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INTRODUCTION OF ECONOMIC ENTOMOLOGY & ECONOMIC CLASSIFICATION OF INSECT PESTS

- A study of the insects that benefit or harm to human beings, domestic animals and crops - **Economic entomology**
- **Classification of insects**
 - Harmful insects
 - Beneficial insects



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Pests in Paddy and their management

Major pests

1. Yellow stem borer: *Scirpophaga incertulas* *Pyralidae*, *Lepidoptera*
2. Gall midge *Orseolia oryzae* *Cecidomyiidae*, *Diptera*
3. Green leafhopper *Nephotettix virescens*, *N. nigropictus*
Cicadellidae, *Hemiptera*
4. Brown plant hopper *Nilaparvata lugens* *Delphacidae*, *Hemiptera*
5. White backed plant hopper *Sogatella furcifera* *Delphacidae*,
Hemiptera
6. Rice earhead bug *Leptocorisa acuta coreidae*, *Hemiptera*

7. Swarming caterpillar *Spodoptera mauritia* Noctuidae, Lepidoptera
8. Leaf folder *Cnaphalocrocis medinalis* Pyralidae, Lepidoptera
9. Rice gundhi bug *Leptocorisa acuta* Coreidae: Hemiptera
10. Rice skipper *Pelopidas mathias* Hesperidae, Lepidoptera
11. Rice hispa *Dicladispa armigera* Chrysomelidae, Coleoptera
12. Whorl maggot *Hydrellia philippina* Ephydriidae, Diptera
13. Rice horned caterpillar *Melanitis ismene* Saturniidae, Lepidoptera

Yellow stem borer: *Scirpophaga incertulas*
Pyralidae, Lepidoptera

Distribution : The pest is widely distributed in all Asian countries, monophagous and is a major pest on rice in India

Host range: Rice

Appearance: The female moth has bright yellowish brown forewings with a clear single black spot and the anal end having tuft of yellowish hair. The male is pale yellow and the spots on the forewings are not conspicuous. Male is smaller than female.

ETL

- 1 egg masses/ m²
- 5% dead hearts - Vegetative stage
- 1% white ear - Flowering stage



Life cycle:

- ✓ Eggs are laid near the **tip on the upper surface of tender leaf** in small masses, covered with a buff coloured mass of hair and scales.
- ✓ Single female lays 2 or 3 clusters of eggs, each having 15-80 eggs. Eggs hatch in about 5-8 days.
- ✓ Newly hatched larvae which are pale white with dark brown head **and prothoracic shield**.
- ✓ They hang down by silk thread, get blown off to other clumps or land on water, swim freely and get to the plants.
- ✓ Larval duration is 33-41 days. Before pupation, the larva prepares an exit hole with thin webbing.
- ✓ Pupation takes place **inside the stem** near base in a white silken cocoon. Moth emerges in 6-10 days

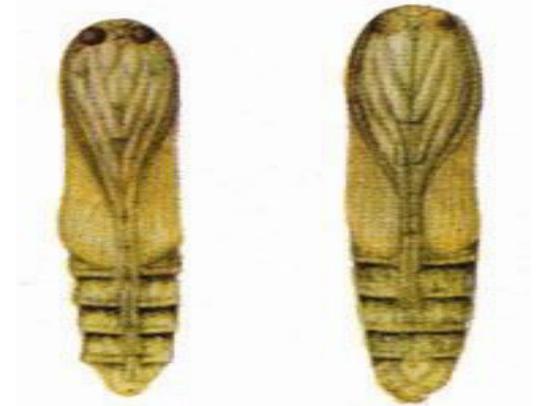
Yellow Stem Borer – Monophagous pest



Egg mass Larva



Adult Pupa



Damage symptoms :

- “**Dead-heart**” at **vegetative stage** which turns brownish, curls and dries off
- “**White ears**” at **heading stage** with empty, partially filled grains
- Presence of egg masses near the tips of tender leaf blades
- Activity of moths in the vicinity
- Frass at the feeding site



Whitehead or dead panicles at reproductive stage (IRRI)

MANAGEMENT

Monophagous nature and peculiar boring habits of yellow stem borer make control with insecticides difficult.

Cultural control

- Harvesting of crop close to soil surface, ploughing or flooding the field after harvest to kill hibernating larvae in the stubbles
- Selection of varieties resistant to yellow stem borer : Swarnamukhi (NLR 145), Pothana (WGL 22245), Varsha (RDR 355)

Mechanical control

- Clipping the tips of the seedlings prior to transplantation aids in the elimination of egg masses
- Setting light traps or pheromone traps for monitoring the pest
- Collection and elimination of egg masses
- Seedling root-dip with chlorpyrifos (0.02%) @ 200 ml in 200 litres of water. Seedling root-dip is effective for 30 days in the main field against stem borer, gall midge, BPH and GLH.

