggs.

Taxonomy	Class: Insecta Order: Hymenoptera Family: Trichogrammatidae
Economic importance	Parasitoid.
Hosts	Eggs of leafhopper, planthopper, stem borer, and leaffolder.
Description	Oligosita aesopi is a greenish yellow wasp with transparent wings. The pedicel of its antennae is two times longer than its funicular segments. It has a triangular wing cell. The front wings have short hairs along the wing margin and the discal ciliation is thick and moderately scattered toward the distal end. It has 3-segmented tarsi in all of its legs.
Biology and ecology	Oligosita aesopi parasitizes eggs of leafhoppers, planthoppers, moths, and butterflies. Each female wasp lays her eggs on 10 hopper eggs daily. Parasitized eggs are lemon yellow and develop into adult wasps in 11 to 12 days. The adult can live for 2 to 5 days.

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Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

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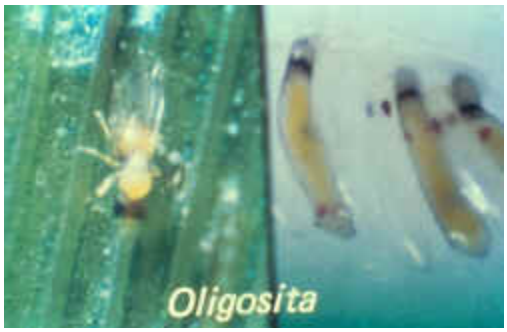
Scientific name: Oligosita naias Girault

Common name: Trichogrammatid wasp



Another parasitoid of hopper eggs, Oligosita naias Girault

Taxonomy	Class: Insecta Order: Hymenoptera Family: Trichogrammatidae
Economic importance	Parasitoid.
Hosts	Eggs of leafhoppers, planthoppers, moths, and butterflies.
Description	Oligosita naias adults are greenish yellow with transparent wings. The pedicel of their antennae is more than twice the length of the funicular segments. The funicular segments are slightly wider than the pedicel. The four-sided wing cell is visible on the front wings. The wing margin of the front wings has long hairs. The parasitoid has three-segmented tarsi in all the legs.
Biology and ecology	Each female adult locates the egg host with its antennae. Once the host is located, it oviposits its eggs. Parasitized eggs are lemon yellow, whereas unparasitized eggs are creamy white. Eggs develop into adults in 11 to 12 days. A female can parasitize as many as 10 eggs per day. The adult lives for 2 to 5 days.

Selected references

Barrion AT, Litsinger JA. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 13-362.

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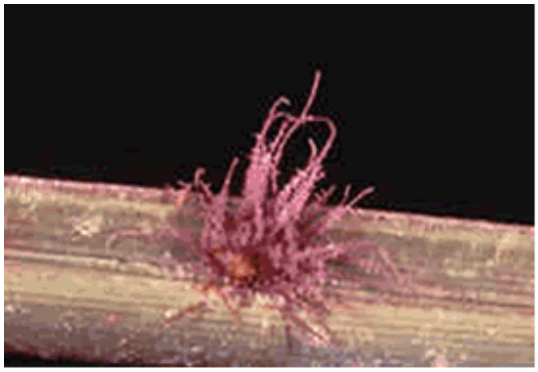
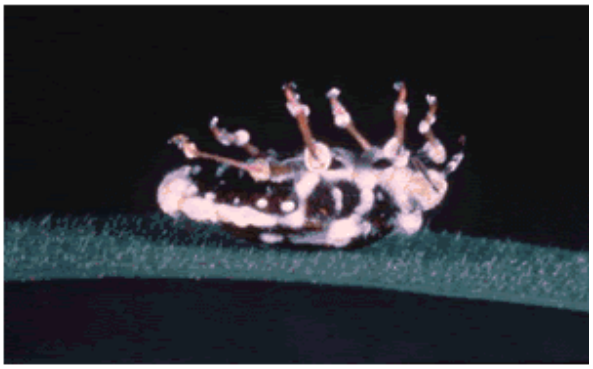
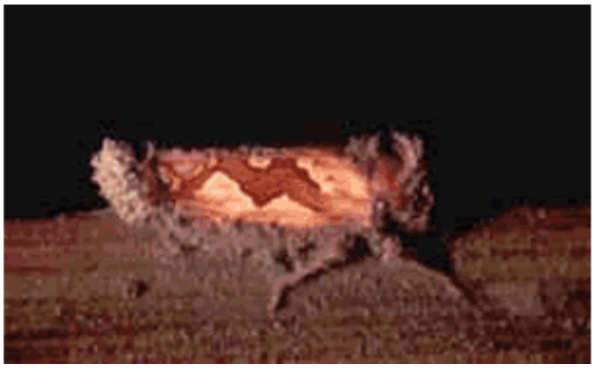
Insect pathogens

Insect pathogens

Naturally occurring insect pathogens, including fungal, virus, and bacterial pathogens, attack a range of pest species.
Information on seven important pathogens can be accessed by clicking on the appropriate link to the left.







