

## Fall Armyworm: Major Pest in Maize Crop and Its Management

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### Introduction

The Fall Armyworm *Spodoptera frugiperda* (J.E. Smith) (Insecta: Lepidoptera: Noctuidae) commonly referred to as (FAW) is a crop pest native to the Americas. It is widely distributed in Eastern and Central North America and in South America. It only survives the winter in the most southern regions of the United States, namely Texas and Florida. Because of this, the fall armyworm is a more prominent pest in Southeastern States.

It was first formally reported in 1<sup>st</sup> Africa in January 2016 and has spread to several countries across Africa. The pest has been reported for the first time in India in Karnataka in Mid of 2018. The Indian Council of Agricultural Research (ICAR) - National Bureau of Agricultural Insect Resources (NBAIR) issued a pest alert on 30<sup>th</sup> July 2018. In addition to maize (major host), FAW can eat more than 80 plant species including rice, sorghum, cotton, sugarcane etc.

The early emergence in crop life cycle, voracious feeding habit, large-scale aggressive behaviour, high fecundity, fast migration, wide host-range and irreparable nature of crop damage make FAW as a key pest on maize. It is difficult to trace its arrival into India. However, it is believed that the FAW arrived in India from Africa through human aided transport, natural migration (capable to fly hundreds of kilometres in one night on prevailing winds) and escaped regulatory systems or quarantine. Since the FAW is an invasive pest in the country, the Ministry of Agriculture and Farmers Welfare, GOI, inter alia has constituted a High-Powered Committee (HPC) for efficacious management of FAW. Agriculture Commissioner (DA&FW) suggested to constitute sub-committees at state level for continuous monitoring and implementing various IPM strategies at the ground level. Periodical awareness campaign to farmers and suitable training to extension workers and pesticide dealers are required to manage FAW successfully in India.

**Occurrence:** More cloud cover, coupled with low temperature and high rainfall favour the rapid increase of population of FAW to an outbreak.

**Identification of FAW:** The pest completes its life cycle in 30 days during warm weather and during winter it completes its life cycle in 60 to 90 days. They can move from one place to another. The adult can fly well and move from one place to other place and lays eggs.

**Egg stage:** The eggs are cone shaped. The base of the egg is flat and 0.4mm breadth, 0.4mm height. The female adult lays eggs in groups and in single egg group there will be 100 to 200 eggs. A female adult can lay eggs from 1500 to 2000 and they cover the eggs with whitish or violet colour scales in order to protect the eggs. Egg period is 2 to 3 days.

**Larval stage:** The fall armyworm has 6 larval instars. The young larva looks greenish with black head. They feed superficially on one side of the leaf. The well grown larva will measure 30 to 36 mm in length and looks brownish with variations. Darker individuals appear when over crowing occurs. The larval period is 14 days during summer and 30 days during winter. When there is hot weather, the larvae will hide below the leaves and damage the crop.

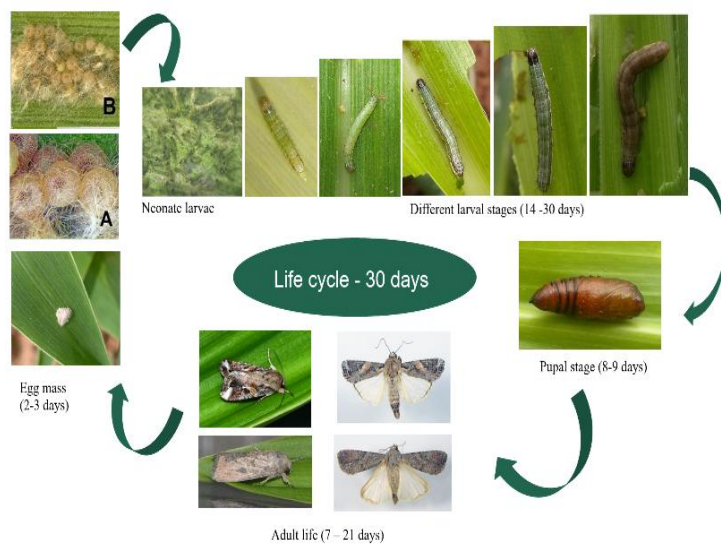
**Detection of Fall Armyworm larva:** Look for inverted Y shaped suture in the front side of the head. The suture colour is different from head colour. Look for four dark pimples like spots with hair arranged in perfect square shape, on 2<sup>nd</sup> last segment, the arrangement of which is different from spots of other segments. Look for dark pimples like spots with hair on dorsal side all over the body on all segments.

