

A.2. Identification of Insects

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A.2.1. Rice Army Worm (*Mythimna separata*)



Picture 57 : Young larva.

Description: Young larva is green and becomes brownish with thin pale dorsal line later instars. Pupa is brown and formed in the soil. The adult moth has brown forewings with dark specks. The hind wings are pale brown.



Picture 58 : Mature larva.



Picture 59 : Pupa.

Damage :

- Cutting off leaf tips, leaf margins, leaves and even the plants at the base.
- Cutting off rice panicles from the base.

Factor favoring insect development:

- Presence of many alternate hosts.
- Periods of drought followed by heavy rains.



Picture 60 : Adult moth.

Host plants:

Rice, corn and other plants.

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A.2.2.

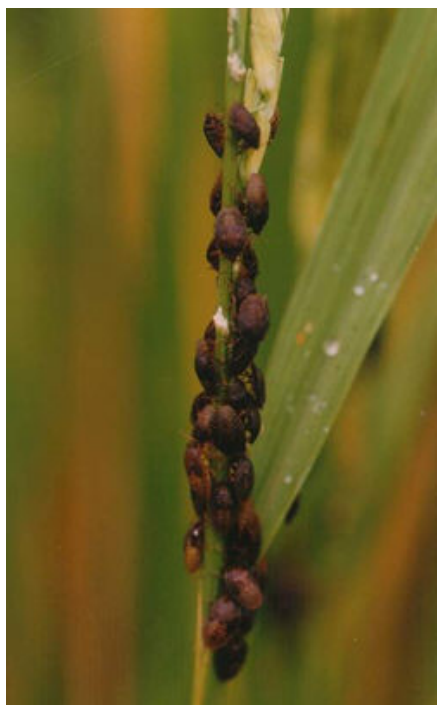
Black Bug (*Scotinophara coarctata*)

Description:

Eggs are laid in clusters on the basal parts of the rice plants near the water surface. Nymph is light brown. Adult is shiny brownish black to shiny black as it matures. It prefers to feed on the rice stem than on the leaves. During the day, the adults are found at the base of the plant and at nighttime they move upwards.



Picture 61 : Female adult with its eggs.



Picture 62 : Nymph on the rice stem.

Damage:

Both the adults and nymphs suck the plant saps. They prefer to infest the bases of the rice stems causing the plant to weaken. Heavy infestation causes stunted growth, formation of white heads, half-filled or empty grains, and browning of leaves or bug burn.

Factor favoring insect development:

- Rainfed and irrigated wetland environments.
- Vegetative stages of the rice plant.
- Poorly drained fields.
- Densely planted fields.
- Staggered planting of the rice crop.
- Excessive use of nitrogen.
- Presence of alternate hosts/plants.
- Lunar phase.



Picture 63 : Black bug on the rice stem.

Host plants: Rice and corn.

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A.2.3. Brown Planthopper (*Nilaparvata lugens*)



Picture 64 : Eggs of brown planthopper.

Description:

Eggs are whitish. Nymphs are creamy white and pale brown. Adults have 2 forms, long winged and short winged. BPH is usually more abundant in the dry season than in the wet season.

It is commonly found in rainfed and irrigated fields during the reproductive stage of the rice plant.



Picture 65 : Nymph of brown planthopper.

Damage :

The adults and nymphs suck the plant sap of the leaf blades and leaf sheaths causing the yellowing of the plants. Hoppers burn or a complete drying of the plants is observed when there is a very high population density of BPH. The feeding exposes the plants to fungal and bacterial infections. BPH transmits ragged stunt and grassy stunt viruses.

Factor favoring insect development:

- Rainfed and irrigated wetland environments.
- Continuous submerged conditions in the field.
- Reproductive phase of the rice plant.
- High shady and humidity.
- Densely seeded crops.
- Excessive use of nitrogen.
- Early season insecticide spraying.



Picture 66 : Short winged and long winged adult.

Host plant:

Rice.

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A.2.4. Golden Apple Snail (*Pomacea canaliculata*)



Picture 67 : Eggs of gold apple snail.

Description:

Eggs are light pink.

Adult is yellowish to dark brown shell. Most destructive stage is when the length of the shell is from 10 mm to 40 mm. It is active in the night.