Chemical control

Nursery:

- 5 days before pulling the nursery application of carbofuran 3G @ 200 g/cent of nursery in a little water (seedling root-dip not required)
- Foliar sprays with monocrotophos 1.6 ml/l or chlorpyrifos 2.0 ml/l at 10 and 17 DAS

Main field:

- Foliar sprays with chlorpyrifos 2.5 ml/l or phosphamidon 2.0 ml/l or acephate 1.5 g/l or cartap hydrochloride 2.0 g/l or chlorantraniliprole 0.4 ml/l
- At panicle initiation stage: cartap hydrochloride 4 g @ 8 kg/acre,
- Carbofuran 3 g @ 10 kg/acre rice

Biological control

Egg parasitoids: *Trichogramma chilonis*

Larval parasitoids: *Goniozus indicus*

Pupal parasitoids: *Elasmus albopictus*

Predator: *carabid beetles*

Gall midge *Orseolia oryzae* Cecidomyiidae, Diptera

Distribution: The pest is endemic and is distributed in most parts of India. It is a major pest in Telangana, North Coastal region of Andhra Pradesh and mainly a pest of *kharif*.

ETL: 10% silver shoots

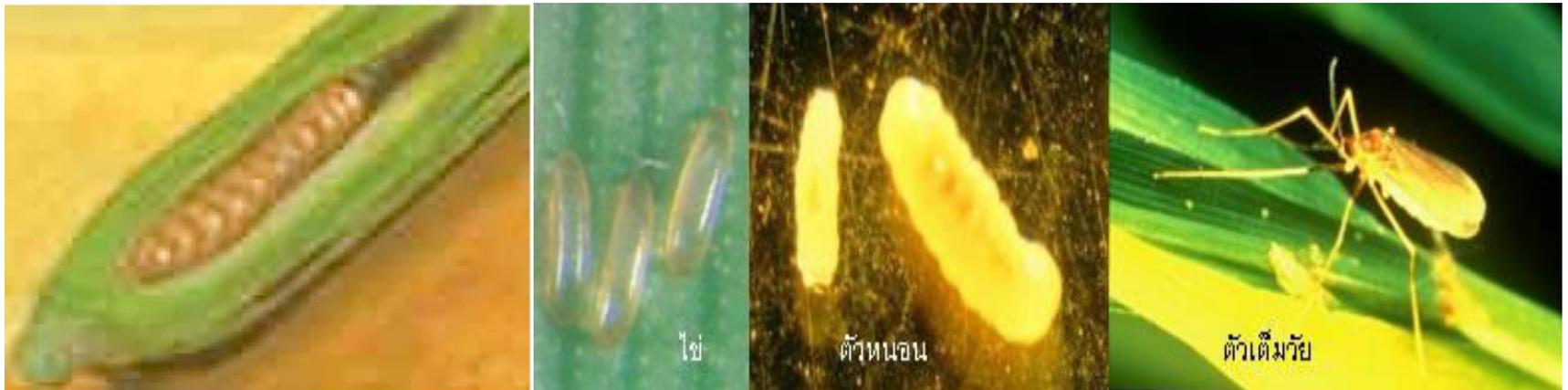
Morphology: Fly is mosquito like and is 3-3.5 mm long. Female has bright orange red abdomen, swifter with a reddish telescopic body. Male is darker and smaller.

- Maggot which is pale reddish, apodous



Life history:

- Eggs are laid singly or in groups of 2-6 just below or above ligule *i.e.*, on **leaf blade or leaf sheath**. Single female lays 100-300 eggs. The reddish, elongate eggs hatch in 3-4 days. Larval duration is 15-20 days. Adult longevity is 1-3 days.
- Maggot are moves down to the shoot apex without boring into plant tissue.
- Throughout its development it feeds at the base of the apical meristem leading to suppression of apical meristem, formation of radial ridges from inner most leaf primordium and elongation of leaf sheath.



The symptoms of damage are

- Hollow whitish to pale green cylindrical tube in tillers known as **gall / silver shoot/onion shoot** bearing at its tip a green, reduced leaf blade complete with ligules (membraneous or hairy tissues located at the junction of the leaf blade and leaf sheath) and auricles (slender extensions of the collar and are located at the junction of the leaf blade and leaf sheath).
- Gall is a modified leaf sheath. Vigorous subsidiary tillering if infested in early growth period



▪The pest infests even nursery but prefers tillering stage. Infested tillers do not bear panicles. At panicle initiation stage, the maggot cannot cause damage.

▪Only one larva develops at shoot apex, remains throughout its development inside the gall. Larval duration is 15-20 days. The full grown larva is 3 mm long and pale red in colour.

▪Pupation is at the base of the gall, but the pupa wriggles up to the tip projecting halfway out. Pupal period is 2-8 days. The gall dries up after fly emergence. It spends its entire larval and pupal period inside a single tiller.



Empty Pupal case protruding out

MANAGEMENT

Cultural control

- Avoid late transplanting in endemic areas. Early planted kharif crop escapes pest
- Selection of variety resistant to a biotype of the region is imperative since six biotypes of rice gall midge have been identified in India.

Mechanical control

- Seedling root dip with chlorpyrifos 0.02%

Biological control

- The larvae are naturally parasitized by *Platygaster oryzae*

Biotype: New populations capable of damaging and surviving on plants previously resistant to the populations of same species. Certain physiological and behavioral changes in the new populations of insect make it easy to feed and develop on resistant varieties.