**Pupal stage:** Fall army worm generally pupates in soil at the depth of 2 to 8 cm. If there is hard soil, then they pupate with the help of fallen leaves. The size of the pupa is 14 to 18mm in length and 45mm in breadth and looks in brownish colour. During warm weather the pupal period is 8 to 9 days and it is 20 to 30 days during winter.

### Adult stage and its identification level at adult level

The moths have a wingspan of 32 to 40 mm. In the male moth, the forewing generally is shaded grey and brown, with triangular white spots at the tip and near the centre of the wing. The forewings of females are less distinctly marked, ranging from a uniform

grayish brown to a fine mottling of grey and brown. The hind wing is iridescent silver-white with a narrow dark border in both sexes. Adults are nocturnal, and are most active during warm, humid evenings. After a pre-oviposition period of three to four days, the female normally deposits most of her eggs during the first four to five days of life, but some oviposition occurs for up to three weeks. Duration of adult life is estimated to average about 10 days, with a range of about 07 to 21 days.



**Fig. 1. Life Cycle of Fall Armyworm *Spodoptera frugiperda***

### Nature of Damage

1. The female adult lays eggs in group of 100 to 200 eggs mostly bottom side of the leaf. Generally, they lay the eggs in bottom leaves and when there is high infestation the eggs can be seen at the top portions or in weeds.
2. The neonate larvae will scratch the leaves and eat due to which the leaf will look without chlorophyll. By the second or third instar, larvae begin to make holes in leaves, and eat from the edge of the leaves inward. Feeding in the whorl of corn often produces a characteristic row of perforations in the leaves. Larval densities are usually reduced to one to two per plant when larvae feed in close proximity to one another, due to cannibalistic behaviour. Older larvae cause extensive defoliation, often leaving only the ribs and stalks of corn plants, or a ragged, tor appearance.



**Fig. 2. Superficially, feeding by young caterpillars (1<sup>st</sup> & 2<sup>nd</sup> instars) on the undersides of leaves**



**Fig. 3. 3<sup>rd</sup>-6<sup>th</sup> instars feed on whorl region; kill the young plants at their growing point; results in no new leaves/cobs**

### Management practices for FAW



**Fig. 4. Fall armyworm damage in maize foliage, tassel and cob**

The following Integrated pest management of FAW is done with following strategies viz.,

Monitoring, Scouting, Cultural control, Mechanical control, biological control and Stage wise options including chemical control

### 1. Monitoring

Installation of pheromone traps @ 5/acre in the current and potential area of spread in crop season and off-season.

### 2. Scouting

- Start scouting in 'W' manner as soon as maize seedlings emerge
- At seedling to early whorl stage (3-4 weeks after emergence) - Action can be taken if 5% plants are damaged.
- At Mid whorl to late whorl stage (5-7 weeks after emergence) - Action can be taken if 10% whorls are freshly damaged in mid whorl stage and 20% whorl damage in late whorl stage.
- At tasselling and post tasselling (Silking stage) - Do not spray insecticides (No insecticide application). But 10% ear damage needs action.