Picture 68: Young golden apple snail.

Damage:

- Rasp plant tissue.
- Feeding damage causes missing seedlings and floating cut leaves.



Picture 69: Adult golden apple snail and its eggs.

Factor favoring insect development:

- Wetland and dryland habitats.
- Irrigation canals and rivers.
- Presence of alternate hosts.
- Presence of young seedlings.
- Continuous flooding of the rice fields.
- Presence of both gills and lung-breathing organs.
- Ability to survive in any environmental condition.

Host plants: Rice, taro and other crops.

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A.2.5. Green Leafhopper (*Nephotettix virescens*)



Picture 70 : Eggs laid inside leaf sheaths.



Picture 71 : Nymph of green leafhopper.



Picture 72 : Adult of green leafhopper.

Description:

Eggs are cylindrical, whitish or pale-yellow and later become brown with red eyespots.

Nymphs are pale-yellow with small spines on the dorsal surface of abdominal segments.

Adults are slender and green and may have black markings on the head or wings. They are generally found in small numbers at the leaf blade and feed on the upper portion of the rice canopy.

Damage:

- Feeds on rice by sucking the plant sap.
- Transmits virus diseases such as tungro, yellow dwarf, yellow-orange leaf, and transitory yellowing.

Factors favoring insect development:

- Grasses near irrigation canals.
- Rice ratoons.
- Lot of sunshine, low rainfall, and high temperature.
- Rainfed and irrigated wetland environments.
- Excessive use of nitrogen.

Host plants: Rice, wheat, corn, sugar cane and others.

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A.2.6. Leaf Folder (*Cnaphalocrocis medinalis*)



Picture 73 : Young larva of leaf folder.

Description: Larvae are yellow, turn yellowish-green with brown heads as they mature, and are about 12-25 mm long. Each larva can make 2-4 folded leaves. Pupa is about 9-12 mm long and is found inside the rolled leaf. Adults are yellow brown in color. Adults usually emerge in the evening. Females lay eggs at night.



Picture 74 : Larva feeding inside the folded leaf .



Picture 75 : Cocoon.

Damage:

- Larva removes the leaf tissues.
- Larva folds a leaf blade together and glues it with silk strands.
- Larva feeds inside the folded leaf creating longitudinal white and transparent streaks on the blade.



Picture 76 : Adult moth.

Factor favoring insect development:

- Heavily fertilized fields.
- High humidity and shady areas.
- Presence of grassy weeds from rice fields and surrounding borders.

Host plants:

Rice, maize, sorghum, wheat, oats, coconut, barley, banana, tobacco, millet, sugarcane and others.

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A.2.7.

Rice Bug (*Leptocorisa oratorius*)



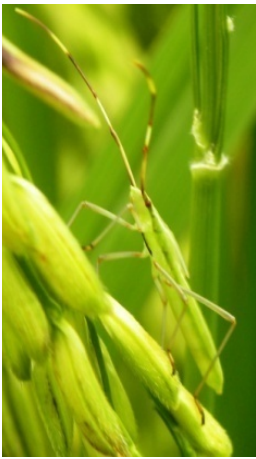
Picture 77 : Eggs.



Picture 78 : Nymph.

Description:

Eggs are oval, shiny, and reddish brown. Younger nymphs are pale in color with long antenna and they become yellowish green later. Adults have long legs with slender body. It is active during the early morning and late afternoon.



Picture 79 : Nymph.



Picture 80 : Adult.

Damage:

Both the nymphs and adults feed on the endosperm of the rice grain that results in small, shrivelled, spotty, or deformed grains. Their feeding on the soft or dough stages causes grain discoloration.

Factor favoring insect development:

- Staggered rice planting.
- Warm weather, overcast skies, and frequent drizzles.
- Flowering to milky stages of the rice plant.

Host plants:

Rice, tea, guava, millet, mango and others.



Picture 81: Adult.



Picture 82 : Adult.

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A.2.8. Rice Case Worm (*Nymphula depunctalis*)



Picture 83 : Eggs.



Picture 84 : Larva.



Picture 85: Nymph .

Description:

Eggs are laid in single or cluster on the undersurface of the leaves. Larva is light green with a light brownish orange head. Pupa is cream and becomes silvery white in the mature. Adult is small white moth with pale brown.