Geographical distribution of gallmidge biotypes

Biotype 1: Hyderabad, Warangal, Maruteru (A.P) Sambalpur (Orissa), Raipur (M.P)

Biotype 2: Cuttack, Bhubaneswar (Orissa).....East coast

Mangalore (Karnataka), Goa...West coast

Sakholi (Maharashtra).....Central India

Biotype 3: Ranchi (Bihar).....North Wangbal (Manipur).....North East

Jagityala (A.P)

Biotype 4: Srikakulam and Vizianagaram (A.P) Bhadra (Sakholi) (Maharashtra)

Biotype 5: Moncompu (Kerala)

Biotype 6: Manipur

Varieties resistant to different biotypes of gallmidge Biotype Varieties

Biotype 1 Kakatiya, Potana, Kavya, Dhanyalakshmi (BPT 1235), Phalguna, Vikram, Surekha, IR 36, Lalat.

Biotype 2 Phalguna, Vikram, Vikramatya, Lalat.

Biotype 3 Surekha

Biotype 4 IR 36

Biotype 5 Phalguna, Kavya, Dhanyalakshmi, Kakatiya, Divya.

Chemical control:

- Application of granules in nursery 5 days before pulling the nursery – phorate 10 G 60 g/cent or carbofuran 3G @ 200 g/cent
- Application of granules in the main field at 10 -15 DAT: phorate 10 G 5 kg/ac or carbofuran 3G 10 kg/ac in endemic areas

**Green leafhopper *Nephotettix virescens*,
N. nigropictus Cicadellidae, Hemiptera**

Distribution : distributed in all rice tracts in India.

Appearance: *N.nigropictus* possesses two black spots in the males which extend up to the black distal portion of the forewings. Males have a black tinge along anterior margin of pronotum and black submarginal band on the crown of the head. Female is generally entirely green without any black tinge on pronotum.



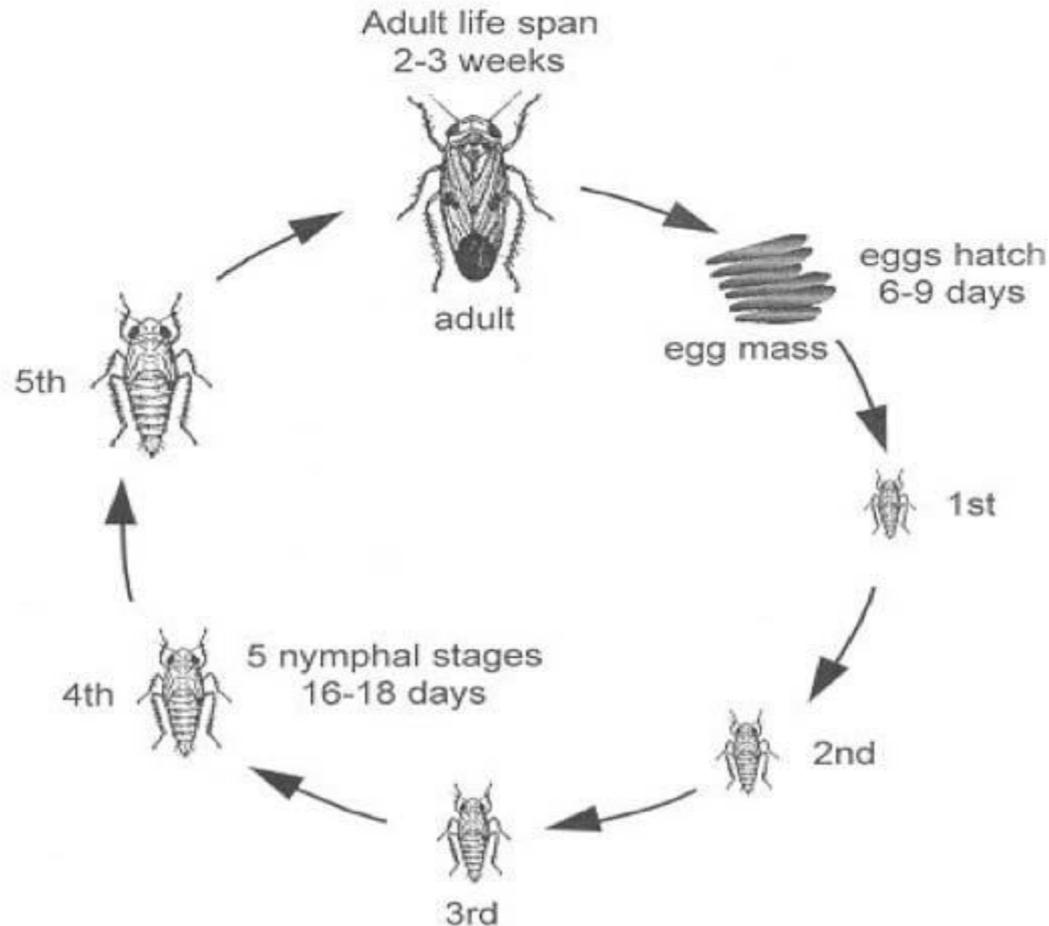
- *N.virescens* can be easily distinguished by the black spots in the male not extending up to black distal portion of forewings and the absence of black tinge on the pronotum and black band on the crown. It causes more damage to rice than *N.nigropictus*

ETLs : Nursery: 1-2 hoppers/m²
Tillering: 10/hill,
Heading: 20/hill,
Tungro endemic areas: 1/hill



Life cycle

- Yellowish eggs are laid in **rows under epidermis of leafsheath @ 53** eggs per female. Incubation period is 6-7 days.
- Nymph passes through 5 instars, becomes adult in about 18 days and it takes about 24 days to complete the life cycle.



