

**Fall armyworm (FAW), *Spodoptera frugiperda* J. E. Smith (Lepidoptera: Noctuidae): An Invasive Threat to India**S. Thangavel<sup>\*1</sup> and R. Vinoth<sup>2</sup>

Article ID: 11

<sup>\*1</sup>Ph D Scholar, Department of Agricultural Entomology, AAU, Gujarat, India<sup>2</sup>Teaching Assistant, Department of Plant Breeding Genetics, Institute of Agriculture, TNAU, Kumulur, Tamil Nadu, India – 641 003Corresponding Author: [entothanga@gmail.com](mailto:entothanga@gmail.com)**Introduction**

The accidental introduction of alien invasive pest species has been resulted in a large number of established population density which led to considerable negative impact on economic of the crop in terms of production as well as market value. The alien species become invasive in introduced area due to absence of natural enemies and congenial environment parameters. Invasive species are considered as the second greatest threat to native species, only behind habitat destruction. The fall armyworm is native to the tropical region of the western hemisphere from the United States to Argentina. *Spodoptera frugiperda* (J. E. Smith) (Lepidoptera: Noctuidae) is considered the most important pest of corn in Brazil, the third largest corn producer in the world after the USA and China. *S. frugiperda* is a polyphagous pest that causes significant losses to agricultural crops. In 2016, it was recorded in Africa causing serious damage on maize crop (Goergen *et al.*, 2016). The value of these losses is estimated at between US\$2,481 million and US\$6,187 million. Now in 2018, this notorious pest has entered India.

**Spread and distribution**

*S. frugiperda* is found in most parts of the Western Hemisphere, from southern Canada to Chile and Argentina. This species was reported to have spread to Africa – São Tomé, Nigeria, Bénin and Togo in 2016 and to Ghana in 2017, causing widespread crop damage. In India, the incidence of *S. frugiperda* was observed in May 2018 in Maize fields at College of Agriculture, University of Agricultural and Horticultural Sciences (UAHS), Shivamoga, Karnataka. Further, this pest was also reported in Tamil Nadu, Telangana and Gujarat states of India.

**Host Plants**

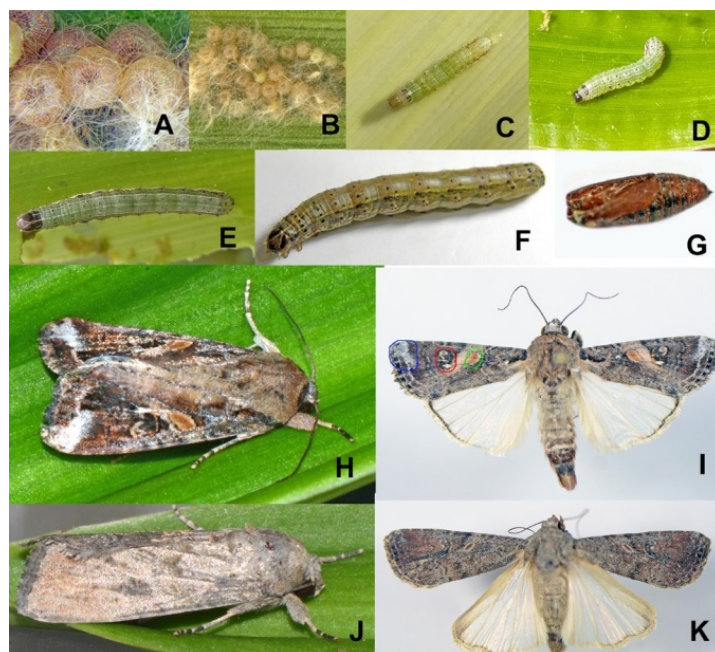
The fall armyworm caterpillars feed on leaves, stems and reproductive parts of more than 100 plant species in 27 different families (CABI). This pest prefers to that include maize, rice, sorghum, sugarcane, pearl millet and cotton, as well as some vegetable crops like cabbage, beet, peanut, soybean, alfalfa, onion, tomato, potato and cotton etc.

**Description of the pest life cycle****Egg**

Egg laying occurs on the inner side of the whorl and also on the under surface of the leaf in a mass of deposited in layers. Egg is dome shaped, and measures around 0.4 mm in diameter and 0.3 mm in height. Adult females lay 100-200 eggs on the lower leaves. They change from green to light brown before hatching. Eggs are covered in a protective scale rubbed off from the moth's abdomen. Eggs are hatch in 2 to 4 days in optimum temperatures.

## Larva

FAW typically has six larval instars. First instar larva is greenish in colour with black head while the final instars are with dark grey head and dull grey body with white sub dorsal and lateral white lines. The mature larva is with a white inverted on the head and with distinct black spots on the body. Arrangement pattern of black spots is square on 8th and trapezoidal on 9th segment. Larval duration is about 14 days during the summer and 30 days during cool weather conditions. Fall armyworm larva does not have the ability to diapause.



