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INVASION OF THE CROP RAIDERS: THE RISE OF THE FALL ARMY WORM

Tirumala Geethika
M. Sc. Horticulture, Department of Entomology
Dr. Y. S. R Horticultural University, College of Horticulture,
Anantharajupeta, Annamayya Dist. Andhra Pradesh
e-mail: tirumalageethika@gmail.com

INTRODUCTION

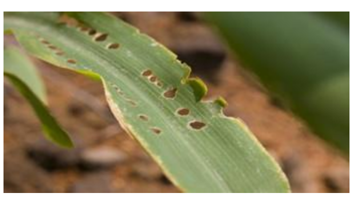
The Fall Army Worm (FAW), scientific name Spodoptera frugiperda, belongs to family Noctuidae, under order Lepidoptera. As a polyphagous pest, it inflicts damage on economically significant cereal crops like maize, rice, sorghum, cotton, and various vegetable crops, ultimately affecting global food security. This pest has been documented to infest 353 different plant species. Native to the tropical and subtropical regions of the Americas, the Fall Army Worm has swiftly expanded its presence to diverse regions worldwide, causing extensive damage to agricultural systems. The Fall Army Worm has become a global concern due to its ability to spread quickly across different climates and its resistance to many commonly used insecticides. It's introduction to new regions often leads to severe economic consequences, impacting food security and livelihoods of farmers. Researchers, farmers, and agricultural authorities worldwide are actively engaged in finding sustainable and environmentally friendly solutions to combat the Fall Army Worm. Integrated pest management (IPM) techniques, incorporating biological controls, involve a comprehensive approach to pest control that aims to minimize reliance on chemical pesticides. By utilizing a combination of natural predators, parasites, and pathogens, alongside cultural and mechanical methods, IPM seeks to manage pest populations effectively while minimizing environmental impact and preserving ecosystem balance. As the battle against the Fall Army Worm continues, international collaboration and knowledge-sharing play crucial role in developing effective measures to protect crops and ensure food security.

ECONOMIC IMPORTANCE

The larval phase of the fall armyworm stands out as highly destructive in nature and poses a significant threat to crops. In infested parts of the plant, the presence of larvae can be noted. To assess the losses attributed to Fall Armyworm (FAW), various variables must be taken into account. Typically, the extent of crop infestation by the pest is contingent upon factors such as pest population, timing of infestation, presence of natural enemies and pathogens, as well as the health status of the plant, including its nutritional and moisture levels at that specific time. Approximately 170,000 hectares of maize crops in India were reported to be impacted by Fall Armyworm (FAW), affecting regions across 10 states in the India. This worm was reported to have infested approximately 10,000 hectares in Indonesia, are affected, while in Myanmar, the figure stands at around 16,200 hectares. Meanwhile, in Vietnam, an estimated 46,000 hectares of land are impacted. In Thailand, the anticipated yield loss caused by Fall Armyworm (FAW) was indicated to range from 25 to 40%, leading to a financial loss estimated between 130 million and 260 million dollars.

SYMPTOMS IN MAIZE

Fall Armyworm (FAW) typically induces symptoms characterized by the presence of papery windows of various sizes on leaves, exhibiting ragged edges and round to oblong-shaped appearances. During the severe infestation stage, noticeable defoliation occurs, accompanied by the presence of excessive fecal matter on the plant. Ultimately, the growth and development of crops come to a halt, leading to the absence of cob or tassel formation. During the initial and second larval instars' infestation, translucent patches become apparent, whereas from the third to sixth instars, conspicuous larger elongated holes become apparent. In the later stages, the Fall Armyworm's excrement takes the form of sawdust-like material observed in the maize funnel or scattered on the leaves.



LIFE CYCLE

The lifecycle has four stages.

Egg: The eggs exhibit a dome-shaped structure with a flattened base. The egg has a diameter of 0.4 mm and a length of 0.3 mm and are creamy white hue. The abdomen is embellished with abdominal hairs along the ribs. Females lay eggs in clusters of 100 to 200, positioning them on both the upper and lower surfaces of the leaf, as well as on the stalk and funnel of the maize plant.

Larvae: In the initial and second instars, newly hatched caterpillars showcase a green color, During the third to sixth instars, the coloration shifts from brown to black. The mature larva is distinguished by a unique white inverted "Y" shaped mark on its anterior. Its epidermis displays a coarse or granulated texture, featuring four dark raised spots arranged in a square configuration. Head capsule widths for the first to sixth instars measure 0.35, 0.45, 0.75, 1.3, 2.0, and 2.6 mm, respectively, while corresponding body lengths approximate 1.7, 3.5, 6.4, 10.0, 17.2, and 34.2 mm.

Head capsule of fall army worm showing a pale-colored inverted "Y" on the front of the head.

Pupa: These are oval-shaped, reddish-brown, and create a cocoon measuring 20-30 mm in length, typically located at depths ranging from 2-10 cm in the soil. The pupae, about 15 mm in length, are commonly situated in the soil within cocoons measuring 20–30 mm across.