Symptoms of damage:

Both nymphs and adults suck sap from leaves causing the following symptoms.

- Yellowing, stunting and withering of plants
- Leaves turning brown with small scratch like marks on leaf in severe infestation
- Uniform yellowing from mid half of leaf

Serious damage is inflicted when leafhoppers transmit virus diseases. *N.nigropictus* is known to transmit *rice dwarf, rice yellow dwarf, while N.virescens* transmits *rice tungro, rice transitory yellowing and rice yellow dwarf*. Rice green leafhoppers are abundant during rainy season. Optimum temperature and high humidity favour the pest.



MANAGEMENT

Cultural control

- Early clipping of infested leaf tips to prevent virus transmission
- Removal of left over nursery
- Removal of alternative hosts during off season such as *Panicum spp.*, *Echinochloa spp.*, *Cyperus spp.*, and other grasses
- Seedling root dip with chlorpyrifos 0.02%
- Varieties resistant to green leafhopper IR-20, Vani, Vikramarya

Chemical control

Foliar sprays (directing the spray towards base of plants) with any of the following insecticides *viz.*, *ethofenprox 2 ml/l*; *acephate 1.5 g/l*; *BPMC 2 ml/l*; *imidacloprid + ethiprole 80 WG 0.25 g/l*; *monocrotophos 2.2 ml/l*; *carbofuran 3G 10 kg/ac*

Biological control: Eggs are parasitised by *Oligosita nephoteticum*



BROWN PLANTHOPPER

Nilaparvata lugens Delphacidae: Hemiptera

- Adults are brown dorsally and deep brown ventrally. The female is 5 mm long and male 4.5 mm. Female exists in two forms, the fully winged macropterous and the truncated – winged brachypterous.
- Eggs are thrust within parenchymatous tissues of the plant along the **midrib of leaves** in bunches of 2-12 eggs, A female lays, about 232 eggs. The egg is white elongated and shaped like a **curved club**. It hatches in 7-9 days. Brownish nymph undergoes five instars during a nymphal period of 10-18 days

Brown plant hopper



Eggs

● Nymphs & adults



Adults



Symptoms of Damage:

- Both nymphs and adults suck sap from basal portion of plant **clustering at the base of rice clump**.
- They inject toxic saliva while feeding which results in “**hopper burn**”.
- Population of white backed plant hopper (WBPH), *Sogatella furcifera* is commonly seen in association with that of BPH on rice. **WBPH dominates during vegetative phase while BPH dominates from PI stage..**

The symptoms include

- Premature yellowing of leaves and drying of plants in isolated circular patches
- Drying of plants spreads in a circular fashion
- Sooty mould
- Exuviae at the base of plants
-

Damage



Hopper burn

- BPH is reported as vector of **grassy stunt** and **ragged stunt virus**. Apart from rice, it infests *Cyperus rotundus* and *Panicum repens*. The pest is serious from PI to booting till post flowering. **Higher doses of N and high plant density per unit area invite the pest problem.**

- ETLs

Tillering stage: 10 hoppers / Hill

Heading stage : 20-25/Hill

MANAGEMENT

- Avoiding monoculture of susceptible varieties.
- Growing resistant varieties like Chaitanya (MTU 2067), Godavari (MTU 1032), Krishnaveni (MTU 2077), etc.
- Seedling root dip with chlorpyrifos 0.02%
- **Formation of alleys or pathways** of 20 cm width for every 2 metres of planting to facilitate aeration, light, basal spraying, monitoring and other farm operations.
- Alternate wetting and drying of the field.

- Conservation of natural enemies

Spider : *Lycosa pseudoannulata*

Mirid bug : *Cyrtorhinus lividipennis*

Chemical control:

Foliar sprays (directing the spray towards base of plants) with any of the following insecticides viz., *ethofenprox 2 ml/l; acephate 1.5 g/l; BPMC 2 ml/l; imidacloprid + ethiprole 80 WG 0.25 g/l; monocrotophos 2.2 ml/l; carbofuran 3G 10 kg/ac*

RICE HISPA *Dicladispa armigera*

Hispididae: Coleoptera

Distribution: This is known to occur in all rice tracts in India, especially in Andhra Pradesh, West Bengal and Bihar. It is serious on young rice, it also infests sorghum, maize, bajra, sugarcane and grasses.

Appearance: Beetle is a small 4.5 – 5 mm long, square shaped, bluish black and shiny with spines on thorax and elytra.

- ETLs :2 adults / hill, 2 damaged leaves / hill



Life cycle :

- Eggs are laid singly, partially inserted **beneath the epidermis of tender leaves generally towards the tip @ 55 eggs/ female.**
- The egg hatches in 4-5 days. Small, yellowish, flattened grubs feed on leaf tissue inside the leaf mine causing **Blister spots towards leaf tip**
- After feeding for 7-12 days, it pupates in leaf mine or grub tunnel and the beetle emerges in 3-5 days. Adult longevity is about 78 days.

Damage symptoms:

Adults scrape green matter on upper surface of leaf blade causing

- ✓ Whitish leaf tips of young leaves giving dried up appearance.
- ✓ **White, rectangular streaks parallel to veins on older leaves**, which initially appear glistening, membranous, papery white, later turning pale reddish, straw coloured.



