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## Integrated Pest Management Strategies for Rice

S D Mohapatra, A K Nayak, B B Panda, R Tripathi, Md Shahid, S Mohanty, S Saha,  
S Priyadarsini, D R Sarangi, U S Nagothu and H Pathak



भाकृअनुप-राष्ट्रीय चावल अनुसंधान संस्थान  
ICAR - National Rice Research Institute, Cuttack



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## Introduction

Rice is a staple food and the foundation of national stability and economic growth of India. The crop is prone to biotic stress throughout the crop growth period due onslaught from different pests such as insects, diseases, weeds, rats etc. All of the plant parts are vulnerable to insect – feeding from the time of sowing until harvest. There are over 800 insect species damaging rice in one way or another; although the majority of them do very little damage. Majority of rice insect pests are controlled by a complex and rich web of predators and parasitoids that live in or on the rice plant, rice water or soil. Warm and humid conditions in rice fields favour the survival and proliferation of insects, pests and diseases. If biotic stresses in rice are taken care; the rice production may be enhanced by 30-35%.

## Rice Insect Pests

### Yellow stem borer

In vegetative stage, larvae feed inside the leaf sheath leads to yellowing and drying of the youngest shoot, resulting in the formation of 'dead- heart'. In reproductive stage larvae feed inside the stem results in panicles with unfilled grains called 'white ear head'.



Yellow stem borer



Brown plant hopper

### Brown plant hopper

The adults and nymphs of brown plant hopper (BPH) are brown in colour remain at the plant base and suck the plant sap from the leaf sheath at the base of the plants. Due to heavy desapping, the plants turn yellow and then finally die which is known as 'hopper burn'. The nymphs also transmit 'grassy stunt viral' disease.

### Leaf folder

Leaf margins are folded longitudinally and feed the rolled leaves by scraping chlorophyll. Affected leaves dry up giving seriously infested fields a scorched appearance. In a severely infested field, the whole crop gives a sickly appearance with white patches. The infestation at boot leaf stage results in heavy loss of grain yield



Leaf folder



Gundhi bug

### Gundhi bug

Nymphs and adults suck the sap from individual grains at milky stage leads to chaffy grains and black spots appear on the grains at the site of feeding puncture.

### Gall midge

The maggots enter the young tiller and start feeding on growing portion, resulting in elongation of the leaf sheath into a tubular gall. Damaged tillers turn into tubular galls which dry off without bearing panicles. Main external symptom is SILVER SHOOT or GALL which resembles onion leaf. Attack to rice seedlings leads to profuse tillering and these new tillers often become infested.



Gall midge



Swarming caterpillar

### Swarming caterpillar

Larvae feed gregariously and march from field to field. Newly hatched larvae cause the plants to look sick with withered tips and cut leaves. They appear suddenly in masses and move from one field to another field in large numbers like an army and almost completely defoliate the rice crop, when it attacks direct seeded fields. In severe infestation the field looks like cattle grazed appearance.

### Caseworm

The larva cuts the leaves into small bits making tubular cases and scraps the chlorophyll inside the cases. Leaf cases floating on water. Leaves cut at right angles as with a pair of scissors. Leaves with papery upper epidermis that were fed on. Skeletonized leaf tissues usually appear ladder-like.



Caseworm



Thrips

### Thrips

Nymphs and adults lacerate the tender leaves and suck the plant sap. Damaged leaves have silvery streaks and translucent marks, leaves curl longitudinally from the margins inwards leading to sharply pointed leaf tips resembling needles, which finally dry up.

### Panicle mite

Mites are found between stem and leaf sheath in colonies and damages parenchymatous tissues of rice plant and reduce the amount of nutrient flow to the developing grain resulting in reduction of grain weight and size. They carry pathogenic fungi, act as wounding agent for microbe's infection, and enhance grain discoloration, grain sterility.



Panicle mite



Termite

### Termite

Adults feed on the roots of plant resulting yellowing of older leaves, wilting or even death of the plant in case of severe infestation. Damaged plants can easily be pulled out by hand.

## Rice Diseases

### Blast

Spindle-shaped lesions with brown margin and grayish/ashy center tapering toward both ends. These lesions can enlarge and later coalesce to form big irregular patches and finally kill the entire leaves. Black necrotic lesions on the node and around the base of the panicles may occur resulting in breakdown of panicles and formation of chaffy grains.