Green Muscardine Fungus

Green Muscardine Fungus

Metarhizium anisopliae is a common insect pathogen.

Dark green Metarhizium anisopliae (Metchnikoff) Sorokin

Scientific name: Metarhizium anisopliae (Metchnikoff) Sorokin

Common name: Green muscardine fungus

Dark green Metarhizium anisopliae (Metchnikoff) Sorokin

Taxonomy	Class: Hyphomycetes Order: Moniliales Family: Moniliaceae
Economic importance	Metarhizium anisopliae is a common insect pathogen. More than 200 insects have been recorded to be infected with the fungus. It can decimate cultures of both rice planthoppers and leafhoppers.
Hosts	Bugs, leafhoppers, planthoppers, and beetles.
Description	Metarhizium anisopliae has cylindrical conidiogenous cells. Inside the conidiogenous cells are powdery masses of dark green to yellow-green columns of conidia that arise from white mycelium. The conidia are > 9 µm long and are cylindrical with a slight central narrowing. They form very long and laterally adherent chains. The spores are shaded green.
Biology and ecology	The spores land on the host's body. High humidity favors the growth of the fungus on the insect body. During its development, the fungus growing within the host's body consumes its host's contents. When the host dies, the fungus emerges as a white growth from the host. With age, it turns dark green. The spores are spread by wind or water to new hosts.

Selected references

Humber RA. 1997. Fungi: identification. In: Manual of techniques in insect pathology. San Diego, California (USA): Academic Press Inc. p 153-185.

Rombach MC, Roberts DW, Aguda RM. 1994. Pathogens of rice insects. In: Biology and management of rice insects. Manila (Philippines): International Rice Research Institute. p 613-655.

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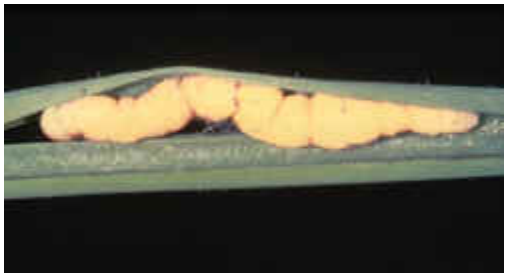
GV Baculovirus

GV Baculovirus

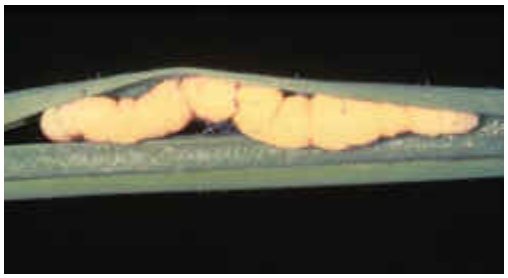
Granulosis viruses are composed of ellipsoidal, irregular, and sickle-shaped capsules.



A virus-infected larva becomes constricted and segmented

Scientific name: Granulovirus spp.

Common name: Baculovirus, GV



A virus-infected larva becomes constricted and segmented

Taxonomy	Family: Baculoviridae
Economic importance	Granulosis virus or GV is an important pathogen that attacks larvae of moths and butterflies in rice ecosystems.
Hosts	Moth and butterfly larvae.
Description	Granulosis viruses are composed of ellipsoidal, irregular, and sickle-shaped capsules. The capsules are 433 x 243 nm in length. Each capsule contains a single virion that measures 301 x 83 nm. The inclusion bodies of the virus measure 0.3 to 0.5 µm.
Biology and ecology	Granulosis viruses attack moth and butterfly larvae. The infected larva starts to stop feeding; thus, movement is affected. One to two weeks later, the infected larva shows constriction of the body. Body segmentation is evident. Its color changes to yellow, pink, and black. The infected larva becomes soft.

Acknowledgment

We thank Dr. Gerry R. Carner of the Department of Entomology at Clemson University in South Carolina, USA for clarifying the classification of Granulovirus spp.

