

Introduction: The fall armyworm, *Spodoptera frugiperda* (J.E. Smith) (FAW) is native to North and South America and it was first recorded in African continent in 2016 then subsequently spread rapidly across Asia causing severe damage to cereal crops. In India, it was first reported in 2018 on maize. Within a short period of time, the pest spread to almost all the maize growing Indian states except Jammu and Kashmir. In 2019, Karnataka State had the highest area affected with FAW (2,11,300 ha) followed by Telangana (24,288 ha), Maharashtra (5,144 ha) and low infestation in Tamil Nadu, Madhya Pradesh, West Bengal and Arunachal Pradesh (< 500 ha) .

Biology

Female moth lays eggs in mass, which is often covered with scales. Single female may lay 300-1100 eggs in her life time. Egg incubation period ranges from 2-4 days. Fall armyworm passes through six larval instars and the larval duration is completed in 13-20 days. Pupation generally occurs in soil and pupal duration lasts for 7-10 days. Total developmental period from eggs to adult is completed in 25-33 days.



Egg

Larva

Adult

Host plants

Fall armyworm is polyphagous pest. Worldwide it has been reported to feed on 182 plants belonging to 42 families. In India it has been reported to feed and cause damage to maize, sorghum, pearl millet, barnyard millet, and finger millet.

Nature of damage: Immediately after hatching gregarious larvae start scraping the leaf surface and make papery windows. As they grow they move to other plants and enter inside the whorl. Due to excessive feeding it causes large holes which give torn appearance. Frass could also be seen in whorls indicating the presence of larvae. . Continuous and deep feeding may destroy developing tessels. Later they may enter in cobs and start feeding on kernels. These larvae are cannibalistic in nature. As they grow, maximum 1-2 grown up larvae are found inside the whorl.



Damage by FAW larvae

Management of Fall armyworm:

- Seed treatment with cyantraniliprole 19.8%+ Thiamethoxam 19.8% FS @ 6ml/kg for protection of crop for 15-20 days.
- Practice proper crop management tactics through appropriate dose of fertilizers, manures and proper irrigation.
- Intercrop/alley and mixed crop of maize with pigeon pea/black gram/green gram.
- Plant 3-4 rows of napier grass as trap crop around maize.
- After harvesting, practice deep ploughing to expose pupae to sun and predators.
- Install pheromone traps (10 traps/acre) immediately after emergence of seedling for monitoring and mass trapping males.

- Scout the crop for the presence of egg mass and neonates or damaged plants and destroy egg masses and neonates.

Seedling to early whorl stage (0 -2 weeks after emergence)

- Start releasing egg parasitoid (3-4 releases of *Trichogramma chilonis*/ *T. pretiosum* @ 1,00,000 adults/ha or *Telenomus remus* @ 15,000-20,000 adults/ha) at weekly intervals when 1-2 adult moths are caught in pheromone trap.
- Spray neem oil @ 3ml/litre or 5% Neem Seed Kernel emulsion (NSKE) or azadirachtin 1500ppm @ 5ml/l water to kill eggs and neonates.
- One Spray of NBAIR BT-25 @ 20 ml/litre if required to be given after one week of the neem spray.

Early whorl to mid-whorl stage (2-4 weeks after emergence)

- Release of *Bracon brevicornis* @ 4000 adults/ha to target mature larvae.
- Spray *Metarhizium anisopliae* (NBAIR Ma-35) (1×10^8 cfu/g) @ 5gm/litre **or** aqueous suspension of SpfrNPV @ 4 ml/L of water (at a concentration of 1.5×10^{12} POBs/ha) if required.
- Spray any of the chemical recommended by Central Insecticide Board and Registration Committee (CIB&RC), Govt. of India for fall armyworm in maize.

Chlorantraniliprole 18.5 SC (80 ml/acre)@ 0.4 ml/ litre.

Thiamethoxam 12.6% +Lambda cyhalothrin 9.5% ZC @0.25 ml/litre.

Spinetoram 11.7% SC (100ml/acre)@ 0.5 ml/litre.

Biocontrol based IPM management of fall armyworm in Maize

Mid whorl to late-whorl stage (4-7 weeks after emergence)

- If new brood appears, release *Trichogramma chilonis*/ *T. pretiosum* @ 1,00,000 adults/ha or *Telenomus remus* @ 15,000-20,000 adults/ha to target egg stage.
- Release of *Bracon brevicornis* @ 4000 adults/ha to target mature larvae.
- Spray neem oil @ 3ml/litre or 5% Neem Seed Kernel emulsion (NSKE) or azadirachtin 1500ppm @ 5ml/l water to kill eggs and neonates.
- Spray *Metarhizium anisopliae* (NBAIR Ma-35) (1×10^8 cfu/g) @ 5gm/litre or aqueous suspension of SpfrNPV @ 4 ml/L of water (at a concentration of 1.5×10^{12} POBs/ha) if required.

Late-whorl stage (7 weeks onwards of emergence)

- Spray any one of the insecticide mentioned above.

Tasseling stage to harvest

- Do not use any insecticide
- Manually pick the larvae and destroy them.

Note: Maintain gap of 4-5 days between parasitoid release and *Metarhizium anisopliae*/neem oil/ any of the above mentioned chemical. Both parasitoids (egg & larval) can be released together.

Biocontrol agents:

Egg parasitoid

Trichogramma chilonis Ishii is widely distributed egg parasitoid in Indian agroecosystem and currently emerged as important egg parasitoid of fall armyworm infesting maize in India.

Telenomus remus Nixon is an excellent egg parasitoid of FAW. Natural parasitism of this parasitoid has been reported on FAW eggs infesting maize in India. This parasitoid has ability to parasitize deepest layer of FAW eggs.

Chelonus formosanus Sonan is Neotropical and Oriental in distribution and now has been reported from FAW eggs in India. It is an egg-larval parasitoid and amenable to mass rearing in laboratory on *Corcyra cephalonica* eggs as well as on FAW eggs.



T. chilonis

T. remus

C. formosanus

***Metarhizium anisopliae*:** The talc formulation of *M. anisopliae* (NBAIR Ma-35) contains 2.0×10^8 cfu/g. The formulation is stored in milky white polypropylene pouches for further use in field trials.

ICAR-NBAIR BT-25: This is a naturally occurring *Bacillus thuringiensis* bacteria and this strain is very effective against FAW early instar larvae. The NBAIR BT-25 is available as liquid formulation.

SpfrNPV-NBAIR-1: This is a naturally occurring virus which infects *S. frugiperda*. The infected larvae were collected and the virus was multiplied on the live FAW larvae, harvested and packed for use. The formulation can be sprayed in the early morning or evening hours.



ICAR-NBAIR BT-25

ICAR-NBAIR Ma-35



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