- Spray chlorpyriphos 20 EC @ 2.5 litres/ha or quinalphos 25 EC @ 2.0 litres/ha or triazophos 40 EC @ 1.0 litres/ha or dichlorvos @ 76 SL 600 ml/ha or the newer insecticide recommended for lepidopteran pests of rice can be applied as folior spray on the rice crop.
- Whole-plant spraying is effective at vegetative stage of infestation of the larvae. But, for earhead cutting caterpillars, the pesticide spray should be applied in the morning, to the basal portion of the plant as the insect remains at the plant base during day time. Since the farmers are worried about pesticide residue in grain, they are advised not to spray to the upper panicle portion.
- Application of malathion 2% dust @ 25 kg/ha or chlorpyriphos 1.5% dust @ 25 kg/ha along the bunds of the field facilitate to kill the ear head cutting caterpillar and also prevents its migration.

Proper strategy for future management

- Long term control can be achieved by developing resistant/tolerant varieties. The rice germplasm can be searched for resistant /tolerant donors and the resistance can be transferred to elite/popular varieties. If not highly resistant, even a tolerant genotype will need less pesticide application.
- Bund application of insecticide dust, as recommended earlier, may be reviewed as it is not applicable for early damage during rain. Only it will add to environmental pollution.
- In Hawaii, NPV has recorded against this pest, so there is a need to identify the native NPV strain which may provide very good control against swarming caterpillar.
- Release of egg parasitoid, *Telenomus* spp. or larval parasitoid, *Apanteles* spp. @ 1 lakhs/ha may be attempted.

Swarming Caterpillars in rice: Status and their Management

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Swarming Caterpillars in rice: Status and their Management

Mayabini Jena, G. Guru Pirasanna Pandi, K.B. Pun, K. Saikia, P.C. Rath, G. Basana Gowda, Naveenkumar B. Patil, S.D. Mohapatra and Totan Adak

Paddy swarming caterpillars are emerging as a serious threat to rice cultivation. Generally they occur either singly or in combination of genus *Spodoptera* and *Mythimna* (Noctuidae; Lepidoptera). They move in a swarm or army, hence known as swarming caterpillar or army worm. They are also known as cutworm as they cut leaves and panicles while feeding. It was first reported as a sporadic pest from Tamilnadu during 1937 and afterwords from Kerala and Odisha in 1957. Swarming caterpillar is a voracious leaf feeder of rice and needs immediate attention. It occurs mostly at nursery or during early transplanting.

Spodoptera mauritia

Mythimna venalba

Mythimna seperata

Habitat and infestation

The common habitat of these insects is forest or unused bushy areas of suitable hosts where its multiplication coincides with the onset of rainy season. With heavy flush of rain water, the larvae flow out along with the rushing water and harbours in the rice fields where the water loses its velocity. Generally, rice fields adjacent to bushy, forest or hilly areas coming under upland suffer frequent infestation of swarming caterpillar. At the same time, irrigated or low-lying areas are also prone to attack by invasion of a large number of larvae through water/irrigation channels. They generally infest during July-August after heavy rain. Rice nurseries, direct seeded lowlands and early transplanted fields suffer severe damage. Damage was also caused to mature crop by cutting earheads, mostly by *M. separata/venelba* during October-November.

Swarming caterpillar-prone area – Hilly tracts with flash flood after heavy rain

Outbreak status of swarming caterpillar

Year	Area affected	District/States
1969	Not Available	Chattisgarh
1970	Not Available	Punjab
1993	Not Available	Tamil Nadu
1999	250 ha	Kotma Block/Central India
2004	100 ha	Dhenkanal/Odisha
2007	50 ha	Tangi Block/Cuttack/Odisha
2008	150 ha	Sonepur, Balangir, Sambalpur, Baragarh and Kalahandi /Odisha
2009	1.25 lakhs ha	Odisha
2013	100 ha	Barpeta/Assam
2015	250 ha	Anantanag/Assam
2016	17,418 ha	Buksha /Udalgiri/Assam
2016	1304 ha	Kuttanad/Kerala

The pest is continuously infesting paddy in different rice growing tracts of eastern India from 2007 to till date. The total yield loss due to swarming caterpillar ranges from 20% in moderate infestation to 70% in severe infestation. This infestation not only is causing yield loss in rice but also incurring huge expenditure in terms of pesticides and operational charges to control this pest.

