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Integrated Pest Management of Rice Leaffolder and Their Bio-Control Agents

R. P. Soundararajan[1*], M. Chandrasekaran[1] and N. Chitra[2]

[1]Dept. of Plant Protection, Horticultural College and Research Institute for Women, Tamil Nadu Agricultural University (TNAU), Trichy, Tamil Nadu (620 027), India

[2]Dept. of Agricultural Entomology, Tamil Nadu Agricultural University (TNAU), Coimbatore, Tamil Nadu (641 003), India

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Corresponding Author

R. P. Soundararajan

e-mail: sound_insect73@rediffmail.com

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Abstract

Rice is a major food crop in India and Asian countries. Several insect pests are attacking rice crops and causes considerable damage. Among them rice leaf folders are important defoliator pests which affect rice crop through the year. There are 2-3 leaffolder species prevailing in our country. The difference between three species can be distinguished in larval as well as adult stages. The integrated management strategies comprises of cultural methods, mechanical methods, chemical methods and biological control methods. There are several bio control agents recorded in India and the different group of parasitoids, predators and pathogens attacking rice leaffolder are narrated.

Introduction

India has largest area under rice cultivation in the world (44.6 million hectares) and ranks second in production. Among biotic stress, insect pest are major problem and significant yield looses was recorded. Of late, rice leaffolder become major insect pest and its severity recorded through out India. The yield of rice crop reduced drastically because of their ability to defoliate or to remove the chlorophyll content of the leaves.

Three major species (Table 1) of rice leaffolders (Crambidae; Lepidoptera) occur in India, *viz.,*

1. *Cnaphalocrocis medinalis*
2. *Marasmia patnalis*
3. *Marasmia ruralis*

Among them, *Cnaphalocrocis medinalis* is a major species in many parts of India. The incidence of *Marasmia ruralis* was very meagre and found throughout the year.

Table 1: Differentiation between three species (Heinrichs, 1995)

Species	Larva	Adult
Cnaphalocrocis medinalis	Prothoracic shield straight apically and rounded laterally	Yellow brown wings with complete inner and outer bands but the mid – median band incomplete
Marasmia patnalis	Prothoracic shield trapezoidal	Outer band on forewing is Zigzag inwards to the mid – median band and runs downwards to the anal margin
Marasmia ruralis	Anal shield distinct and with black spot; meso and meta thorax with a pair of black spot	Costal margin of forewing with alternate black and white dots

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E-mail: *bioticapublications@gmail.com*

Damage Potential

The damage caused by leaffolder is important when it affects more than half of the flag leaf and the next two youngest leaves in each tiller. At vegetative phase, crops can generally recover from damage. High feeding damage on the flag leaves can cause yield loss. The yield loss is from 30 to 80 % at epidemic situation. Leaffolder damage can reduce yield by 14.0% during summer months. Modern agricultural practices, use of high yielding varieties, use of excess nitrogenous fertilizers are the major reason for the pest to attain major status. Cloudy weather with low sunlight favours the pest build up in the rice field. The economic threshold level for this pest at vegetative stage is 10% damaged leaves and during flowering stage 5% damaged leaves (flag leaf).

Symptoms of Damage

The larvae of leaffolder fold the leaves longitudinally and fasten the leaf margins with stitches of thread like silk. The larvae feed by scraping the green mesophyll resulting in linear pale white stripe damage. Starting with the late second instar, when larvae regularly roll up leaves they become solitary. Heavily infested fields appear scorched with many folded leaves. In case of severe infestation, the leaf margins and tips became dry and crop gives whitish appearance. The damage is more conspicuous during active tillering to booting stage.

The adult female lays single eggs under surface of tender leaves. The eggs hatch within four to seven days and the caterpillars fold the rice leaves and feed inside the folded portion. Folded rice leaves are commonly found in the early stages of establishment of the rice plants.

Management Practices

The Integrated pest management package includes following methods and can be combined to achieve successful management. IPM concept deals with use of all available techniques, since pesticide exposure causes variety of adverse health effects and environmental pollution. Alternate methods and restricted use of pesticide can minimize the risk of pesticide usage (Soundararajan, 2012).

Cultural Methods

• Split the fertilizer application during the growing season and apply nitrogenous fertilizer judiciously.

• Follow rice with a different crop or fallow period.

• Reduce density of planting; follow system of rice intensification (SRI) with 20 cm × 20 cm or 25 cm × 25 cm spacing.

• Use resistant varieties like TKM 6, PTB 33, CO 51.

• Higher damage will occur in shaded areas. Remove the shade creating trees with in and around the field.

• Use neem coated urea @ 5:1 with normal urea.

• Hand picking of larva and pupa.

• Remove grassy weeds to prevent the build up of rice leaf folders which act as the alternative hosts like buffalo grass - *Brachimaria mutica,* jungle rice - *Echinochloa colona,* finger millet - *Eleucene coracana,* swamp rice grass - *Leersia hexandra.*

Mechanical Method

• Set up light traps to attract moths and kill them with use of water pan added with oils or insecticide.

Chemical Methods

• Use neem based insecticide in the initial period of infestation like Azadirachtin 0.03% @ 1000 ml/ha or neem formulations.

