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Eco-friendly Management of Fall Armyworm in Maize under Maharashtra Conditions

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Spodoptera frugiperda (FAW) is one of the most destructive invasive insect pests of maize. In Maharashtra, severe infestation is commonly observed in maize-growing regions such as Kolhapur, Sangli, Satara, Vidarbha, and Marathwada during warm and humid kharif conditions. Since its first report in India during 2018, the pest has spread rapidly and caused considerable yield losses due to its aggressive feeding behavior and high reproductive potential **(Sharanabasappa et al., 2018).** Sustainable management of FAW mainly depends on Integrated Pest Management (IPM), which combines cultural, mechanical, biological, and need-based chemical approaches instead of excessive use of synthetic pesticides **(Krishna et al., 2021).**

Identification Symptoms of Fall Armyworm

FAW larvae mainly feed inside the maize whorl and damage young leaves. Early infestation symptoms include scraping and transparent patches on leaves. Severe infestation results in ragged holes and shredded leaves. Sawdust-like frass is commonly observed inside the whorl region. Larvae generally remain hidden inside the funnel of maize plants during daytime **(FAO, 2018).**

Important Identification Features

- Brown to greenish-black caterpillar
- Distinct inverted "Y" mark on the head
- Four black spots arranged in square pattern near the tail region
- Presence of frass inside maize whorl

Monitoring and Surveillance

Regular field monitoring is essential for early detection and effective management of FAW. Farmers should inspect maize fields frequently from 15–20 days after sowing. Pheromone traps may be installed at around 5 traps per acre for monitoring adult moth activity. Early management is important because young larvae are easier to control through biological and eco-friendly methods **(Singh et al., 2021).** Management practices are generally initiated when visible damage crosses the economic threshold level during the seedling and whorl stages **(FAO, 2018).**

Eco-friendly Management Practices

Cultural Management

Timely sowing with the onset of monsoon helps reduce severe infestation. Late-sown crops are more prone to pest attack. Farmers should avoid staggered sowing because continuous crop availability favors rapid multiplication of FAW. Deep summer ploughing exposes pupae to sunlight and predatory birds, thereby reducing carryover population **(Krishna et al., 2021).**

Field sanitation is also important. Removal of heavily infested plants, destruction of egg masses, and weed management help suppress pest population. Intercropping maize with legumes such as cowpea, pigeon pea, soybean, black gram, and green gram supports natural enemies and reduces pest spread. In some areas, Napier grass is also used as a trap crop around maize fields **(Saritha and Visalakshi, 2024).**

Mechanical Management

Mechanical methods are economical and suitable for smallholder farmers. Hand collection and destruction of egg masses and young larvae help reduce infestation during the early crop stages. Application of dry sand, ash, charcoal powder, or sand-lime mixture into the maize whorl suppresses larvae hiding inside the funnel region.

Installation of pheromone traps and light traps also helps in monitoring and reducing moth population **(Mooventhan et al., 2019).**

Biological Management

Biological control is one of the safest approaches for managing Spodoptera frugiperda. Neem-based products such as neem oil, Azadirachtin formulations, and Neem Seed Kernel Extract (NSKE) are effective against early larval stages. Biopesticides based on *Bacillus thuringiensis* (Bt) also provide good larval control while remaining safe to beneficial insects **(Keerthi et al., 2023).** Entomopathogenic fungi such as *Beauveria bassiana*, *Metarhizium anisopliae*, *Nomuraea rileyi*, and *Verticillium lecanii* naturally infect and kill FAW larvae. Egg parasitoids like *Trichogramma pretiosum* and *Telenomus remus* also help reduce egg hatchability and pest establishment **(Harrison et al., 2019).**

Conservation of Natural Enemies

Conservation of beneficial insects is important for sustainable pest management. Excessive use of broad-spectrum insecticides should be avoided because they destroy natural enemies such as ladybird beetles, spiders, predatory bugs, parasitoid wasps, and insectivorous birds **(Harrison et al., 2019).** Installation of bird perches in maize fields encourages predatory birds to feed on larvae. Intercropping and habitat management also improve biodiversity and strengthen natural biological control **(FAO, 2018).**

Need-based Chemical Management

Chemical control should be adopted only when infestation exceeds the economic threshold level. Seed treatment with Cyantraniliprole + Thiamethoxam provides protection during the initial crop stages. Selective insecticides such as Spinetoram and Chlorantraniliprole may be used during severe infestation at the whorl stage (Krishna et al., 2021). Broflanilide 20 SC and Cyclaniliprole 10 DC are effective against FAW larvae and significantly reduce leaf damage in maize crops. Sprays should be directed into the maize whorl during morning or evening hours for better effectiveness. Proper timing of application during early larval stages improves control efficiency and minimizes unnecessary pesticide use.

Simple eco-friendly FAW management schedule for Maharashtra

Crop stage	Eco-friendly action
Before sowing	Timely sowing + clean field
15 DAS	Install pheromone traps
20–30 DAS	Monitor whorl damage weekly
Early infestation	Apply sand/ash in whorl
Small larvae stage	Spray neem or Bt
Moderate infestation	Use *Beauveria* or *Metarhizium*
Throughout season	Remove egg masses and conserve natural enemies

Conclusion

Fall Armyworm has become a serious threat to maize cultivation in Maharashtra. Timely monitoring and adoption of integrated eco-friendly management practices can effectively reduce pest infestation and crop damage. Cultural, mechanical, and biological approaches

should be preferred for sustainable pest management, while chemical insecticides should be used only when necessary. Proper implementation of IPM practices not only reduces pesticide dependence but also supports environmental safety and long-term maize productivity.

These images show typical FAW damage symptoms in maize such as ragged holes, feeding inside the whorl, and larvae hiding in leaves.

These are close-up images of *Spodoptera frugiperda* larvae commonly found on maize plants.

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