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A New Invasive Insect Fall Army Worm, *Spodoptera frugiperda* (J. E. Smith) (Noctuidae: Lepidoptera) on Maize

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Abstract

The fall armyworm (FAW), *Spodoptera frugiperda* (J.E.Smith) (Noctuidae: Lepidoptera) is a serious polyphagous pest of voracious nature with a wide host range of approximately more than 100 recorded plant species in 27 families. This pest prefers plants from the Gramineae family including many economically important plants such as maize, millet, sorghum, sugarcane, rice, wheat, *etc*. There are reports on its infestation on other field crops like cowpea, groundnut, potato, soybean, cotton, etc. The fall armyworm was first officially reported in Nigeria in West Africa in 2016, and rapidly spread across 44 countries in sub-Saharan Africa. Yield reductions in maize due to feeding of the fall armyworm have been reported as high as 34% and some areas suffering up to 70% crop destruction. Fall armyworm causes significant yield losses if not well managed. It has several generations per year and the moth can fly up to 100 km per night.

Introduction

Maize (*Zea mays* L.) is the third most important crop after rice and wheat in India in terms of its area coverage and contribution to total foodgrains production. It is a cereal grain, also known as Queen of Cereals due to its diverse usages. Depending on the regions and socio-economic conditions of the population, the maize-grain is used for various purposes including food, feed, fodder, green cobs, sweet corn, baby corn, popcorn, starch, and several industrial products. India's maize production touched a record of 26.88 million tonnes in 2017-2018, with a bulk of the output coming from the Kharif season. In the previous year, maize output stood at 25.90 million tonnes. However, the recent invasion of this pest in and around the maize growing regions of Karnataka and Tamil Nadu threatened the maize growers.

First Evidence of Fall Army Worm in India

The fall armyworm is native to the tropical region of the western hemisphere from the United States to Argentina. Till 2015, this pest has not been reported in any other part except in America. In 2016, it was recorded in Africa causing serious damage to maize crops In September 2017, the UK Aid and CABI published a report commissioned by the UK Department for International Development called: "Fall Armyworm: Impacts and Implications for Africa", according to which the Fall Armyworm (FAW) could potentially cause corn yield losses in a range from 8.3 million to 20.6 million tonnes in 12 African countries per annum (if no control methods are put in place). The value of these losses is estimated at between US$2,481 million and US$6,187 million. Now in

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2018, this notorious pest has entered India. The incidence of an invasive pest fall armyworm, *S. frugiperda* was confirmed and observed in maize in Karnataka, Tamil Nadu, and Andhra Pradesh during July 2018.

Description of Life Stages

Eggs

The egg of the fall armyworm is "oblate-spheroidal" (0.39 mm in height, 0.47 mm in diameter). Freshly oviposited eggs are initially greenish-gray in color and become progressively darker with age. Approximately 12 h after deposition, eggs appear brown and become nearly black just before larval eclosion (Dew, 1913).

Larva

When first instars eclose (L1), larvae are colored off-white to yellow with black head capsules, and small black spots from which primary setae protrude. Larvae darken as they feed and appear greenish. The proceeding two larval instars (L2–L3) are similar in color to earlier instars just after molting from the preceding instar but typically darken just before molting to the proceeding instar. The three final instars (L4–L6) are typically dark in color, with varying color patterns depending on their diet and other factors. The larva displays a prominent inverted "Y" on the head capsule. The head capsule is traditionally dark in color, ranging from brown to black. Later instars (L4–L6) lack primary setae and are generally smooth. Older larvae may range from light green to brown or even black. Markings on the larvae can include a non-continuous white line in the mid-dorsal area, as well as yellow and red "flecking" on the venter (abdomen). Larvae also have a distinct pattern of four "dots" on the eighth abdominal segment Fall armyworm larvae possess tooth-like projections on their mandibles. The pupal case has an orange-brown appearance, typical of most Noctuids and turning darker as it ages. Larval length ranges from 1.68 mm for first instars to 34.15 mm for sixth instars. Head capsule width ranges from 0.314 mm for first instars to 2.78 mm for sixth instars (Luginbill, 1928).