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Hirsutella citriformis

Hirsutella citriformis

Hirsutella citriformis is widely distributed on rice hoppers in rice-growing areas of Asia.

Fresh dirty white long filaments of a fungus, Hirsutella citriformis Speare

Mature stage of Hirsutella citriformis

Scientific name: Hirsutella citriformis Speare

Common name: Fungus

Fresh dirty white long filaments of a fungus, Hirsutella citriformis Speare

Mature stage of Hirsutella citriformis

Taxonomy	Class: Hyphomycetes Order: Moniliales Family: Stilbaceae
Economic importance	Hirsutella citriformis is widely distributed on rice hoppers in rice-growing areas of Asia. It causes a high mortality rate of insects during periods of high insect population. Dozens of infected specimens are clustered on a single rice stem after being infected with the fungus.
Hosts	Leafhoppers and planthoppers.
Description	The synnemata or hyphae of H. citriformis are long and numerous. They usually measure 1-10 mm long. They are gray or brown with many short lateral branches. The conidiogenous cells are 45 µm long. They have a globose to ellipsoid base and long, slender needle-like necks. The conidia contained within the cells are 5-8.5 x 2-3 µm. They are cymbiform with rounded ends or ellipsoid. They are enveloped in mucus.

Biology and ecology	The fungus enters the body of the host. It consumes its host's inner tissues for its development. It then grows out as long filaments that are dirty white. The fungus turns gray upon maturation. The dispersing infectious spores are produced from the filaments.

Selected references

Humber RA. 1997. Fungi: identification. In: Manual of techniques in insect pathology. San Diego, California (USA): Academic Press Inc. p 153-185.

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Metarhizium flavoviride

Metarhizium flavoviride

Metarhizium flavoviride is composed of clavate to broadly ellipsoid conidiogenous cells.

Light green strain of Metarhizium flavoviride Gams and Roszypal on hopper

Scientific name: Metarhizium flavoviride Gams and Roszypal

Common name: Fungus

Light green strain of Metarhizium flavoviride Gams and Roszypal on hopper

Taxonomy	Class: Hyphomycetes Order: Moniliales Family: Moniliaceae
Economic importance	Metarhizium flavoviride is an important entomophagous fungus. It attacks leafhoppers, planthoppers, bugs, and beetles. It is commonly isolated from soil where conidia can survive.
Hosts	Leafhoppers, planthoppers, bugs, and beetles.
Description	Metarhizium flavoviride is composed of clavate to broadly ellipsoid conidiogenous cells. The conidia are light gray-green. They are ovoid and about 7-11 µm long.
Biology and ecology	The spore, once it comes in contact with an insect, germinates and grows on the insect body. The developing fungus consumes the host's contents. When the host dies, the fungus emerges as a white growth from the host joints. It later turns light green. Wind or water disperses the spores to a new host. This fungus also parasitizes zigzag leafhoppers.

Selected references

Humber RA. 1997. Fungi: identification. In: Manual of techniques in insect pathology. San Diego, California (USA): Academic Press Inc. p 153-185.

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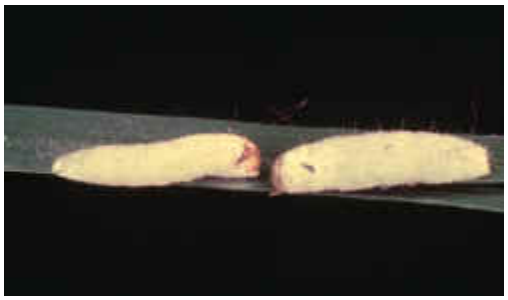
Nomuraea rileyi

Nomuraea rileyi

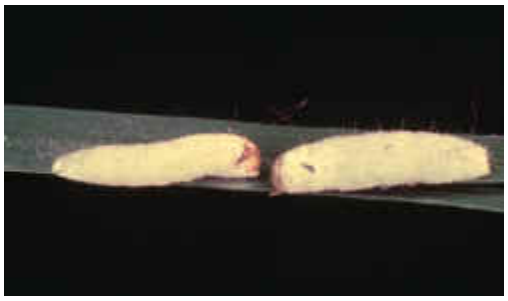
Nomuraea rileyi is composed of pale green to gray-green conidiophores on a white basal felt of mycelium.



