

The Oriental Armyworm, *Mythimna separata* (Lepidoptera: Noctuidae) and its Management

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Project Coordinating Unit

ICAR-AICRP on Small Millets
GKVK, Bengaluru - 560065

2018



AICRP
on Small Millets

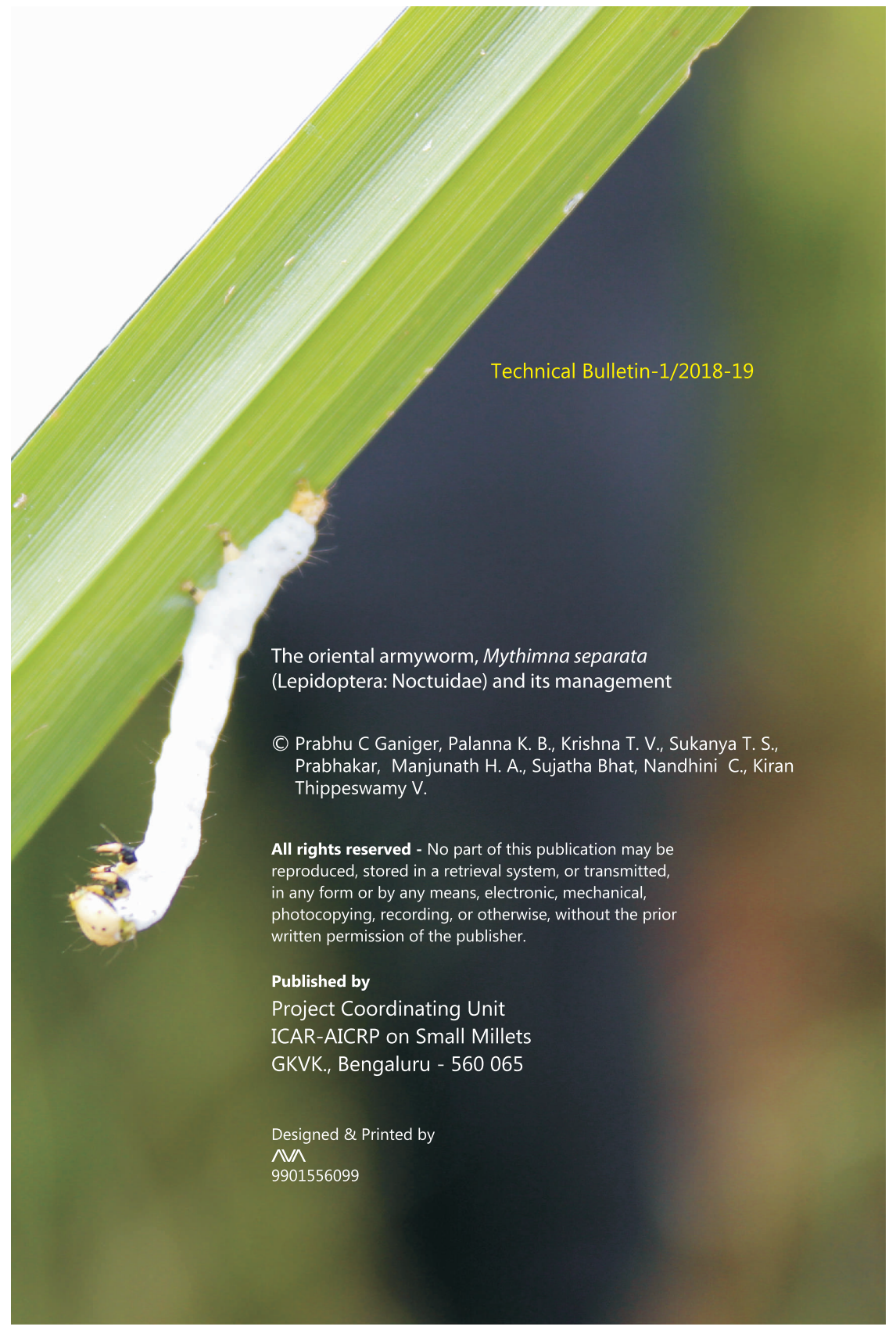


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Technical Bulletin-1/2018-19

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Published by

Project Coordinating Unit
ICAR-AICRP on Small Millets
GKVK., Bengaluru - 560 065

Designed & Printed by

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9901556099

Foreword

Insect pests are one of the key biotic stresses limiting rice, maize and finger millet production in India. Commonly known as armyworm, the *Mythimna separata* insect has already wreaked havoc in as many as 15 districts of North and South interior Karnataka affecting across 1.77 lakh hectares of fields (Kharif, 2017). The gluttonous insect feeds on paddy, maize, millets, sunflower and groundnut. Nocturnal in nature, the armyworm has delivered a severe blow in Bengaluru Rural, Kolar, Chikkaballapur, Tumakur and other adjoining districts.