### 3. Cultural Measures

- Deep ploughing is recommended before sowing. This will expose FAW pupae to predators.
- Timely and uniform sowing over a large area is advised. Avoid staggered sowings.
- Intercropping of maize with suitable pulse crops of particular region. (eg. Maize + pigeon pea/black gram /green gram).
- Erection of bird perches @ 10/acre during early stage of the crop (up to 30 days).
- Sowing of 3-4 rows of trap crops (eg. Napier) around maize field and spray with 5% NSKE or azadirachtin 1500 ppm as soon as the trap crop shows symptom of FAW damage.
- Clean cultivation and balanced use of fertilizers.
- Cultivation of maize hybrids with tight husk cover will reduce ear damage by FAW

### 4. Mechanical Control

- Hand picking and destruction of egg masses and neonate larvae in mass by crushing or immersing in kerosine water.
- Application of dry sand in to the whorl of affected maize plants soon after observation of FAW incidence in the field.

- Application of Sand + lime in 9:1 ration in whorls in first thirty days of sowing.
- Mass trapping of male moths using pheromone traps @15/acre.
- Traps: Spread blue cloth measuring 2 m in places randomly in an acre area to attract and kill the larvae
- Install FAW pheromone trap @ 5 numbers/ac and light trap @ 1 number/ha at early stage of crop

### 5. Bio-control Strategies

- *In situ* protection of natural enemies by habitat management: Increase the plant diversity by intercropping with pulses and ornamental flowering plants which help in build-up of natural enemies
- Augmentative release of *Trichogramma pretiosum* or *Telenomus remus* @ 5 cc per acre at weekly intervals or based on trap catch of 3 moths/trap
- **Biopesticides:** Suitable at 5% damage in seedling to early whorl stage and 10% ear damage with entomopathogenic fungi and bacteria.
- **Entomopathogenic fungal formulations:** Application of *Metarhizium anisopliae* talc formulation (1x10<sup>8</sup> cfu/g) @ 5g/litre whorl application at 15-25 days after sowing. Another 1-2 sprays may also be given at an interval of 10 days depending on pest damage
- *Nomuraea rileyi* rice grain formulation (1x10<sup>8</sup> cfu/g) @ 3g/litre whorl application at 15-25 days after sowing. Another 1-2 sprays may also be given at an interval of 10 days depending on pest damage
- Application of *Bacillus thuringiensis* var *kurstaki* formulations @ 2g/litre (or) 400g/acre
- Apply Azadirachtin 1% EC @ 10,000 ppm or neem oil @ 5 mL/lit. as oviposition deterrent on one week after sowing
- Erect bird perch @ 25-50 numbers/ha to attract predatory birds during early stage of the crop (up to 30 days) on feeding various larval stages of FAW

**6. Chemical control:** Some of the pesticides recommended by CIB&RC for management of FAW includes the following:

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| i. Broflanilide 20% SC - 125 ml in 500 litres of water per hectare for which waiting period is 29 days for harvesting.         | vi. Spinetorum 11.7% SC - 250 ml in 500 litres of water per hectare for which waiting period is 32 days for harvesting.                                  |
| ii. Chlorantraniprole 50% w/w FS as seed dresser @ 1-2 ml/kg of seed   | vii. Emamectin benzoate 1.5% + Profenophos 35% w/w WDG - 750 g in 500 litres of water per hectare for which waiting period is 35 days for harvesting.    |
| iii. Flubendiamide 20% WG 250g in 500 litres of water per hectare for which waiting period is 5 days for harvesting.           | viii. Lufenuron 4% + Emamectin Benzoate 1.5% EC - 750-1150 ml in 400- 500 litre of water per hectare for which waiting period is 35 days for harvesting. |
| iv. Isocycloseram 18.1% W/W SC - 300 ml in 500 litres of water per hectare for which waiting period is 48 days for harvesting. | ix. Novaluron 5.25% + Emamectin Benzoate 0.9% SC 1500 ml in 500 litres of water per hectare for which waiting period is 27 days for harvesting.          |
| v. Pyridalyl 10% EC - 1000 ml in 750 litres of water per hectare for which waiting period is 27 days for harvesting.           |  |

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