Adult

Fall armyworm adults (moths) have a wingspan of about 1.5 inches (3.81 cm). The upper portion of the forewings is a mottled dark gray, with a distinctive white spot near the dorsal tip, or apex, of the wing, while the lower portion of the forewings is a light gray to brown color. The hind wings appear light gray to white. Male adults are often confused with yellow striped armyworms, *Spodoptera ornithogalli* (Guenee). Yellow striped armyworm adults have crescent-shaped markings on the forewings resulting in more contrast in color shades compared to fall armyworm male forewings. Fall armyworm female adults also may be confused with beet armyworms, *Spodoptera exigua* (Hubner). Beet armyworm adult forewings have a paler ground color with a pale round orbicular spot, while female fall armyworm adult forewings have an oval dark centered orbicular spot. Fall armyworm moths have filiform (threadlike) antennae common in Noctuids. These moths are generally most active at night (Oliver and Chapin, 1981).

Symptoms of Damage

- Larvae start causing damage from 15 DAS.
- Scraping and skeletonizing the upper epidermis leaving a silvery transparent membrane.
- The older larvae feed on the developing primordial shoot, thus resulting in dead heart symptoms.
- The infestation cause stunting and destruction of developing tassels and kernels, which reduces grain quality and yield.
- When the caterpillars burrow into the side of the cob damage to grain can lead to rot.
- The symptoms of damage includes are pinholes, small to medium elongated holes, parallel shot holes and irregularly shaped holes on leaves, loss of a top portion of leaves, presence of chewed up fresh material, fecal pellets in the leaf whorl and drooping of leave portion above the feeding area and feeding on the tassel.

Seasonal Distribution of Fall Armyworm

Population peak in the spring (March-May) and fall (October-December), with a prolonged decline in numbers in summer (July-October) and a smaller reduction in mid-winter (January). The number of generations occurring in an area varies with the appearance of the dispersing adults. The Diapauses stage is absent in this species.

Control Measures

- Use light trap @ one / ha. Collection and destruction.
- The following botanical and synthetic insecticides recommended as per IRAC modes of Action *viz*., Azadirachtin 1% EC (10000 ppm) 400 ml/ac, Thiodicarb 75 WP 400 g/ac, Flubendamide 480 SC 60 ml/ac, Chlorantraniliprole 18.5% SC 60 ml/ac, Emamectin benzoate 5% SG 80 ml/ac, Spinosad 45 SC 80 ml/ac.
- Apply neem cake @ 100 kg/ac to control the pupae.

Figure 1: Eggs are covered in protective scales rubbed off from the moths' abdomen and after hatching, the young caterpillars begin feeding on the leaves

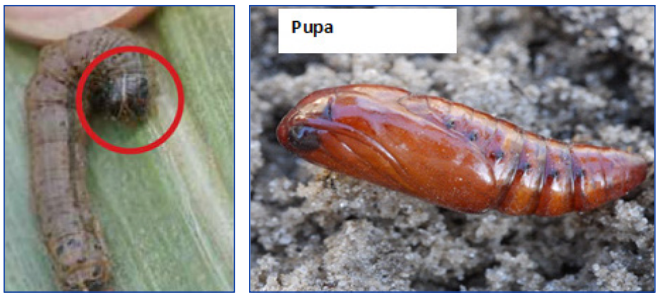

Figure 2: Worms have a dark head with a pale up-side down Y shape on the front and The pupa is shiny brown and usually found 2-8 cm into the soil

Figure 3: Adult fall army worm

Figure 3: Adult fall army worm

Figure 5: Damage to maize cob

Figure 6: Damage to maize cob

Conclusion

Integrated control of *S. frugiperda* must be facilitated through cultivation practices to destroy overwintering sites, improved varieties with resistance to leaf feeding through conventional mechanisms, or via markers assisted breeding program. Biological controls are prevalent and should be encouraged through reduced spaying of insecticides.

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