Last year abnormal multiplication of and sudden appearance of armyworm due to long period of drought followed by unexpected heavy late rains, warm humid weather and late sown crop. The caterpillar increase very rapidly and the ryots find their fields suddenly invaded by great armies of them and wonder where they came from. So farmers need technology for management of armyworm and its awareness.

To know its occurrence, reasons for outbreak, its life cycle and management of armyworm, our scientists made an effort to bring out this bulletin '**The oriental armyworm, *Mythimna separata* (Lepidoptera: Noctuidae) and its management**'. This bulletin would serve as a useful information and reference for farmers, students, extension officials, state agricultural department personnel as well as other millet workers. I appreciate the efforts put in by the scientists in bringing out this bulletin in an impressive manner.

Date: 12-04-2018

Place: Bengaluru



(PRABHAKAR)

Project Co-ordinator
ICAR-AICRP on Small Millets

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Introduction

The armyworm, *Mythimna separata* Walker is one of the serious defoliators, is principally a pest of rice and wheat. However in the recent years this species attained a status of major pest on many other cereal crops like maize, sorghum, finger millet, sugarcane, little millet etc. The caterpillar migrate in thousands like an 'army' from field to field and hence the name 'Army worm'. Sometimes, the armyworm appears in epidemic form and its outbreak results in severe to complete crop losses. Its epidemics have been reported from time to time on different crops in many parts of the country. With the onset of monsoon rains during June, the pest appears in few numbers on cereal crops. The population rapidly builds up to reach a peak by the end of August, causing heavy losses on many crops. Within next fortnight the population declines to reach a level below ETL. It is mainly due to the key mortality factors observed during the kharif season.

During kharif, 2017, based on the the survey on outbreak of armyworm in finger millet was carried out in different districts of southern Karnataka. Defoliators like armyworm, leaf folders and semiloopers affected finger millet crop in five districts viz., Chikkaballapur, kolar, Bangalore rural, Bangalore urban and Tumkur districts. The per cent damage was ranged from 20 to 100 per cent. The Chikkaballapur district affected area was around 10,186 ha whers as in Tumkur and kolar district defoliator affected 35,150 and 4148 ha ragi fields in southern Karnataka, respectively.

The insect has caused damage in parts of North and South interior Karnataka. In about 15 districts, crops across 1.77 lakh hectares have been damaged by these insects. In Chitradurga and Davanagere districts, armyworm outbreak noticed on maize, groundnut, finger millet, foxtail millet and jowar affecting area around 1,05,120 and 56,872 ha, respectively (State Department of Agriculture, 2017).