MANAGEMENT

- ✓ Clipping of leaf tips of seedlings while transplanting eliminates eggs laid towards the tip
- ✓ Removal of left over nursery
- ✓ Grubs are parasitized by *Bracon sp.*,
- ✓ Foliar sprays with profenophos 2 ml/l or monocrotophos 1.6 ml/l or chlorpyriphos 2.5 ml/l.

RICE LEAF FOLDER *Cnaphalocrocis medinalis*

Pyralidae: Lepidoptera

Appearance:

- Moth is small with a wing span of 15 mm, brownish orange coloured with light brown wings having two distinct dark wavy lines on forewings and one line on hind wings.
- Both wings have dark brown band on their outer margin. Adult longevity is 3-4 days.
- **ETL:1 larva/hill, 2 damaged leaves/hill**



Life history:

- Flat oval, yellowish eggs are laid singly on the **under surface of tender leaves** which hatch in 4-7 days.
- The pest causes more loss at boot leaf stage. Pale yellowish green larva measuring 16-20 mm long becomes full grown in 15-27 days.
- Pupation is **inside the leaf fold** and the moth emerges in 6-8 days. Total life cycle takes 26-42 days. The pest is abundant during rainy season with optimum temperature and high RH.



Damage symptoms:

- The larva folds 3-4 leaves of young plants feeding from within. In grown up plants, it folds leaf longitudinally from tip downwards bringing together the margins with silken threads, lives in tubes thus formed feeding on chlorophyll. Single larva damages several leaves causing the following symptoms.
- **Whitish membranous folded leaves with typical white streaks**
- Faecal pellets when leaf opened
- Reduced vigour of the plant

Leaf folder





MANAGEMENT

- Early clipping of infested, folded leaf tips
- Removal of alternative hosts *Echinochloa spp.*, and *Panicum spp.*, and other grasses .
- The *ichneumonid*, *Xanthopimpla emaculata* is parasitic on the pest larvae
- Passing a rope 2-3 times over the crop at tillering stage mechanically to dislodge caterpillars
- Foliar sprays with chlorpyrifos 2.5 ml/l or acephate 1.5 g/l or cartap hydrochloride 2 g/l or granules of cartap hydrochloride 4 G 8 kg/ac

EARHEAD BUG/GUNDHI BUG *Leptocorisa acuta*

Coreidae: Hemiptera

Appearance:

- This is present in all rice growing tracts and is a regular pest in certain parts of Telangana and Rayalaseema regions of Andhra Pradesh.
- The bugs emit characteristic unpleasant odour indicative of their presence in the field, hence the name, gundhi bug. The pest appears on rice just before flowering stage and continues until panicles ripen. **ETL : 1 or 2 bugs/hill**

- The adult is active, diurnal, elongated bug with long legs. It is olive brown and ventrally green measuring 15.5-17 mm long.



Gundhi Bug on Rice

Life cycle:

- Eggs are laid in single or double rows close to **midrib on the upper surface of leaves** @ 10-20 per cluster. Each female lays about 100 eggs. Dark reddish brown egg is boat shaped. Egg hatches in about 7 days.
- Nymphs are pale yellowish green **possessing odoriferous glands on the fifth abdominal segment**. Nymph passes through 5 instars in about 15-21 days. The total life cycle takes about a month. After the harvest of rice, the bug over- winters in millets and wild grasses.

Damage symptoms :

- Both nymphs and adults suck juice from grains in milky stage, also from peduncle, leaves and stem causing the following symptoms
 - ✓ Affected grains become shrivelled and **chaffy**
 - ✓ Brown spot is observed at the feeding site where sooty mould develops
 - ✓ Lower grain quality and broken grains when infested at soft dough stage



Damaged grains caused by rice bug (IRRI)

MANAGEMENT

- Clean cultivation
- Collection of bugs by hand nets .
- Foliar sprays in the evening hours at milky stage starting from borders of the crop with dichlorovos 1 ml/l + endosulfan 2 ml/l or chlorpyriphos 2 ml/l or malathion 2 ml/l
- Dusting with endosulfan 4 D 10 kg/ac or carbaryl 10 D 10 kg /ac.

Swarming caterpillar *Spodoptera mauritia* *Noctuidae, Lepidoptera*

Damage symptoms

- This is a sporadic pest but causes very serious damage to young crops when it appears in large numbers. The caterpillars feed at night and hide during the day.
- Larvae cut the seedlings in large scale and appears as if **grazed by cattle by its nocturnal feeding**. Peduncles of ears are bitten through in maturing crop. They feed gregariously and march from field to field



Rice case worm *Nymphula depunctalis*

Pyraustidae, Lepidopera

- Larva cuts the leaf blades into short lengths and constructs a tubular case inside which it remains and feeds on the foliage scraping green matter in streaks. Damage appears ladder like with alternate dark and light rows of green patches.
- Sprinkling kerosene on water and **passing a rope over the crop to dislodge and kill the larvae in the cases.** Stagnant water along with leaf cases is drained. Monocrotophos 1.6 ml/l or chlorpyriphos 2.5 ml/l is effective.