Blast



Bacterial blight

### Bacterial blight

On seedlings, infected leaves turn greyish green and roll up. As the disease progresses, the leaves turn yellow to straw-coloured and wilt leading whole seedlings to dry up and die. Water-soaked, yellowish stripes on leaf blades are starting at leaf tips with a wavy margin. On older plants, lesions usually develop as water-soaked to yellow-orange stripes on leaf blades or leaf tips or on mechanically injured parts of leaves. In early morning in humid areas, yellowish, opaque, turbid droplets of bacterial ooze may be seen.

### Brown spot

Oval to circular brown colour lesions appear on the coleoptiles, leaf blade, leaf sheath and glumes. Mostly observable damage is the numerous big spots similar to sesame seed that seen on the leaves which will kill whole leaf after drying. The seedlings die in affected nurseries which can be often recognized from a distance by their brownish scorched appearance. Infection also occurs on panicle and neck with brown coloured spots.



Brown spot



Sheath blight

### Sheath blight

The disease will prevent the panicle exertion from sheath and in severe condition, total panicle infection occurs on the upper most leaf sheath at late booting stage. Spots are oblong to irregular with gray center and brown margins on the flag leaf sheath. Whitish powdery growth inside the affected sheaths and young panicles can be observed. Infected panicles and grains are sterile, shriveled, partially or unfilled and discolored.

## Need For IPM

Integrated Pest Management is the approach of mutual integration of available pest control tactics to maintain the pest numbers below economic threshold level with an aim of least or no hazards to the environment. The pest control activity was aimed at eradication of pests by use of chemical (synthetic) pesticides. Overuse and misuse of chemical pesticides have led to development of a series of negative ecological consequences like

- Residual toxicity in plant parts and eatables, soil, water etc.
- Health hazards to animals and human beings
- Destruction of natural enemies (predators and parasitoids)
- Development of insecticide resistance in insects
- Resurgence and outbreak of insects
- Conversion of minor pests and diseases to major one

## Pest Identification

The identification of insect pests and diseases is a tricky issue. ICAR-National Rice Research Institute has developed a robust mobile app “ricexpert” to facilitate farmers for accurate and confident identification of rice insect pest and diseases to serve as a handy tool on real-time basis. There is inbuilt provision in the app through which the farmers can also send the picture, text message or recorded voice to the expert for further clarification if any.



## Pest Monitoring

### a. Survey/Field Scouting

For field scouting farmers should be mobilised to observe the insect pests and diseases occurrence as per stipulated intervals. The plant protection measures are required to be taken only when insect pests and diseases cross Economic Threshold Level (ETL) as per results of field scouting

- Roving survey:** Undertake roving survey at every 10 km distance at 7-10 days intervals (depending upon pest population). Every day at least 20 spots should be observed.
- Field scouting:** Field scouting for pests and bio-control fauna by extension agencies and farmers once in 3-5 days should be undertaken to workout ETL.

### b. Pheromones/light trap:

Majority of insect population can be monitored by fixing pheromone trap or light trap or through sweep net at appropriate stage of crop.

- Pheromone trap:** 8 traps per ha may be used to monitor yellow stem borer moth population.
- Light trap:** Alternate Energy (Solar) Light trap or any other light trap developed by ICAR-NRRI can be operated for 2 to 3 hours in the evening to observe photo-tropic insect pests.
- Sweep-net:** Besides visual observations sweep-nets may be used to assess the population of insect pests and bio-control agents to determine the type of pesticides to be recommended.

## Methods of Pest Management

### Cultural Control

- Raise pre-crop *kharif* grow *Sesbania* and incorporate 45 days old crop in soil during land preparation wherever possible.

- Normal spacing with 30-36 hills/ m<sup>2</sup> depending on the duration of the variety.
- 30 cm alley formation at every 2.5 to 3 m distance in plant hopper endemic areas.
- Balanced use of fertilizers and micro-nutrients as per local recommendations.
- Proper water management (alternate wetting and drying to avoid water stagnation) in plant hopper endemic areas.
- Harvest close to ground level to destroy insect pest present in the internodes/stubbles. This will also expose the insects to birds thus help in natural biocontrol of insect pests.
- After harvest, the fields should be thoroughly flooded with water and ploughed with discs or rotators to kill hibernating larvae of stem borer present in the stubbles. Summer ploughing of fields also expose larvae and pupae of rice swarming or ear cutting caterpillar (climbing cutworm) hidden in the soil to birds and weather factors.