Damage:

- Cutting off leaf tips to make leaf cases.
- Ladder-like appearance of skeletonized leaf tissues.

Factor favoring insect development:

- Rice field with standing water.
- Transplanting young seedlings.
- Wetland and irrigated environments.



Picture 86: Adult moth.

Host plants: Rice, Cyperaceae and others.

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A.2.9. Rice Thrip (*Stenchaetothrips biformis*)



Picture 87 : Eggs and young larva.



Picture 88 : Larva.



Picture 89 : Pre pupa.



Picture 90 : Pupa.

Description:

Egg is very tiny white when freshly laid and turns pale yellow toward maturation.

The nymph is elongated, elliptical, slender, and is pale-yellow in color.

The pupa has short wing buds that are not functional.

The adult has a slender small body, yellowish to dark-brown in color. It is 1-2 mm. It can exist in two forms, winged or wingless.

Damage:

The feeding damage causes tearing of the plant tissues.

The damaged leaves are having silvery streaks or yellowish patches and curled from the margin to the middle.

Infested panicle causes unfilled grains.



Picture 91 : Mature adult.

Factor favoring insect development :

- Dry weather.
- No standing water.
- All rice environments.
- Presence of graminaceous weeds.

Host plants: Rice, maize and others.

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A.2.10. Yellow Stem Borer (*Scirpophaga incertulas*)



Picture 92 : Eggs.



Picture 93: New emergence.



Picture 94: Young larvae.

Description:

Eggs are white in color. They are oval, flattened, and covered with brownish anal hairs of the female moth. The larva has a pale hairless yellow body with a small orange head. Pupate occurs in the stem. The female is whitish to yellowish in color. It has a pair of clear black spots in the middle of each forewing. The male is smaller and dull in color. It has two rows of black spots at the tip of the forewings.



Picture 95 : Young larva inside the stem.



Picture 96 : Mature larva inside the stem.



Picture 97 : Pupa inside the stem.

Damage:

- Causes deadheart or drying of the central tiller during the vegetative stage.
- Causes whiteheads at reproductive stage.

Factor favoring insect development:

- Fields planted late.
- Stubbles that remain in the field.

Host plants: Rice, barley, sorghum, maize, wheat, and others .



Picture 98 : Female moth.



Picture 99 : Male moth.

A.3. Diseases

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A.3.1.

Blast (*Pyricularia grisea*)



Picture 100 : Leaf blast.

Description: The disease caused by fungal infection.

Leaf blast: An infected leaf has diamond-shaped or elliptical or spindle-shaped spots with gray or white centers and brown margins. The spots may merge leading to a complete drying of the infected leaf.

Collar blast: Lesion is located at the junction of the leaf blade and leaf sheath and can kill the entire leaf .

Node blast: The infected node rots causing all above parts to die.

Panicle blast: The infected panicle turns white and dies before being filled with grain.

Neck blast: Symptoms appear at the base of the panicle . Infected panicles appear white and are partly or completely unfilled . The whitehead symptoms can easily be confused with a stem borer attack which also results in a white and dead panicle.



Picture 101 : Collar blast.

Factor favoring disease development :

- Infested or diseased seeds.
- Excessive use of nitrogen.
- Poor air flow and poor sunlight penetration.
- Rainy days with high humidity.
- Cloudy skies, frequent rain, and drizzles.



Picture 102 : Node blast.



Picture 103 : Panicle blast.



Picture 104 : Neck blast.

Host plant: Specific to rice.

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A.3.2. Leaf Blight (*Xanthomonas oryzae* pv. *oryzae*)



Picture 105 : Appearance of bacterial that looks like a milky or opaque dewdrop on young lesions early in the morning.



Picture 106 : Dried leaf edges.

Description:

The disease is caused by the bacterial pathogen. An infected leaf has yellow water soaked lesions at the margin of its leaf blade. The lesions run parallel along the leaf and when they join together may cover the whole leaf. Bacterial discharge appears on young lesion early in the morning that looks like a milky dewdrop. As the disease progresses, the leaf dries-up with white lesions and the leaf blade has wavy margins.



Picture 107 : Leaves wilt and roll up and become grayish green to yellow.