Whorl maggot *Hydrellia philippina*
Ephydriidae, Diptera

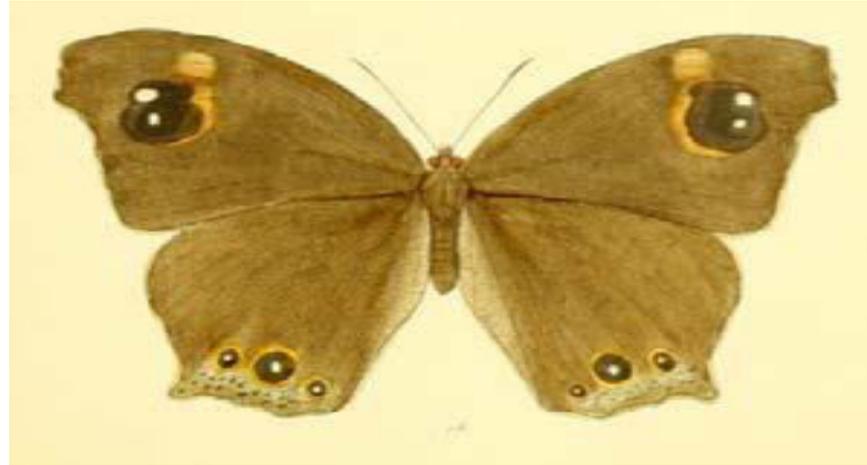
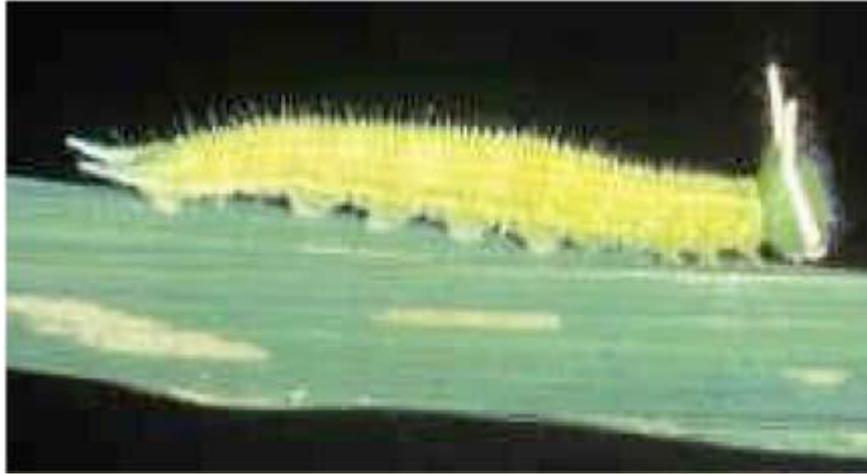
- Maggots attack the leaf blades even before unfurling and the initial damage is characterised by the presence of narrow stripes of whitish area in the blade margins. Boot leaf and spikelet damage has also been noticed. The maggots feed on spikelets and cause shrivelling.
- Maintenance of irrigation water during initial establishment stage of seedlings and application of carbofuran 3 G @ 33 kg/ha is effective.



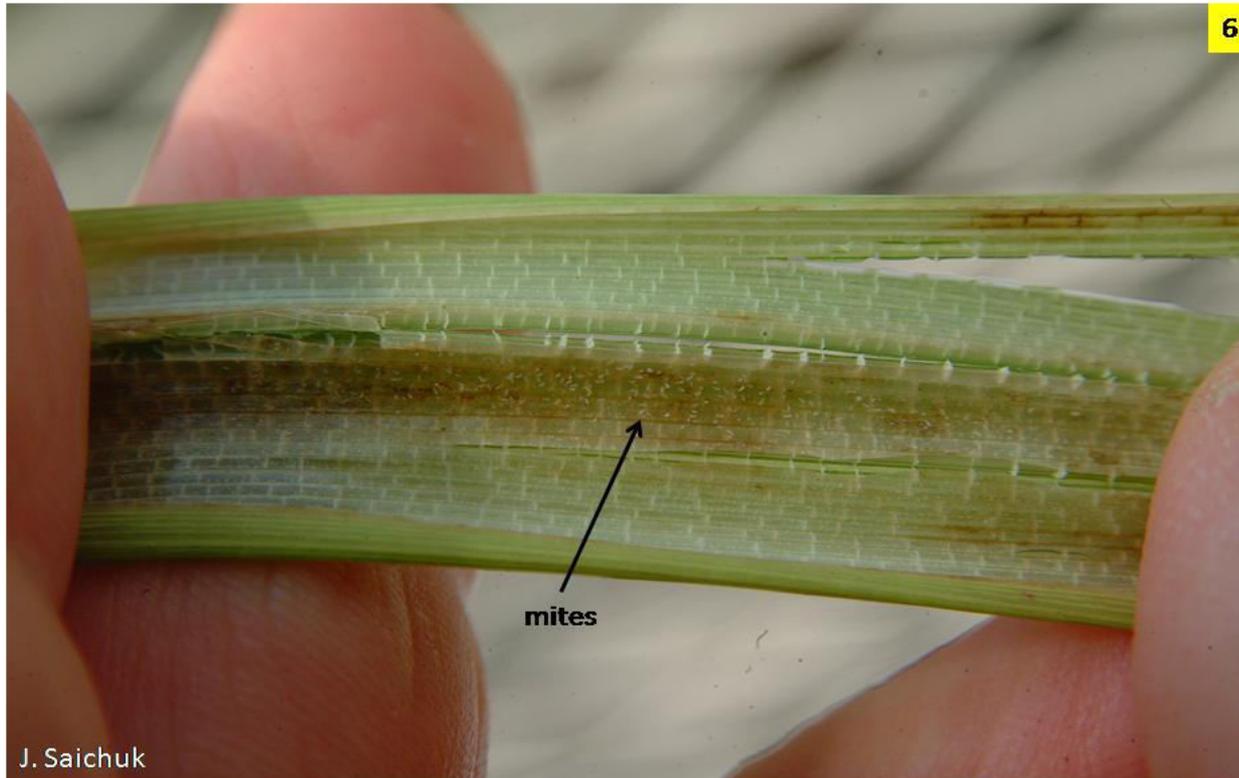
Rice horned caterpillar *Melanitis ismene*
Saturnidae, Lepidoptera