• Use any one of the following insecticide in 500 litres of water to cover one hectare crop area.

• Chemical insecticides: Chlorpyriphos 20% EC 1.25 lit/ha or Dichlorvos 76% SC @ 630 ml/ha or Cartap hydrochloride 50% SP @ Cartap hydrochloride 4% WG 1 kg/ha or Chlorantraniliprole 18.5% SC 150 g/ha or Flubendiamide 20% WG 175 g/ha.

• Avoid use of Carbofuran and Phorate as far as possible as these will result in resurgence of the pest.

• Repeated use of same insecticides should not be done.

Bio-Control Agents

Natural enemies were prevalent in rice ecosystem on rice leaf folders. In India 80 species of natural enemies including 45 parasites, 35 predators, 4 pathogens and one nematode have been reported on rice leaffolder (Joshi *et al*., 1987). A number of natural enemies in the form of egg, larval, pupal parasitoids were identified (Table 2 & Table 3).

• The egg parasitoid *Trichogramma* spp., the larval parasitoids *Cardiochiles philippinensis*, *Apanteles sp., Goniozus sp., Trichomma cnaphalocrocis,* Pupal parasitoid *Xanthopimpla flavolineata* and larval-pupal parasitoid *Brachymeria* sp. were prevalent in the rice ecosystem on leaffolder.

• Inundate release of egg parasitoid, *T. chilonis* thrice @ 1,00,000 /ha when the leaffolder moth incidence noticed in the field is one of the biocontrol method which can be easily adopted by the farmers.

• The parasitoids can be protected from rains and predatory ants, the egg cards can also be placed with in small perforated polythene covers tied to bamboo pegs.

• Spraying of bacterial pathogen formulation, *Bacillus thuringiensis* @ 1.0 kg/ha kills the leaffolder larva.

• These natural enemies can be protected by proper use of chemical insecticides, avoiding broad spectrum chemicals and synthetic pyrethroids.

• Following crop rotation, protecting natural flowering plants

to encourage foraging parasitoids and predators, growing cowpea as border or bund crop will provide support to natural enemy development in the field.

Table 2: Record of parasitoids of rice leaffolder in India

Order & Family	Parasitoid species
Order: Hymenoptera	
Braconidae	*Apanteles angaleti, Cotesia angustibasis, Apanteles cypris, Cotesia flavipes, Cotesia ruficrus, Apanteles opacus, Cotesia sp., Aulacocentrum philippinensis, Bracon gelechiae, Bracon hebetor, Bracon ricinicola, Cardiochiles philippinensis, Chelonus munakatae, Habrobracon sp., Macrocentrus philippinensis, Meteorus bacoorensis*
Elasmidae	*Elasmus brevicornis, Elasmus claripenn, Elasmus philippinensis*
Thylidae	*Goniozus indicus, Goniozus triangulifer, Goniozus sp.*
Chalcididae	*Brachymeria excarinata, Brachymeria lasus, Brachymeria tachardiae, Brachymeria sp. Trichospilus pupivora*
Encyrtidae	*Copidosoma sp., Copidosomopsis nacoleiae*
Eulophidae	*Tetrastichus howardi, Tetrastichus israelensis*
Order: Ichneumonidae	
	Acropimpla hapaliae, Barylypa apicalis, Casinaria simillima, Charops bicolour, Diatora lissonata, Eriborus argenteopilosus, Eriborus sinicus, Eriborus vulgaris, Goryphus basilaris, Ischnojoppa luteator, Itoplectis narangae, Leptobatopsis indica, Temelucha basimacula, Temelucha biguttula, Temelucha philippinensis, Temelucha stangli, Trathala flavo-orbitalis, Triclistus aitkiai, Trichomma cnaphalocrocis, Xanthopimpla flavolineata, Xanthopimpla punctate
Scelionidae	*Telenomus dignus*
Trichogrammatidae	*Trichogramma chilonis, Trichogramma japonicum, Trichogramma spp.*
Order: Diptera	
Phoridae	*Megaselia scalaris*
Tachinidae	*Chaetexorista javana*

Table 3: Record of predators of rice leaffolder in India

Order & Family	Predator species
Order: Coleoptera Family: Carabidae	*Ophionea indica*
Order: Coleoptera Family: Staphylinidae	*Paederus fusiformis*
Order: Hemiptera Family: Nabidae	*Nabis capsiformis*
Order: Hemiptera Family: Pentatomidae	*Andrallus spinidens*
Order: Hymenoptera Family: Formicidae	*Pheidole* sp.
Spiders Order: Araneae	Different family and species of spider groups – general predators

Pathogens

Fungal pathogens

- *Beauveria bassiana*
- *Fusarium pallidoroseum*
- *Erynia radicans*

Bacterial pathogen

- *Bacilllus thuringiensis*

Conclusion

The rice leaffolder can be managed effectively by using various integrated strategies. The methods like cultural, mechanical and chemical methods are widely used by several farmers. There are lot of scope for use of biological control method as there are several bio-control agents present in nature as indicated. However, the mass culturing and standardized methods are available for only few natural enemies. The natural resources can be utilized through developing standard protocols in biological control methods by taking up intensive research programmes.

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