White fungus of Nomuraea rileyi (Farlow) Samson

Scientific name: Nomuraea rileyi (Farlow) Samson

Common name: Fungus



White fungus of Nomuraea rileyi (Farlow) Samson

Taxonomy	Class: Hyphomycetes Order: Moniliales Family: Moniliaceae
Economic importance	Nomuraea rileyi is an important fungus that attacks larvae of rice insects. An outbreak of this fungus was reported in 1985 when it prevented an increase in the population of Spodoptera sp.
Hosts	Leaffolder, stem borer larva, green hairy caterpillar, armyworm, and caseworm.
Description	Nomuraea rileyi is composed of pale green to gray-green conidiophores on a white basal felt of mycelium. The conidia are broadly ellipsoid and in dry chains. They are 3.5-4.5 x 2-3 µm long. The conidiophores have branches. Each branch contains 2-5 phialides or conidial chains.
Biology and ecology	The early infective stage of N. rileyi is a white mass of fungus covering the larva. After a few days, the spores are formed and the host becomes pale green. Nomuraea rileyi attacks the larvae of stems borers, leaffolders, armyworms, and caseworms.

Selected references

Humber RA. 1997. Fungi: identification. In: Manual of techniques in insect pathology. San Diego, California (USA): Academic Press Inc. p 153-185.

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NPV Baculovirus

NPV Baculovirus

Nuclear polyhedrosis viruses have numerous polyhedral inclusion bodies 0.3 to 15 µm in diameter.

A sluggish larva affected by a nuclear polyhedrosis virus

Later stage of infected larva by nuclear polyhedrosis virus

Scientific name: Nucleopolyhedrovirus spp.

Common name: Baculovirus, NPV

A sluggish larva affected by a nuclear polyhedrosis virus

Later stage of infected larva by nuclear polyhedrosis virus

Taxonomy	Family: Baculoviridae
Economic importance	NPV is an important pathogen that attacks armyworms and cutworms.
Hosts	Armyworms and cutworm.
Description	Nuclear polyhedrosis viruses have numerous polyhedral inclusion bodies 0.3 to 15 µm in diameter. The inclusion bodies contain rod-shaped viral particles with a size of 35 x 215 nm. The viral particles within the inclusion bodies are bundled in envelopes in groups of 2 or3.
Biology and ecology	NPV is common in armyworms and cutworms. The larvae become infected with NPV once they eat virus-contaminated foliage. The NPV-infected larva becomes sluggish and stops feeding. It develops a whitish ventral side that becomes prominent at the intersegmental membranes. Later, the infected larva turns black. It eventually dies and is seen hanging on the foliage.

Acknowledgment

We thank Dr. Gerry R. Carner of the Department of Entomology at University of Clemson in South Carolina, USA for clarifying the classification of Nucleopolyhedrovirus spp.

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White Muscardine Fungus

White Muscardine Fungus

Beauveria bassiana forms white powdery conidial masses.

Chalky white spores of Beauveria bassiana (Balsamo) Vuillemin on brown planthopper body

Beauveria bassiana on body of rice bug

Scientific name: Beauveria bassiana (Balsamo) Vuillemin

Common name: White muscardine fungus

Chalky white spores of Beauveria bassiana (Balsamo) Vuillemin on brown planthopper body

Beauveria bassiana on body of rice bug

Taxonomy	Class: Hyphomycetes Order: Moniliales Family: Moniliaceae
Economic importance	Beauveria bassiana is a white muscardine fungus that is commonly collected in agricultural crops. It is used for agricultural pest control worldwide.
Hosts	Leafhoppers and planthoppers.
Description	Beauveria bassiana forms white powdery conidial masses. The conidia are globose to broadly ellipsoid. They measure 2.5-3.5 µm. They are produced on sympodial conidiogenous cells that are present on hyphae arising from the mycelium mat. The conidiogenous cells are globose to flask-shaped. They are 2-3 x 2-4 µm with dented zigzag-shaped rachis. The rachis reaches up to 20 µm.

Biology and ecology	Beauveria bassiana is a white fungus that attacks planthoppers, leafhoppers, stem borers, leaffolders, rice bugs and black bugs. During development, the fungi use the soft tissues and body fluids of the host. The growth of B. bassiana requires conditions of prolonged high moisture for the airborne and waterborne spores to germinate. When ready to produce the spores, the fungi grow out of the body. The spores appear chalky white. Beauveria bassiana occurs in all rice environments.

Selected references

Humber RA. 1997. Fungi: identification. In: Manual of techniques in insect pathology. San Diego, California (USA): Academic Press Inc. p 153-185.

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