Damage symptoms

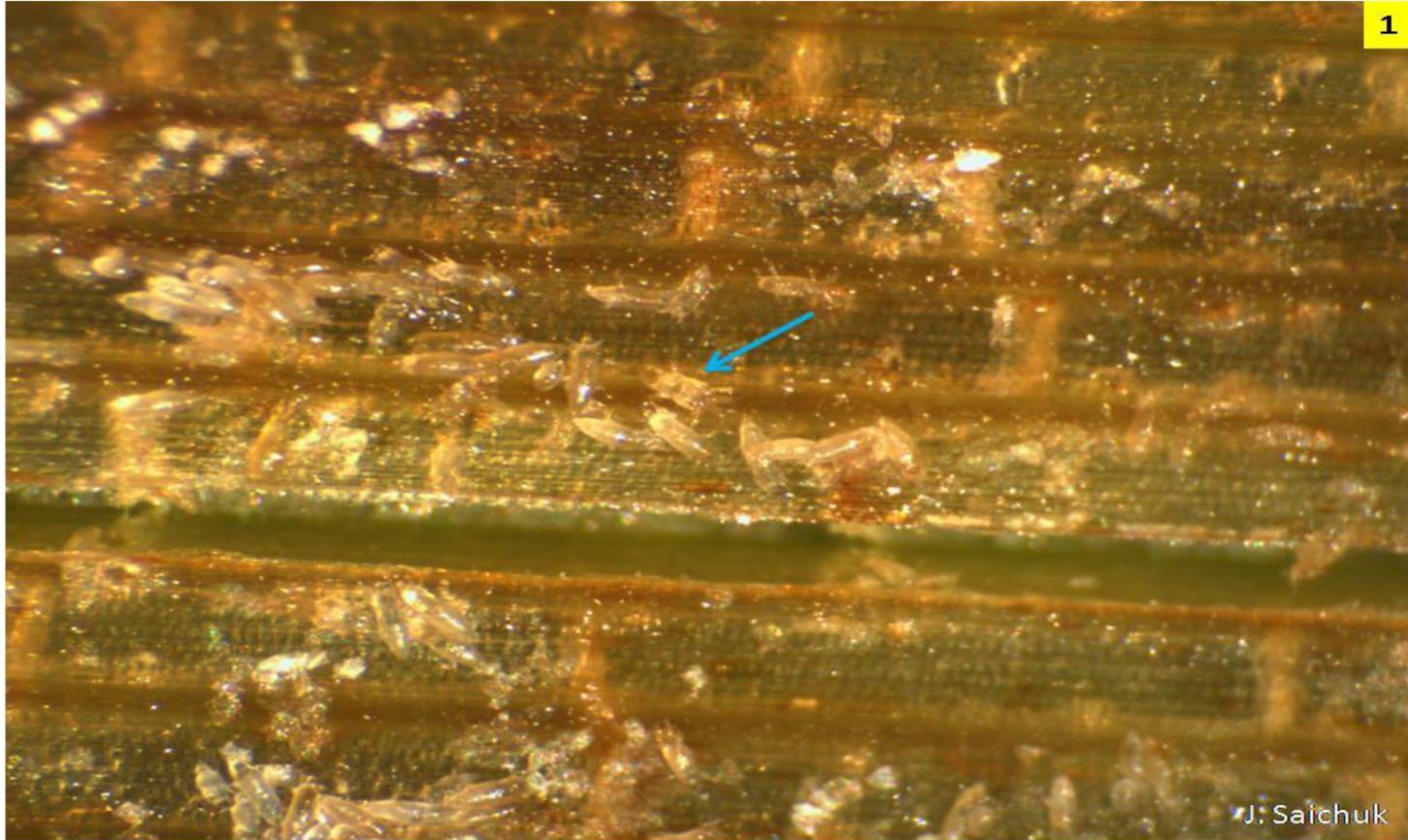
- The larva of this butterfly feeds on leaf blades of rice. Leaves are defoliated from the margin or tip irregularly