Favourable factors for outbreak

- Prolonged dry condition followed by heavy rainfall
- Presence of alternate host: Nut grass, *Cyperus rotundus,* Brassicaceae (cruciferous crops), *Gossypium* (cotton), Poaceae (grasses), *Saccharum officinarum* (sugarcane), *Zea mays* (maize) and Safed Musli, *Chlorophytum sp.*
- Presence of water channel adjacent to the rice field
- High dose of fertilizer application to the crop
- Wind and rain which helps in migration of pest to long distances
- Grassy or bushy areas for pest migration and off season survival

Migration of larvae with rain water

Damage

In case of early infestation, rice plants in the nursery beds are severely affected, but recent observations revealed that it is also attacking the transplanted crop at vegetative stage. The larvae damages the rice plants by cutting off young seedlings and leaves. They can also cut off rice panicles from base. The pest is nocturnal and larvae usually feed on upper portion of the rice canopy and migrates at night or on cloudy days while it rests in daytime at the base of the plant. They appear suddenly in masses and move like an army from field to field so that seedbeds or the direct seeded fields look as if grazed by cattle. Newly hatched larvae cause the plants to look sick with withered tips and cut leaves, but older larvae (more than 10 days old) feed voraciously and almost completely defoliate the plants. Extensive losses are often caused within week. The absence of standing water in the fields facilitates migration of caterpillars.

Biology

Eggs are laid in masses each eggmass consisting of 100-150 eggs and a female can lay upto 500 eggs. Larvae of *S. mauritia* are very aggressive feeder on rice. After feeding either pupate on rice or move towards weedy bunds or bushes. The next generation adult prefers laying eggs on plants having broad leaf of grassy bushy weeds so that the larva is not commonly present towards maturity of rice crop. But in the case of *M. separata and M. venelba,* next generation adults lay eggs on rice plant. The freshly hatched larvae grows on rice plant till the crops become mature. As a result, these insects cause major damage by cutting earheads.

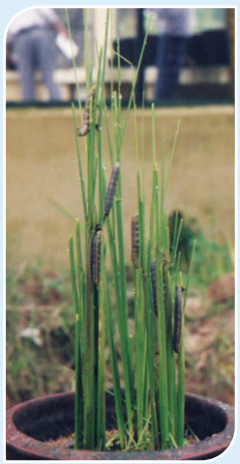
Field infested by swarming caterpillar

Species	Egg period	Larval period	Pupal period	Adult period	Total life cycle
S. mauritia	5-7 days	20-30 days	8-10 days	3-5 days	35-50 days
M. separata	4-5 days	12-15 days	10-15 days	2-4 days	30-35 days
M. venelba	4-5 days	15-18 days	8-11 days	2-4 days	30-38 days

Caterpillars move towards the tip of the rice plant during evening due to their nocturnal habit. They eat the young leaves and cut the panicles from its base. In the day time, they remain in the middle position of the hill at base of plant. So, the farmers find it difficult to locate them at the initial stage. At the end of the larval period, they pupate at the plant base.

eggmass - *S.mauritia*

Pupa at tiller base



Larvae - *M. venelba*

Evaluation and field validation of insecticides against the pest by NRRI, Cuttack

The evaluation of insecticides for their efficacy against swarming caterpillar/ army worm/cut worm and validation of effective insecticides in farmers field have been conducted time to time by the Entomologists of NRRI (Former CRRI), Cuttack.

Field effectiveness against *Mythimna venelba*

During Kharif 1983-84, earcutting caterpillar invaded a vast area of Cuttack district (Cuttack sadar block) of Odisha. The larvae were collected and reared on rice plant. Evaluation and validation of insecticides in field condition against *Mythimna venelba* (cut worm/ear cutting caterpillar) showed that foliar spray of 0.04% solution of carbosulfan, chlorpyriphos and quinalphos applied to the base of the plants and bund area could kill 100% of the larvae within 24 hours and protected the crop till harvest.