#### b. Mechanical Control

- Collection of egg masses and larvae of pest to be placed in bamboo cages for conservation of biocontrol agents.
- Removal and destruction (burn) of insect pests infested plant parts.
- Clipping of rice seedlings tips at the time of transplanting to minimize carryover of rice hispa, case worm and stem borer infestation from seed bed to the transplanted fields.
- Use of coir rope in rice crop for dislodging case worm, cut worm, swarming caterpillar and leaf folder larvae etc. on to kerosinized water (1 L of kerosene mixed on 25 kg soil and broadcast in 1ha).

#### c. Biological Control

- *Trichogramma japonicum* and *T. chilonis* may be released @ 1 lakh/ha on appearance of egg masses / moth of yellow stem borer and leaf folder in the field.
- Biocontrol agents, spiders, drynids, water bugs, mirid bugs, damselflies, dragonflies, meadow grasshoppers, staphylinid beetles, carabids, coccinellids, *Apanteles*, *Tetrastichus*, *Telenomus*, *Trichogramma*, *Bracon*, *Platygaster* etc. should be conserved.
- Collection of egg masses of stem borers and putting them in a bamboo cage-cum-percher till flowering will permit the escape of egg parasites and trap and kill the hatching larvae.
- Management of farmland and rice bunds with planting of flowers like marigold, sun hemp increases beneficial natural enemy population.
- Provide refuge like straw bundles having charged with spiders to help in build up spider population and to provide perch for birds

#### d. Behavioural Control

Mass trapping of yellow stem borer male moths by installing pheromone traps @ 20 traps/ha with lures containing 10-15 mg pheromone at 20 days after transplanting.

#### e. Chemical Control

Chemical pesticides are to be applied on need base and judiciously. Recommended chemicals are to be applied at right time at recommended dose. The details of the chemical control measures to be adopted against insect pests are given. Spraying should be undertaken based on the ETL values.





### Economic threshold level (ETL)

Crop stage	Pest	ETL
Nursery	Yellow stem borer	1 egg-mass/m <sup>2</sup>
Early to late tillering	Leaf-folder	2 Fully damaged leaves (FDL) with larva/hill
	Stem borer	2 egg-mass/m <sup>2</sup> or 10% dead heart or 1 moth/m <sup>2</sup> or 25 moths/trap/week
	Gall midge	1 gall/m <sup>2</sup> or 10% Silver shoot
	Brown planthopper/ WBPH	10-15 hoppers/hill
	Rice hispa	2 adults or 2 dead leaf /hill
	Rice caseworm	2 FDL/hill
	Swarming caterpillar	1 damaged tiller/hill or 2 larvae/ m <sup>2</sup>
Panicle initiation to booting	Stem borer	2 egg-mass/m <sup>2</sup> or 1 moth/m <sup>2</sup> or 25 moths / trap / week
	Leaf-folder	2 Folder Damaged Leaves/hill
	BPH/WBPH	15-20 hoppers/hill
	Swarming caterpillar/ cut worm	1 damaged tiller/hill or 2 larvae/ m <sup>2</sup>
Flowering to milky grain	Gundhi bug	2 bugs/hill
	Rice panicle mite	No ETL

### IPM STRATEGIES FOR RICE

#### A. NURSERY STAGE

##### Stem-borer, gall midge, thrips

- In the stem-borer endemic areas, install pheromone traps @ 8 traps/ha for pest monitoring and 20 traps/ha for direct control through mass trapping
- Apply fipronil 0.3 G @ 33 kg/ha in nursery at 5 to 7 days before uprooting the seedlings or spray with chlorpyrifos 20 EC @ 2.5ml/ lit or quinalphos 25 EC @ 2 ml/lit or lambda-cyhalothrin 5 EC@ 0.5 ml/lit water

##### Blast

- Early sowing and flooding in the field as often as possible
- Seed treatment with carbendazim 50% WP@2g/ kg seed or *Pseudomonas fluorescens* @10g/ kg seed
- Spray kasugamycin 3SL@1.3ml/ lit water carbendazim 50% WP @ 1 g/lit or isoprothiolan 40% EC @ 1.5 ml/lit or tricyclozole 75% WP @ 6 g/10 lit or tricyclazole 70% WG @ 6 g/10 lit for blast disease management
- Spray ground paste of botanicals like bael@25g/ lit or tulsi@ 25g/lit

##### Bacterial Blight

- Treat 10 kg of seeds with 1.5 g streptomycin + 2.0 g of captan dissolved in 20 lit water for 8-10 hours.
- Spray of streptomycin sulphate 9% + tetracycline hydrochloride 1% SP @ 100-150 ppm for Bacterial blight disease

#### B. VEGETATIVE STAGE

##### Termite

- In termite endemic areas, seed treatment with chlorpyrifos 20% EC @ 10000 ml/ha along with 10% solution of gum arabica or imidacloprid 30.5% SL @ 0.25 litre/100 kg seed along with 10% solution of gum Arabica in 3.75 litre of water just before sowing.