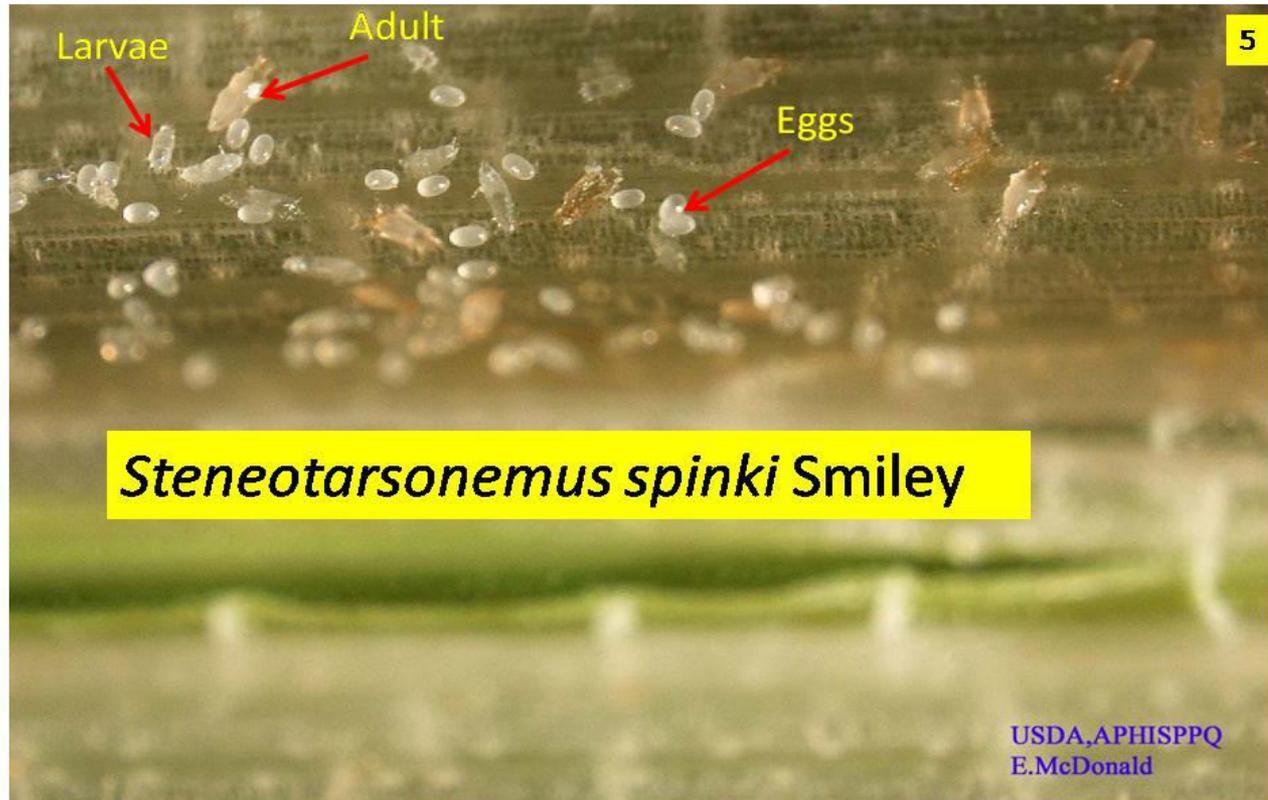
Panicle mite - *Steneotarsonemus latus*



Mites inside leaf sheath



Stages of the mite



Discolouration of leaf sheath



Twisting of panicle ,breaking of grain, grain damage



Management

- Destruction of stubbles
- Removal of weeds
- Fallowing for 2 weeks
- Predatory mite- *Amblyseius taiwanicus*
- Chemical control- Profenophos-2ml/l
Dicofol 5 ml/l

Integrated Pest Management in Rice

A. Cultural method

1. **Remove / destroy stubbles** after harvest and keep the field free from weeds.
2. **Trim** and plaster the **bunds** of rice field to expose the eggs of grasshoppers and to eliminate the bug breeding in grasses.
3. Form the **bunds narrow** and short to reduce the damage by **rodents**.
4. Use resistant varieties wherever available.
5. Provide effective **drainage** wherever there is problem of BPH.

6. **Clip** the tip of seedlings before transplanting to prevent the carry over of egg masses of rice yellow stem borer from nursery to mainfield.
7. Organise synchronized planting wherever possible.
8. Formation of **alleys** or pathways of 20 cm width for every 2 metres of planting to facilitate aeration, light, basal spraying, monitoring and other farm operations.
9. Avoid use of **excessive nitrogenous fertilizers**.
10. Use irrigation water judiciously (Alternative wetting and drying reduce BPH and case worm).
11. Remove the egg masses of stem borer in the main field.

B. Mechanical methods

1. Dig out the rat burrows and destroy the rats and young ones at the beginning of the season.
2. Set up light traps to monitor and control pests.
3. Set up-bow traps to kill rodents.

C. Biological methods

1. Release *Trichogramma japonicum* twice on 30 and 37 DAT @ 5 cc/ha/release against stem borer.
2. Release *Trichogramma chilonis* on 37, 44 and 51 DAT (thrice) @ 5 cc/ha/release against leaf folder.
3. Release of *Platygaster oryzae* parasitized galls @ 1 per 10 m² in the mainfield on 10 DAT against gall midge.
4. Set up owl perches to reduce rat damage.

D. Plant products

1. Spray neem seed kernel extract 5% (25 kg/ha), neem oil 3% (15 lit/ha) to control brown planthopper.
2. Spray botanicals viz., *NSKE*, *Vitex negundo* (Notchi), *Prosopis juliflora* and *Ipomoea carnea* leaf extract 5% to control earhead bug and black bug.

E. Chemical methods

1. In BPH prone area / season avoid use of synthetic pyrethroids, methyl parathion and quinalphos and use recommended chemical at recommended doses.
2. Use insecticides based on ETL.