Picture 108 : Seedling wilt completely.

Damage: Yellowing and drying of leaves.

Factor favoring disease development:

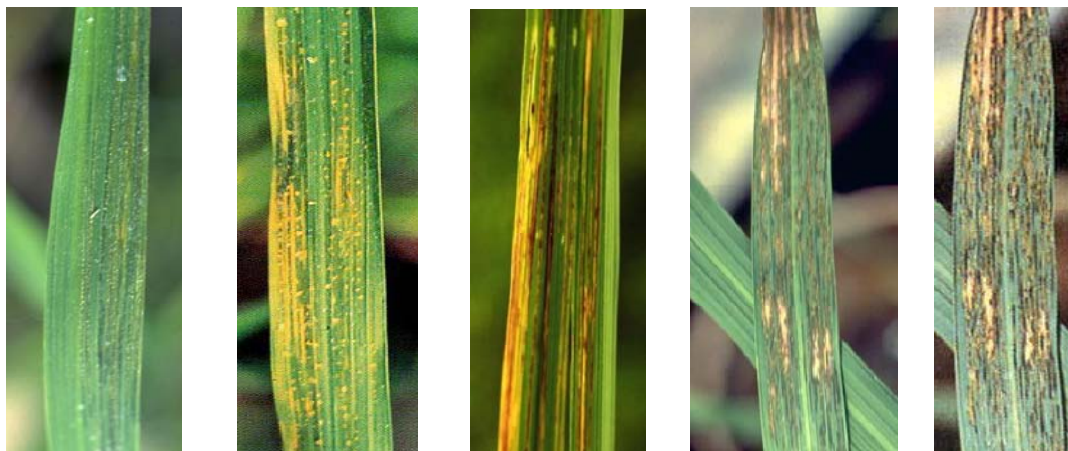
- Presence of weeds.
- Presence of rice stubbles of infected plants.
- Presence of bacteria in the rice paddy and irrigation canals.
- Warm temperature, high humidity, rain and deep water.
- Over fertilization.

Host plan:

Rice and others.

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A.3.3. Leaf Streak (*Xanthomonas oryzae* pv. *oryzicola*)



Picture 109 : From early to severe infection (from left to right).

Description:

The disease is caused by bacterial pathogen.

Initial symptoms are dark-green and water-soaked streaks on interveins from tillering to booting stage. Streaks later enlarge to become yellowish gray and translucent.

Bacterial exudates on surface of lesions. Lesions turn brown to grayish white then dry.

Damage:

- Browning and drying of leaves.
- Reducing yield under severe condition.



Picture 110 : Rice leaves infected by leaf streak.

Factors favoring disease development:

- Presence of the bacteria on leaves and in the water or those surviving in the debris left after harvest.
- High temperature and high humidity.

Host plant: Species of *Oryza*.

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A.3.4.

Tungro



Picture 111 : Discolored leaves.

Description: Tungro virus disease is transmitted by leafhoppers, wherein the most efficient vector is the green leafhopper.

- Discoloration begins from leaf tip and extends down to the blade or the lower leaf portion.
- Infected leaves may also show mottled or striped appearance – stunting.
- Reduced tillering.
- Delayed flowering, which may delay maturity.
- Panicles are small and not completely exerted.
- Most panicles are sterile or partially filled with grains and covered with dark brown blotches.

Damage:

- Reduce tillering.
- Delay flowering and maturity.



Picture 112 : Appearance of plant infected by tungro.

Factor favoring disease development:

- Presence of the virus sources.
- Presence of the vector.
- Age and susceptibility of host plants.

Host plants: Rice and others.

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A.3.5.

Rice Grassy Stunt Virus

Description: Transmitted by Brown Planthopper. The symptom develops in 10-20 days after infection. The main symptoms of infected plant are :

- Stunting.
- Excessive tillering.
- Very upright growth habit.
- Leaves which are short, narrow, and yellowish green.
- Small rusty spots or patches.
- Infected plants usually survive until maturity.



Picture 113 : Infected plant.

Damage: No panicles have been produced by infected plants.

Factor favoring disease development:

Presence of brown planthopper.

Host plants: The disease found only on rice crop.