### Stem-borer

- Clipping of leaf tips of the seedlings at the time of transplanting will help in destruction of egg masses.
- Removal of excess nursery and incorporation into soil.
- Apply chlorantraniliprole 0.4G @ 10kg/ ha or imidacloprid 0.3 G @15kg/ha or cartap 4G @ 25 kg/ha or fipronil 0.3 G @ 25 kg/ha.
- Install pheromone traps with 5 mg lure @ 8 traps/ha for pest monitoring or 20 traps/ha for direct control through mass trapping. Replace lures at 25 to 30 days interval during the crop period.
- Inundative release of egg parasitoid, *Trichogramma japonicum* @ 100,000 adults/ha for 5 to 6 times starting from 15 days after transplanting.

### Gall midge

- Apply fipronil 0.3 G @ 25 kg/ha

### Brown Plant Hopper

- If possible, do alternate wetting and drying the field.
- Prepare alley at 6ft interval to facilitate the exposure of sunlight to the basal portion of the plant and spraying operation
- Don't apply nitrogenous fertilizer which will facilitate the BPH infestation
- Spray pymetrozine 50 WG @ 300g/ha or imidacloprid 200 SL @ 125 ml/ha or thiamethoxam 25WG @ 100 g/ha or ethofenprox 10 EC @ 500 ml/ha or acephate 75 WP @ 1000 g/ha or BPMC 50 EC @ 600 ml/ha.
- Spray triflumezopyrim 10SC@ 234g/ha, pymetrozine 50 WG @ 300g/ha or flonicamide 50WG @ 150g/ha or dinetofuran 20SG@150g/ha or clothianidin 50WDG @20g/ha or imidacloprid 200 SL @ 125 ml/ha or thiamethoxam 25WG @ 100 g/ha.

### Green leafhopper

- Spray acephate 50 WP @ 1.5 g/lit or ethofenprox 10 EC @ 1 ml/lit or imidacloprid 17.8 SL @ 2.5 ml/10 lit or thiamethoxam 25 WG @ 100 g/ha. Alternatively, apply fipronil 0.3 G @ 25 kg/ha

### Hispa

- Spray triazophos 40 EC @ 400 ml/ha or chlorpyrifos 20 EC @ 2.5 ml/lit or quinalphos 25 EC @ 1,200 ml/ha or ethofenprox 10 EC @ 450 ml/ha or fipronil 5 SC @ 1.25 ml/lit.

### Leaf folder

- Spray chlorantraniliprole 18.5 SC @ 3 ml/10 lit or flubendiamide 20 WG @ 2.5 g/10 lit or chlorpyrifos 20 EC @ 3.5 ml/lit or cartap 50 WP @ 2 g/lit or acephate 75 WP @ 2 g/lit or fipronil 5 SC @ 1.25 ml/lit or triazophos 40 EC @ 1250 ml/ha.
- Inundative release of egg parasitoid, *Trichogramma chilonis* 5 to 6 times @ 100,000 adults/ha starting from 15 days after transplanting

### Whorl maggot

- Apply fipronil 0.3 G @ 25 kg/ha or chlorpyrifos 20 EC @ 2.5 ml/lit

### Case worm

- Drain water from the field and spray carbaryl 50 WP @ 1000 g/ha or apply carbaryl 10DP @ 25 kg/ha

### Blast

- Spray kasugamycin 3SL@1.3ml/ lit water carbendazim 50% WP @ 1 g/lit or isoprothiolan 40% EC @ 1.5 ml/lit or tricyclozole 75% WP @ 6g/10 lit or tricyclazole 70% WG @ 6g/10 lit for blast disease management
- Spray ground paste of botanicals like bael@25g/lit or tulsi@ 25g/lit

### Bacterial Blight

- Spray with streptomycin sulphate 90% + tetracylin hydrochloride 10% @ 100 to 150 ppm or streptocycline @ 150 ppm and copper oxy chloride @ 2g/lit or plantomycin @ 1g/lit of water.
- Spray *Pseudomonas fluorescens* @ 10 g/kg during cool hours preferably morning or evening

### Sheath blight

- Seed treatment with carbendazim 50% WP @ 2.0 g/kg of seeds or captafol 75 WP @ 4 g/kg or *Pseudomonas fluorescens* @ 10 g/kg followed by seedling dip in *Pseudomonas fluorescens* @ 10 g/lit of water for 30 min will effectively eliminates the seed borne inoculum.
- Foliar spray of carbendazim 50% WP @ 2.0 g/lit or propiconazole 25 SC @ 2.5 ml/lit of water or biocontrol agents like *Pseudomonas fluorescens* @ 10 g/kg three times depending upon the intensity of disease.