Table 1 : Fast history of outbreak

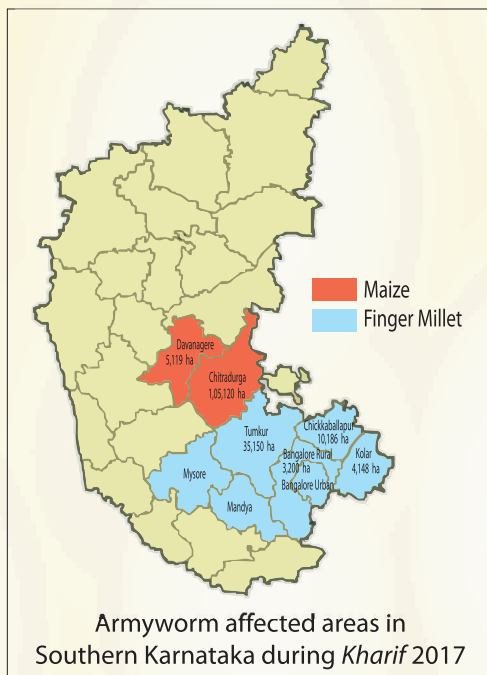
Year	Crop	Place of outbreak
1916	Paddy	Assam
1922	Jowar	Burma
1929	Finger millet and little millet	Oct –Nov. armyworm on a wider scale extending over Kunigal, Tiptur, and tumkur taluks of Tumkur Dist. Magadi, Doddaballapur, Devanahalli and Bangalore in Bangalore Dist. and Mulabagal and Kolar in Kolar districts.
1950	Sugarcane	Beds of rivers Panchganga and Krishna in Kolhapur and Ugar
1953	Sugarcane	Pusa farm, Bihar
1956	Sugarcane (17 th Oct)	Appeared in the kunigal tank and channel bed areas (Karnataka)
1974	Maize	In Bangalore, 75 to 80 per cent of leaves damaged
1980	Rice	In Bihar, 80-90 per cent damage to panicles
1981	Wheat	Caused 42.2 per cent yield loss in Punjab
1982	Sorghum	Pest (EIL 1.05 larvae/plant) caused 55.6 percent yield loss in Karnataka
1986	Maize	Pest cause 80 per cent damage in Himachal Pradesh
2017	Finger millet, Maize and Paddy	Aug-Nov, Kunigal, Tiptur, and Tumkur taluks of Tumkur Dist. Magadi, Doddaballapur, Devanahalli and Bangalore in Bangalore Dist. Chikkaballpur, Kolar, Mandya, Chitradurga and Davanagere (Karnataka)

Distribution

The armyworm occurs throughout India. It was first reported from Patna in 1889 by Coates subsequently from Bengal (1891-93), Uttar Pradesh and Poona (1928). It is present all over India. However, it has not been reported from Gujarat, Sikkim, Arunachal Pradesh, Nagaland, Mizoram, Tripura, Pondicherry and Goa.

Nature and Extent of Damage

Balasubramanian (1975) reported 47-53 per cent infestation in finger millet and yield losses of 1641 kg/ha have been reported in paddy by Katiyar and Patel (1969). In 1929 outbreak about 33 per cent of the finger millet crop and 42 per cent of little millet crop were affected. The extent of loss depend on the stage of the crops at the time of attack. Those crops that were fairly advanced escaped or harvested early to save further loss. The more immature crops suffered badly, the damage amounting to very nearly the whole crop in the worst cases.



In general the green blades except midribs were devoured in sugarcane, ragi, Jowar, paddy etc., and since the caterpillars were very abundant, every blade of each plant was eaten up in a severely infested area. The grass blades were fed upon entirely. The immature ragi earheads also did not escape. But in the more advanced crop the earheads were partly eaten. The



Maize



Paddy



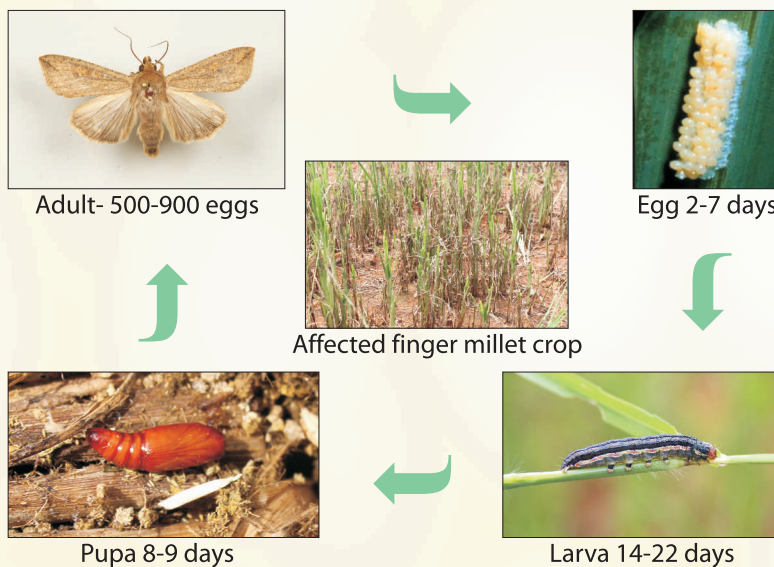
Sugarcane

caterpillars are known to cut off the just ripening paddy ears such damage was actually seen in the present outbreak (2017).

