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## Fall army worm is one of emerging pest in Maize: Review article

**Megha Dubey, Anjum Ahmad, Nidhi Verma and Neha Sharma**

### Abstract

Fall armyworm, is one of the most important pest of lepidopteran family that feeds on different crops but it may causes major damage to the main crops of Madhya Pradesh like maize, rice, sorghum, sugarcane, wheat etc along with vegetable crops. It is native of Americas and was reported from Africa in the year 2016 when it caused major damage to maize. In the year 2018, *S. frugiperda* was reported for the first time in Indian subcontinent. It has been spread to different countries of the world and caused damage to maize crops. The favorable condition for its spread is found in Africa and Asian countries only. It is able to produce several generations in one season therefore, its growth rate is very high and because of this character it is very difficult to control in last stage.

**Keywords:** fall army worm, cultural control, biopesticide, larvae, moth

### Introduction

Fall armyworm can be one of the more difficult insect pests to control in field corn. Late planted fields and later maturing hybrids are more likely to become infested. Fall armyworm in initial stage cause damage to young leaves and if its damage is in cob formation stage than it affect the yield. The late planted maize crop is damaged by this pest before silking stage. Therefore, if regular monitoring, field sanitation and inspection of pest is done the insect attack can be controlled by insecticide application. Farmers who are growing maize crop during kharif and and rabi season should be very careful and monitor the fields regularly. This type of problem occurs in early planted maize fields especially during June. As soon as the pest is recognized the pest will be controlled soon. Its larval stage can be controlled at a very early stage. But as the adult stage is achieved this insect is very difficult to control because it attack the maize crop in all stages. So, early planting is considered best instead of late planting for maize crop to escape favorable growth condition for the pest. The fields should be monitored and when 5% egg masses or 20-25% plant population shows the damaging symptoms it should be controlled. It is very difficult to control the larvae at the last stage because it start hiding inside the plant parts. Insecticide must be applied before the larvae burrow deep into the whorl of the plant or enter ears of more mature plants. In Madhya Pradesh, FAW has infested crops in 13 districts. The worst affected are the agriculturally prosperous regions of Betul, Hoshangabad, Harda and Chhindwada. In some places fall army worm has reported 80-90 % damage as it spread rapidly due to its rapid growth and speed to migrate from one place to another.

### Detail about various growth stages of fall army worm

**Characters of Eggs:** The eggs diameter is 0.4 mm and height 0.3 mm, pale yellow or creamish in colour, which become light brown prior to eclosion. These eggs get mature in 2 to 3 days if the temperature is 20-30 °C. About 150-200 eggs are laid in masses covered with felt-like layer of grey-pink scales (setae) deep on the surface of the leaf. Each female may lay

1000 eggs which may be laid underside of the leaves, or on top of the leaves. In young crops, eggs may be laid on the stem.

**Characters of larva:** The larvae of this pest is light green to dark brown in color with longitudinal stripes on its body. When it reaches at the sixth instar stage, the length of larvae becomes 4.5 cm, it have eight prolegs, a pair of prolegs are also present on the last abdominal segment. After hatching they color becomes green with black lines and spots on its body some time they color become buff-brown and have black dorsal and spiracular lines. The final instar become black. Larvae have a characteristic symbol of inverted Y-shape in yellow color on the head, black dorsal pinaculæ, long primary setae and four black spots which is arranged in a square on the last abdominal segment. Usually six larval instars, occasionally five as also reported in CIMMYT (2018) [5].

**Characters of pupa:** Pupae of this pest is short in size as compared to the mature larvae (1.3-1.5 cm in males and 1.6-1.7 cm in females and are shiny brown in color. The pupation generally takes place in the soil but it may also occur in the reproductive parts of mature maize ears. When the soil is hard, larvae web together leaf residues to form a cocoon on the soil surface. The pupal stage may vary from 8 to 9 days during the summer season, but it may reach upto 20 to 30 days during the winter season.

**Characters of adult male:** The body length of adult male is 1.6 cm and wing span is 3.7 cm. The forewing is mottled and light brown or grey or straw color. It has a discal cell with straw color on three quarters of the area, dark brown on one quarter of the area with triangular white spots at the tip and near the centre of the wing.

**Characters of adult female:** The body length of female is 1.7 cm and wing span 3.8 cm. The forewings are not distinctly marked, ranging from uniform greyish brown to a fine mottling of grey and brown. Hind wings are straw color with a dark-brown margin. The adults are nocturnal in habit and active during warm, humid temperature in the evenings time. After a pre-oviposition period about 3 to 4 days, the female moth deposits her eggs during first 4 to 5 days of her lifecycle, but some ovi-position occurs up to 3 weeks. Adult life is estimated to be about 10 days, with a range of about 7 to 21 days.

**Effect of taking Phytosanitary measures to control pest:** Planting material or seed should be selected from disease free area where the pest attack was not found.

Jeger *et al.* (2017) [7] has also conducted a pest categorization experiment and observed that fall army worm is a 'Union quarantine pest' which is dangerous and difficult to control.