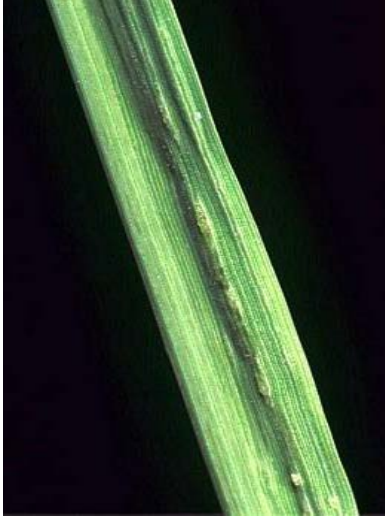


Picture 114 : Infected and healthy plants.

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A.3.6.

Rice Ragged Stunt Virus



Picture 115 : Galls caused by swollen phloem cell.



Picture 116 : Leaf blades twist.



Picture 117 : Flag leaves twist and enclose panicle.

Description: The disease is transmitted only by Brown Planthopper. The infected plants are:

- Stunting during early growth stages of the crop.
- Leaves which are short and dark green with serrated edges.
- Leaf blades are twisted at the apex or base.
- Galls are caused by swollen phloem cells and developed on the leaf blades and sheaths.
- Leaf edges are uneven and the twisting gives the leaves a ragged appearance.
- Ragged portions of the leaves are yellow to yellow-brown.
- Flag leaves are twisted, malformed, and shortened at booting stage.
- Flowering is delayed.
- Incomplete panicle emergence.



Picture 118 : Panicle can not emerge completely.

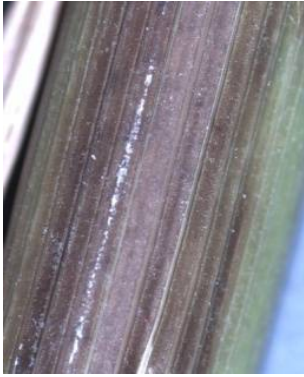
Damage: Partially exerted panicles and unfilled grains.

Factor favoring disease development: Presence of the vector and the host.

Host plants: Rice and others.

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A.3.7. Sheath Rot (*Sarocladium oryzae*)



Picture 119 : Close view of sheath rot lesion (interveinal discoloration).



Picture 120 : Rice sheath rot infection.



Picture 121 : Lesions and necrosis on rice flag leaf.

Description:

The disease is caused by fungus pathogen and presents:

- Irregular spots or lesions, with dark reddish brown margins and gray center.
- Discoloration in the sheath.
- Lesions enlarge and often coalesce and may cover the entire leaf sheath.
- Severe infection causes entire or parts of young panicles to remain within the sheath.
- Unemerged panicles rot and florets turn red-brown to dark brown.
- Whitish powdery growth inside the affected sheaths and young panicles.
- Infected panicles that are sterile, shriveled, or partially filled with grains.



Picture 122 : Head does not completely exert from the leaf sheath.



Picture 123 : Grain discoloration.

Factors favoring disease development:

- Associated with insect injury.
- High amount of nitrogen.
- High relative humidity.
- Dense crop growth.
- Temperature from 20 to 28° C.

Host plants: Rice, maize and others.

Damage:

- Development of spots or lesions.
- Unfilled and discolored panicles.

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A.3.8. Sheath Blight (*Rhizoctonia solani*)



Picture 124 : Lesion development from left to right.



Picture 125 : Lesion on the sheath leaves.

Description:

The disease is caused by the fungal pathogen. The initial symptoms usually develop as lesion on sheath leaf, just below the leaf collar as oval-to-elliptical, green-gray, water-soaked spots. The lesions expand and the center of the lesions may become bleached with an irregular tan-to-brown border. The infection spreads to upper part of plant, including leaf blade, causing extensive, tan, irregularly shaped lesions with brown borders. The lesion will turn dark brown at maturity.

Damage:

- Formation of lesions.
- Production of empty grains.



Picture 126 : Mature lesion on leaf blades.

Factors favoring disease development:

- Presence of the disease in the soil.
- High humidity .
- Temperature from 28-32 ° C.
- High levels of nitrogen fertilizer.
- Presence of irrigation water.

Host plants:

Citrus, chili, groundnut, crucifers, soybean, cotton, rice, lettuce, maize, potatoes and others.