Factor influencing sudden large-scale outbreaks

The army-worm is a good example of an insect of minor importance normally found in small numbers but which appears as a sporadic local pest only in certain years. It displays the remarkable habit of abnormally multiplying and appearing suddenly only in years characterized by a long period of drought followed by unexpectedly heavy late rains and same weather was found in Bangalore at the time of the outbreak during Kharif 2017.

The army-worm is known to be a general feeder in meadows near swamps where the grass is the first preference. Under conditions of a fairly high temperature and a humid atmosphere this pest increases rapidly. Consequently, if there are late rains and if the weather is warm, the moths find the conditions eminently



Life cycle of armyworm, *M. separata*

favorable for them and each lays a large number of eggs. These hatch out in two or three days and the little caterpillars migrate in search of food and swarm wherever succulent young crops are abundant in the neighborhood. They are full grown in about three weeks and the moths emerge a week or so later. Thus the caterpillars increase very rapidly and the ryots find their fields suddenly invaded by great armies of them and wonder where they came from.

Soon, however, colder, drier weather sets in, the food supply begins to give out, parasites, predators and diseases multiply, and the pest population dwindles just as rapidly as it grew. *But they are not all wiped out.* In favorable areas some of them survive and carry on unnoticed in the normal manner. Sooner or later- it may be years later- the combination of favorable conditions occurs again- late rains, warm weather and young succulent crop and grasses, and lack of natural enemies, and the *mystery* worm swarms once more, for a brief period, in its millions, until nature can catch up and restore the balance again. It is believed that the moths migrate in large numbers at night from infested areas to lay their eggs in some distant areas, which perhaps accounts for the discontinuous distribution of the pest in isolated patches in an infested locality.

Life-cycle

The females lay 500-900 eggs, with a recorded maximum of 1943 eggs. The egg stage lasts for 2-7 days. Larval development is completed in 14-22 days. Feeding normally occurs during the night, the larvae hide in cracks during the day time. The pupal period lasts in 8-9 days. Total development completes in 26-38 days. Adults emerge at 8.0-9.0 pm and survive for 4-5 days. Mating takes place on the third and oviposition on fourth day after emergence. Adult populations can be monitored with light traps. Between May to November and then enter into diapause wherein the pupae hibernated into the soil till next monsoon rains.

Description of life stages

Egg

The shining milky white changing to gray eggs laid in rows or in masses of 20-76 between overlapping leaf-sheaths and fixed to the leaf by means of a glutinous secretion which when dry is white and flaky. Each moth may lay 1-4 such egg-masses.

Generally the larvae moult five times and in occasional cases six times before they develop into full grown larvae.

Full Grown Larva

Head grayish brown with dark reticulations. The general body color varies in different individuals, some being dirty pale brown, while others appear very dark and in some cases even almost velvety black. A median dorsal line, dark brown, interrupted by narrow white dashes and interfused with pale lines on the margins. Laterally a dark brown stripe followed by a white stripe, and this is followed by another dark brown stripe just above the line of spiracles. Below the line of spiracles is a yellowish stripe with a pinkish tint, contrasting with the dark brown line above and the dusky brown area beneath. Body sparsely covered with fine hairs placed on minute black tubercles.

Pupa (20 mm)

Smooth, shining dark brown, obtect. The pupa is at first cream-colored and then changes to brown. Pupation in an earthen cell in the soil or naked inside the leaf-sheaths on the plant.

Adult (Expanse 44.5 mm.)

Pale brown with dark specks and blotches. Fore-wing with slight traces of kidney-shaped stigmata; a minute white speck about the middle with a black speck inside it; and an indistinct

oblique streak. Hind-wing pale with a reddish tinge, underside sometimes with faint spots in the middle and series of specks post-medially. The male moths are smaller and are lighter in color than the female moths.

General Habits

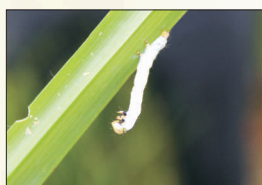
Newly hatched larvae of an egg mass on a leaf usually congregate together, scrape the surface of the leaf and feed on the green matter, the other surface being left as a transparent membrane. When disturbed the young larva curls up and drops down by means of a silken thread remains inactive for a moment before attempting to crawl away. The first and second instar larva crawl about with a looping movement, but this characteristic is lost in the third and succeeding instars. The older larvae feed from the edge of the leaf, devouring all the leaf tissue, except the mid-ribs. More than 80% of all the foliage eaten during the entire life of the larva is consumed during the last larval instar, which explains the fact that the army-worm rarely becomes evident and destructive until the caterpillars are nearly full grown. The larvae are active and feed in the nights. In the daytime they rest usually under the leaves, or under the shade on the ground round about the plants. In the sugarcane and paddy fields, where the ground is wet, they seek shelter in the whorls of tender leaves; as many as from 5-20 larvae may be found inside each whorl sugarcane. The caterpillars are found usually at first in one portion or along one side of a field, but they spread to the entire field damaging every plant. On disturbance they drop down on the ground, curl up and feign death.