**Important hosts affected by the pest:** *S. frugiperda* is a most important polyphagous pest which shows a definite preference for crops of family Poaceae as reported by (Casmuz *et al.*, 2010) [3]. It is also recorded to affect wild and cultivated grasses, maize, rice, sorghum and sugarcane crop to a greater extent. However, Montezano *et al.* (2018) [10] have recently reported 353 host plant species based on his thorough literature review, and additional surveys done in Brazil, from 76 plant families, principally Poaceae (106), Asteraceae (31)

and Fabaceae (31) and concluded his result.

### Major symptoms of fall army worm attack

The young plants/seedlings are fed upon within the whorl. The final stage larvae can cut the base of the plant above the soil the mature plants may suffer from the attack especially on the reproductive parts. In case of tomato plants the buds and growing points may be destroyed and fruits may be pierced. The maize plant leaves are eaten and the whorl (funnel) may be a mass of holes, ragged edges and larval frass. The young larvae form skeleton on the leaf lamina in a typical 'window-pane' damage. Many young larvae are present on the same plant, but normally one or two older larvae may be found on a single plant, and other will migrate and feed on neighbouring plants. Larval instars make larger holes, causing ragged whorl leaves, and produce sawdust-like larval droppings, while fresh feeding produces big lumps. Fall armyworm can destroy silks and developing tassels and limit fertilization of the ear. Maize plants may have the cobs attacked by larvae boring through the kernel and lead to fungal infection and aflatoxins.

**Mode of Movement of Fall Army Worm:** The pest migrant in the American countries and dispersing throughout the USA and flying into southern Canada virtually every summer (Westbrook *et al.*, 2016) [11]. Migration has evolved as a major component in the life of this pest. In the other countries, adult moths have been recorded low-level jet stream, which took them from Mississippi to Canada in 30 h. The rapid spread of fall armyworm invaded in Africa has been attributed to the strong flight capacity of the insect. The rapid spread to the Indian Ocean Islands and to Asia is harder to explain by natural flight. Cock *et al.* (2017) [6] reported potential pathways of spread. Wind-assisted flight alone might not have been sufficient for fall armyworm to cross the Atlantic or the Indian Ocean, but once it arrived, all the pathways listed could have occurred. It is still not clear whether there were multiple introduction events, or a single event involving multiple individuals.

**Fall Army Worm economic Impact:** The pest *S. frugiperda* is found widely throughout the warmer parts of the New World. Its damage results from leaf-eating of healthy plants usually recover quite quickly, but a large pest population will cause defoliation and resulting in yield loss; the larvae then migrate to the adjacent areas in true armyworm. The crop responds to pest infestation dependent on population level, timing of infestation, natural enemies and pathogen levels that can help to naturally regulate the populations, health and vigour of the maize plant. Baudron *et al.* (2019) [2] have reported that maize infestation was found to be 26.4 and 55.9% and impact on yield of 11.57%. Other authors have reported leaf, silk and tassel damage levels ranging between 25 and 50% and grain yield has decreased to 58% (Chimweta *et al.*, 2019) [4].

### Method of control

Summer deep ploughing must be done in the fields which is infested by the pest to destroy its pupal stage which may be inside the soil. Various plant extracts are often included, such as chilli, neem, *Tephrosia*, *Tithonia*, *Lantana* and garlic. Handpicking egg masses and caterpillars has been done Use of light traps and pheromone traps is also done to control its population. Timely sowing, before the monsoon is very effective. Recommended plant spacing and plant population

must be maintained. STV based fertilizers must be done on recommended stages and excess dose of nitrogen must not be applied as it may increase the growth of this pest. In maize crop some pulse crops must be grown as inter cropping like mung, urd. In the initial stages when plants are very small then apply wood crush, sand and ash in the stem hole. Biopesticide like BT must be applied at the rate of 1 kg per hectare or Bevaria Bassiana 1.5 liter per hectare must be applied in the morning or evening time.

**Botanicals:** Azadirachtin (neem) is effective against fall armyworm. Therefore it is applied 1-2 liter per hectare for 2-3 times for controlling the pest at initial stage.

**Host-Plant Resistance:** *Spodoptera* spp. resistance breeding programmes have developed field crop varieties with improved resistance, one example being maize.

Transgenic maize containing genes encoding delta-endotoxins from *Bacillus thuringiensis kurstaki* have been commercialized in the USA and Brazil.

**Use of chemical control:** Flubendamide 20WDG, 250gram per hectare or Spinoasade 45EC, 200-250 gram per hectare or Ethopphenphox 10 EC, 1 liter per hectare or Emamactin benzoate 5 SG, 200 gram per hectare must be applied with in the interval of 15-20 days for about 2-3 times. First spray must be done 15 days after sowing of maize crop.

**Impact of pheromonal control:** The use of sex pheromone for *S. frugiperda* contains (Z)-9-Tetradecenyl acetate (Z-9-14:OAc) which is common to *Trichoplusia ni*, *Spodoptera exigua* and *Agrotis ipsilon*. Mating disruption may be possible given the successes observed for *S. exigua* in which (9Z, 12E)-9, 12-tetradecadienyl acetate released at high concentrations, caused mating disruption in tomato, lucerne and cotton crops.

**Impact of IPM:** Integrated control of species *S. frugiperda* is through cultivation practices such as destroying overwintering sites, cultivate early varieties improved varieties with resistance to leaf feeding through conventional mechanisms or the introduction of Bt crops. Biological controls should be used and spraying of insecticides reduced.

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