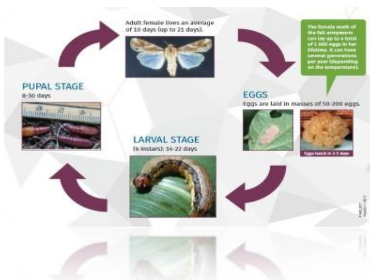
Adult: The mature individuals exhibit nocturnal behavior. Adult moths display a range of colors with a wingspan measuring between 32 to 40 mm. Male moths exhibit forewings in shaded grey and brown hues, embellished with triangular white spots at the apex and in proximity to the center, distinguishing them from female moths. These moths possess migratory tendencies, capable of covering long distances through flight.

Adult Male Fall army worm,

Spodoptera frugiperda

Adult Female Fall army worm,

Spodoptera frugiperda



Life cycle of Fall army worm. FAO (2017)

MANAGEMENT

Physical and mechanical methods

The control measure involving report, which indicate that after observing Fall Armyworm (FAW) infestation in maize fields, dry sand is applied into the whorl of affected plants as a preventive measure. For small gardens with a limited number of eggs or caterpillars, practical measures such as handpicking and crushing can be employed. Another control method includes the manual removal of egg masses and neonate larvae are effectively controlled by crushing them or immersing them in a solution of kerosene and water. Additionally, the strategic installation of pheromone traps at a rate of 5 traps per acre in highly infested areas during both crop and off-seasons aids in controlling the incidence of Fall Army Worm.

Cultural method

While chemical insecticides are commonly used to control Fall Armyworm (FAW), cultural practices offer an alternative approach to minimize crop damage. Intercropping maize with legume crops like pigeon pea, black gram, or green gram has shown effectiveness in FAW management. Additionally, implementing clean cultivation methods, applying fertilizers, and cultivating maize hybrids with tight husk covers can help reduce ear damage caused by FAW and other pests. Early planting or using early maturing varieties can also be effective since higher densities of armyworms tend to occur later in the season.

The "Push-Pull" companion cropping strategy has emerged as a promising method for controlling FAW spread. This involves planting maize alongside a pest-repellent ("push") plant like Desmodium spp., surrounded by a border of a pest-attracting trap ("pull") plant such as napier grass (Pennisetum purpureum or Brachiaria spp.). Despite requiring additional labor and expenses, this method has demonstrated efficacy in FAW management.

Frequent weeding is another cultural practice that can reduce FAW damage, as graminaceous weeds, commonly found in maize fields, are considered significant hosts for the fall armyworm. Research has shown that up to 56 percent of pest management can be achieved through cultural methods.

Biocontrol method

Enhancing natural enemies through habitat management and increasing plant diversity via intercropping with pulses and ornamental flowering plants is recognized as a strategy to bolster biological control against Fall Armyworm (FAW). To effectively manage FAW, *Bacillus thuringiensis var. kurstaki* formulations are applied at a concentration of 2g per liter. Additionally, the application of Metarhizium anisopliae talc formulation (1x108 cfu/g) at a rate of 5g per liter through whorl application at 15-25 days after sowing has shown effectiveness. Furthermore, conducting 1-2 sprays at 10-day intervals has been noted as an effective measure to curb FAW spread and minimize pest damage.

Biopesticides, especially those derived from bacteria like Bacillus thuringiensis (Bt), fungi such as *Beauveria bassiana*, and Baculoviruses, have proven efficacy in controlling FAW. Notably, entomopathogenic fungi have shown effectiveness against FAW eggs and second instar larvae. For instance, a Beauveria isolate resulted in 30 percent mortality of second instar larvae, while a Metarhizium isolate exhibited 87% and 96.5% mortality rates for eggs and neonate larvae, respectively.

Chemical method

Ensuring precise timing for chemical application is paramount for effective fall armyworm management. Individuals must be knowledgeable about the pest's life cycle and the optimal timing for pesticide application. Spraying becomes ineffective when larvae are deeply entrenched within maize whorls and ears. Various chemicals are recommended for fall armyworm control, spanning different insecticide groups such as Methomyl, Pyrethroids, Cyfluthrin, and organophosphates like methyl parathion.

In Africa, commonly used chemicals for fall armyworm control include chlorpyrifos, carbosulfan, emamectin benzoate, cartap hydrochloride, and beta cypermethrin. Notably, emamectin benzoate, cartap hydrochloride, and beta cypermethrin are also suitable for use on vegetables. The effectiveness of newer insecticides like Spinosad, Chlorantraniliprole, flubendiamide, and spinetoram has been observed with over 90% larval mortality, surpassing traditional insecticides such as lambda-cyhalothrin and novaluron.

CONCLUSION

The fall armyworm poses a significant threat to global food security, particularly in the regions where it has become invasive. Its rapid spread, resistance to pesticides, and ability to infest wide range of crops make it a formidable challenge for farmers and policymakers. Effective and sustainable management strategies are crucial to mitigate the impact of the fall armyworm. Integrated pest management, biological control methods, and the development of resistant crop varieties are promising approaches that to be explored and implemented. Additionally, international collaboration and information-sharing are essential to monitor the spread and coordinate efforts to control its infestation. Addressing the fall armyworm menace requires a multi-faceted approach that combines scientific research, technological innovation. By fostering a holistic and adaptive response, we can strive to safeguard global food production systems and ensure the resilience of agriculture in face of emerging threats like the fall armyworm.