Life stages of *S. frugiperda*: A & B, eggs; C-F, larval instars; H, adult male in habitus; I, adult male (dorsal view); J, adult female in habitus; K, adult female (dorsal view). (Source: NBAIR, Bangalore)

## Pupa

Pupa is reddish brown in color and pupation occurs in the soil. The mature caterpillar drops down to ground and makes an earthen cell by constructing cocoon of sand particles mixing with silk. Pair of cremasters is present on the last segment. The pupal stage lasts for 7 to 13 days and survives at the temperature range of 18-24°C.

## Adult

Sexual dimorphism is clearly evident in the adult moths. Adult male forewing is grayish brown with reniform indistinct spot, faintly outlined in black, with a small v-shaped mark light brown orbicular spot, somewhat oval and oblique in shape and white patch at the apical margin of the wing. Adult female forewing is with a mottled coloration of grey and brown, with brown markings and without white patch near apical margin of the wing as seen in male. The duration of adult life is estimated to average about 10 days.

## Migration Behaviour



Adult moth can migrate with a capacity of 100 km overnight and 300 miles per generation. FAW found throughout the year and having 6 to 11 generations per year depending upon temperature.

### ***Intraspecific competition***

The incidence of cannibalism of larval *Spodoptera frugiperda* (Lepidoptera: Noctuidae) was found to account of approximately 40% mortality in the population.

### ***Nature of damage***

FAW infestations occur continuously throughout the year where the pest is endemic. The FAW caterpillar, or larva, cause the most damage to a variety of crops, including maize. Young larvae usually feed on leaves, creating a characteristic “windowing” effect or holes and ragged leaf edges. Young caterpillars can spin silken threads which catch the wind and transport the caterpillars to a new plant. Feeding through the maize whorl can cause a line of irregular “shot” holes, when the leaf unfurls and moist sawdust-like frass near the funnel and upper leaves of crops like maize. Feeding through the maize whorl can cause a line of irregular “shot” holes, when the leaf unfurls and moist sawdust-like frass near the funnel and upper leaves of crops like maize.

### ***Management Strategies of Fall Armyworm, *S. frugiperda****

#### ***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.

#### ***Mechanical measures***

- ✓ 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 FAW specific pheromone traps @ 15/acre.

#### ***Biological measures***

- ✓ In situ protection of natural enemies by habitat management: Increase the plant diversity by intercropping with pulses, oil seeds and ornamental flowering plants which help in build-up of natural enemies.



- ✓ Augmentative release of egg parasitoid *Trichogramma pretiosum* or *Telenomus remus* @ 50,000 per acre at weekly intervals or based on trap catch of 3 moths/trap.
- ✓ Bio-pesticides: If infestation level is at 5% damage in seedling to early whorl stage and 10% ear damage, then use following entomopathogenic fungi and bacteria (*Metarrhizium anisopliae*, *Metarrhizium rileyi* (*Nomurea rileyi*), *Beauveria bassiana*, *Verticillium lecanii* -  $1 \times 10^8$  cfu/g @ 5g/litre whorl application. Repeat after 10 days if required).
- ✓ *Bacillus thuringiensis v. kurstaki* formulations @ 2g/l (or) 400g/acre.

### **Chemical measures**

- ✓ Seed treatment: Cyantraniliprole 19.8% + Thiamethoxam 19.8% FS @ 6 ml/kg of seed will be effective for 15-20 days.
- ✓ First Window (seedling to early whorl stage): To control FAW larvae at 5% damage to reduce hatchability of freshly laid eggs, spray 5% NSKE / Azadirachtin 1500ppm @ 5ml/l of water.
- ✓ Second window (mid whorl to late whorl stage): To manage 2nd and 3rd instars larvae having more than 10% foliar damage the following chemicals may be used upto early tasselling stage: Spinetoram 11.7% SC or Chlorantraniliprole 18.5% SC or Thiamethoxam 12.6% + Lambda cyhalothrin 9.5% ZC.
- ✓ Poison baiting: Poison baiting is recommended for late instar larvae of second window. Keep the mixture of 10 kg rice bran + 2 kg jaggery with 2-3 litres of water for 24 hours to ferment. Add 100g Thiodicarb or just half an hour before application in the field. The bait should be applied into the whorl of the plants.
- ✓ Third Window (8 weeks after emergence to tasseling and post tasseling): Insecticide management is not cost effective at this stage. Bio-pesticides as recommended above to be applied. Hand picking of the larvae is advisable.

(Note: All the sprays should be directed towards whorl and either in the early hours of the day or in the evening time) (Source: <http://ppqs.gov.in/>).

### **References**

- ICAR-NBAIR. 2018. Pest Alert: *Spodoptera frugiperda* (J. E. Smith) (Insecta: Lepidoptera) (published 30/07/2018).
- Goergen, G., Kumar, P. L., Sankung, S. B., Togola, A. and TamòM. (2016). First Report of Outbreaks of the Fall Armyworm *Spodoptera frugiperda* (J. E. Smith) (Lepidoptera, Noctuidae), a new alien invasive pest in West and Central Africa. PLoS ONE 11(10): e0165632. doi:10.1371/journal.pone.0165632.