### C. REPRODUCTIVE STAGE

#### Stem-borer

- Spray chlorantraniliprole 18.5 SC @ 150ml/ ha or flubendiamide 20 WG @125g/ha or thiacloprid 21.7 SC @ 500ml/ha or cartap 50 WP @ 1000 g/ha or chlorpyriphos 20 EC @ 1250 ml/ha or quinalphos 25 EC @ 1000 ml/ha

#### Brown planthopper

- If possible, do alternate wetting and drying the field.
- Prepare alley at 6ft interval to facilitate the exposure of sunlight to the basal portion of the plant and spraying operation
- Don't apply nitrogenous fertilizer which will facilitate the BPH infestation
- Spray triflumezopyrim 10SC @ 5 ml/10 lit, pymetrozine 50 WG @ 6 g/10 lit or flonicamide 50WG @ 3 g/10 lit or dinetofuran 20SG @ 3 g/10 lit or clothianidin 50WDG @ 0.4 g/10 lit or imidacloprid 17.8 SL @ 2.5 ml/10 lit or thiamethoxam 25WG @ 2 g/10 lit.
- Resurgence causing insecticides like chlorpyriphos or synthetic pyrethroids (cypermethrin, deltamethrin) or quinalphos or methyl parathion should not be sprayed.
- During spraying, keep the nozzle towards the basal portion of the plant as the nymphs and adults of BPH rest in the basal zone

#### Green leafhopper

- Spray imidacloprid 200 SL @ 2.5 ml/10 lit or thiamethoxam 25 WG @ 2 g/10 lit or ethofenprox 10 EC @ 1 ml/lit or acephate 75 WP @ 2 g/lit or fenobucarb (BPMC) 50 EC @ 1 ml/lit.

#### Leaf folder

- Spray chlorantraniliprole 18.5 SC @ 150ml/ ha or flubendiamide 20 WG @125g/ha or cartap 50 WP @ 1000 g/ha or chlorpyriphos 20 EC @ 2,000 ml/ha or quinalphos 20 AF @ 3 ml/lit or apply cartap 4 G @ 25 kg/ha

#### Ear-cutting caterpillar/ cut worm

- Spray quinalphos 25 EC @ 3 ml/lit or chlorpyriphos 20EC @ 2,000 ml/ha or carbaryl 50 WP @ 1,500 g/ha

#### Leaf/Panicle mite

- Spray sulphur wettable powder @ 3 g/lit, dicofol 8.5 EC @ 5.0 ml/lit or profenophos 50 EC @ 2.0 ml/liter water.

#### Gundhi bug

- Spray carbaryl 50 WP @ 3 g/lit during afternoon hours.
- Dust methyl parathion 2 D @ 25kg/ha or malathion or carbaryl 10DP @ 30 kg /ha

#### Bacterial blight

- Spray with streptomycin sulphate 90% + tetracylin hydrochloride 10% @ 100 to 150 ppm or streptomycin @ 150 ppm and copper oxy chloride @ 2g/lit or plantomycin @ 1g/lit of water.
- Spray *Pseudomonas fluorescens* @ 10 g/kg during cool hours preferably morning or evening.

#### Sheath blight

- Apply validamycin 3% L @ 3 ml/lit or hexaconazole 5% EC @ 2 ml/lit or propiconazole 25% EC @ 1.5 ml/lit or propiconazole 10.7% + tricyclazole 34.2% SE @ 1 ml/lit.

#### DO'S and DON'T

##### a. Do's

- Timely sowing
- Field sanitation
- Apply pesticides only when required

##### b. Don't

- Don't apply more than the recommended dose of the pesticide
- Don't repeat the same pesticide consecutively
- Don't apply mixture of pesticides

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**Director**

ICAR-National Rice Research Institute, Cuttack-753006, Odisha

Phone : 91-671-2367768-783 (EPABX); Fax : 91-671-2367663

Email : [director.nrri@icar.gov.in](mailto:director.nrri@icar.gov.in), [rrictc@nic.in](mailto:rrictc@nic.in); Website : <http://www.icar-nrri.in>