The mature larva normally it burrows into the soil, to a depth of 0.5-1.5 inches and pupates there in earthen cell. The larva spins silk as a lining for its cell. Pupation may also take place under the trash. When there was standing water round about sugarcane or paddy plants, the pupae were found on the plants themselves inside the leaf-whorls, in cells constructed out of their excreta. In the laboratory naked pupae were obtained in rearing containers when sand was not provided.

In case one, the development took place in an unnatural condition as there was constant disturbance during daily examination. This no doubt prolonged the life-cycle. **The development in case two** represented more closely the conditions in nature. Probably in the field conditions the development may be still faster owing to more favorable environmental factors, which are associated with sudden increase of insect population resulting in serious outbreaks of the armyworm.

Natural enemies

During Kharif 2017, important key mortality factors viz., bacterial, fungal, MsNPV (Nuclear Polyhedrosis Virus) and several parasitoids were observed on armyworm. On 30-40 day old finger millet crop noticed second generation population of armyworm and they didn't survive in laboratory. However, third generation population outbreak was noticed on paddy *i.e* at harvest stage. Around 26 to 41 per cent mortality observed due to virus Ms NPV. However, 20.9 per cent and 8.13 per cent died due to the parasitoids ichneumonids and tachinids, respectively have been obtained from the caterpillars collected in the paddy fields. In fields certain birds were found devouring the armyworm caterpillars. These are crows, sparrow and mynah.



Fungal bioagent



Bacterial biogent



MsNPV

Insect Pathogens

Natural enemies on armyworm



Unidentified Tachinid



Echthromorph agrestoria notulatoria



Chacidids, *Brachymeria lasus*



Unidentified parasitic hymenopteran

Integrated Management of armyworm (Ad-hoc recommendations)

- Attracting and killing moths by setting up bon fires or using gas lights between 7 to 10 pm after receiving good rains during May-July months. A very high proportion of gravid and virgin female would attract to the light sources compare to spent moths indicating that the practice of collection and destruction of moths using light sources would greatly reduce the pest population on the crop.
- Hand collection and destruction of egg masses and grown up larvae.
- Application of insecticide dusts such as fenvalerate 0.4 D or methyl parathion 2 D (25 kg/ha)



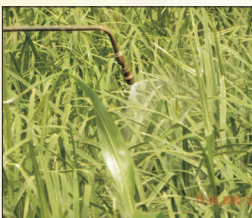
Setting - light trap



Hand collection



Application of dusts



- Spray 5 per cent Neem Seed Kernel Extract (NSKE) against early larval instars.
- Spraying of chlorpyrifos or quinalphos (2 ml/lit of water) against early larval instars.

Use of poison bait against grown up larvae

Mix rice bran (1 kg) and jaggery (100 g) thoroughly add a small quantity of water (enough to moisten the mixture) and allow the mixture to ferment for 24 hours. Then add the insecticide or monocrotophos 36 SL (15 ml/kg bait) to the fermented mixture and spread the bait in field during evening hours at the rate of 10 kgs/acre.



Mix - Rice bran + Jaggery + Insecticide



Poison bait application

Caution: Poison bait may cause harm to the pet animals, be alert.

Confirmation of *M. separata*



Male genitalia

Male genitalia of the available specimen was compared with true diagram of Francmont (1951) and Ramamani and Subbarao (1965) found identical and confirmed as *Mythimna separata*.

Future line of work

- Off season (Jan-May) survival of the pest
- The source of initial infestations and factors leading to outbreaks should be studied indifferent agro- climatic zones
- Exploitation of natural enemies for management
- Detailed studies on the mass multiplication and utilization of MsNPV on large scale
- Pest monitored through setting light trap and pheromone traps
- Possibility of utilizing some of the grass species as trap crop in cereal fields to attract the female moths for oviposition

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