Field effectiveness against *Mythimna separata*

During kharif 2003, the swarming caterpiller, *Mythimna separata* occurred in devastating form in rice nurseries and in direct sown rice crop in Dhenkanal district of Odisha. It remained prevalent during last week of July to 2nd week of August after widespread rain and heavy shower on 26th July. Heavy infestation of the cutworm was observed in the nurseries with about 60-100 larvae/sq.mt. which were in 4th and 5th instar stage. Some of these larvae were collected from field and were utilized for evaluation of effective insecticides and botanicals. Green house and field evaluation of insecticides and botanicals showed absolute control of the pest with ethofenprox, imidacloprid @ 0.1 kg a.i./ha and monocrotophos, carbosulfan, profenfos @ 0.5 kg a.i/ha in terms of quick knock down effect. Ethofenprox was found more persistent in their efficacy as was revealed by green house testing. Among botanicals tested, neem oil and Karanja oil were found to exhibit strong antifeedent action at 1 % concentration.

Field effectiveness against *Spodoptera mauritia*

During kharif 2015, the pest infestation was experienced in the irrigated rice areas of Cuttack and of Kendrapada districts of Odisha. Surveillance in the affected area revealed that the larvae were of *Spodoptera mauritia* which had come through canal water. They were seen crawling at the side of the canal and most of the rice fields adjacent to the irrigation channel were affected. The number of larvae present per 50 continuous hills (10x5) were 32-41 numbers. Insecticides such as Chlorpyrifos 20EC @ 1500ml/ha, imidacloprid 17.8SL @125ml/ha, thiamethoxam 25WG @ 100g/ha, triazophos 40 EC @ 2.5 ml/litre and acephate 75% SP @ 2gm/litre of water were applied immediately with hand sprayer after recording the larvae and the pest was under 100% control.

It was again reported during 2nd week of September (late tillering stage) in fields where farmers had not taken any protection measures during the initial pest invasion. Larval population was on an average @ 12 larvae per 50 hills and about 10 hills were infested to above 50% level. Immediate application of thiamethoxam controlled the pest absolutely with an immediate knock-down effect.

Field observation of *Spodoptera litura*

A swarm of caterpillars were observed in the field condition of NRRI, Cuttack during kharif 2014. They were identified as *Spodoptera litura*. They infested weed *Sphenoclea zeylanica* present in rice field. But very less infestation was observed of rice plant, particulalry, the young rice plants of 15-20 days of transplanting. Observation on their growth and pupation showed that they consumed the weed, grew on it and completed the life cycle. Though they consumed delicate rice plant to some extent, could not complete the life cycle. So, under force-feeding in the absence of this weed, this larvae may become a pest of rice in future.

Feeding of *S. litura* on the rice weed *Sphenoclea sp.*

Integrated Pest Management

I. Monitoring

- As this insect pest starts appearing during the month of May, proper monitoring should start from April with light trap @ 2-3/ha.
- Monitoring for cut leaves in rice nursery or in main field may continue from July.
- Plots adjacent to water streams or irrigation channels are to be monitored with priority.

Experts at the damaged field adjacent to irrigation canal

II. Cultural control

- Deep summer ploughing exposes the hidden larvae and pupae present in the soil.
- Crop rotation with non host crop will check the attack of this caterpillar
- Alternate hosts and excess nurseries after transplanting should be destroyed.
- Flooding the nurseries and small fields will expose the larvae to birds.
- Digging a trench around the infested field will avoid the movement of larvae from one to another.

III. Mechanical Control

- Apply of 2L kerosene/ha, and then shake the plant vigorously with the long rope stretched across the field, so larvae fall into the kerosenized water and ultimately die. But for nursery one should be cautious to apply kerosene as it may cause phytotoxicity.
- Heaping the grasses in the bunds to facilitate hiding place for larvae, which can be collected in the next morning and destoyed by dipping in the kerozinized water.

IV. Biological Control

- Keep bamboo perches which facilitate predation by birds.

V. Chemical Control

- Spraying of contact insecticide should be done at early stage of insect infestation on community basis to get effective result. Fields adjacent to infested field must be treated to check the spread of the pest.