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CABI



Fall Armyworm Field Handbook

Identification and Management

FAO and CABI (2019) Fall Armyworm Field Handbook: Identification and Management, First Edition.

Cover Photo: Fall armyworm larva ©Georg Goergen, IITA

This field handbook is an adapted version of FAO and CABI (2019) Community-Based Fall Armyworm (*Spodoptera frugiperda*) Monitoring, Early warning and Management, Training of Trainers Manual, First Edition. Licence: CC BY-NC-SA 3.0 IGO. It is intended to help extension workers and farmers in the field to identify fall armyworm and know how to manage it.

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Further information

Fall armyworm portal: www.cabi.org/fallarmyworm

Fall armyworm FAO: www.fao.org/fall-armyworm/en

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How to identify fall armyworm

Fall armyworm larvae (or caterpillars) are similar to caterpillars of other related pests (Figure 1). Look for the following features to determine if the caterpillar you have found in your maize is fall armyworm or belongs to another species.

- A dark head with a pale, upside-down **Y-shaped marking** (Figure 2, black circle).
- **Four raised spots shaped like a trapezium** on each body segment seen from above (Figure 3, orange circle).
- **Four spots** forming a square on the second-to-last body segment (Figure 3, red circle).
- Skin appears smooth to the touch.
- Sawdust-like material called “**frass**” is present in the maize funnel or on the leaves, tassels and cobs. Large clumps are formed during fresh feeding (Figure 4).



1



2

Inverted "Y" © Matt Bertone, NCSU



3

Raised dots on body segments © Russ Ottens, Bugwood.org



4

Clumps of frass formed during (fresh) feeding © CABI

Pests that can be confused with FAW

Cotton bollworm (Figure 5) often shows a similar pattern of dots on its back, but its head is usually paler. Although it can also have an upside-down Y-shaped mark, this is usually a similar colour to the rest of the head. Unlike fall armyworm, these caterpillars feel rough to the touch due to tiny spines. These and other species of caterpillars and borers are illustrated below and should not be mistaken for fall armyworm, although they can also be found on maize.



Cotton bollworm *Helicoverpa armigera*



Fall armyworm and Beet armyworm



Southern armyworm *Spodoptera eridania*



© Rikus Kloppers/PANNAR

African armyworm *Spodoptera exempta*



© Whitney Cranshaw, Bugwood.org

Beet armyworm *Spodoptera exigua*



© David Marquina Reyes, Flickr

African cotton leafworm
Spodoptera littoralis



© NBAIR

Spotted stem borer *Chilo partellus*



© R Reeder, CABI

African maize stalk borer *Busseola fusca*

Life cycle of fall armyworm

Fall armyworm has a four-stage life cycle: eggs, larvae (caterpillars), pupae and adults (moths).

Eggs

Eggs are generally laid on the underside of the leaves. When the population is high, the eggs may also be laid on top of the leaves and the stalk (stem) of young maize seedlings.

- The egg masses are cream, grey or whitish in colour with a hairy covering.
- This mass often contains 100–200 spherical eggs (Figure 6).
- A single female moth produces an average of 1,500 eggs in her lifetime.
- The duration of the egg stage is only 2–3 days during warm conditions.



Eggs on maize leaf © CABI

Caterpillars

Eggs hatch into small caterpillars within 3–5 days, and move to the funnel. The small caterpillars can also be carried to other plants by wind (Figures 7–8).

Small caterpillars may appear greenish, while bigger caterpillars vary in colour from orange to green and black or brown (Figure 9-10). Caterpillars mature within 14–22 days (2–3 weeks), after which they drop to the ground to pupate. Up to 12 overlapping generations may hatch in a year.



Eggs hatching into caterpillars © CABI



Young caterpillars moving towards the funnel



Green form of FAW caterpillar
© Matt Bertone, NCSU



Brown form of the FAW caterpillar
© Matt Bertone, NCSU

Pupae

The caterpillar develops into a reddish-brown pupa in the soil (Figure 11). This stage is difficult to observe/see.

If the soil is too hard during pupation, the caterpillars may web together leaf debris and other material to form a protective covering called a “cocoon” on the soil surface (Figure 13). Pupae may also be found in the maize cob (Figure 12). The pupal stage lasts for 8-9 days when it is warm but can be as long as 20–30 days in colder areas.

**11**

Pupal stage © Matt Bertone, NCSU

**12**

**Pupa in a maize cob
© Diedrich Visser, ARC**

**13**

**Pupa in soil cocoon
© Diedrich Visser, ARC**

Adults (moths)

Moths are active at night, especially during warm, humid evenings. The dark grey colour of the moths makes them difficult to see, especially when resting near or on the ground, but in some cases when the population is high some may be found resting on the crop in the field.

The male forewing has a conspicuous (visible) white spot. (Figure 15) The duration of adult life is estimated to average 10 days, with a range of 7–21 days.

The female normally lays most of her eggs during the first four to five days of adult life, but some egg laying occurs for up to three weeks.

**14**

Male moth © Matt Bertone, NCSU

**15**

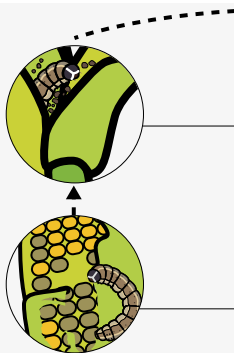
Female moth © Matt Bertone, NCSU

DAY 6–14

LARVAL GROWTH STAGES 4–6

By stage 4, the caterpillar will be bigger and have reached the whorl, where it does the most damage, resulting in ragged holes in the leaves. Feeding on young plants can kill the growing point and as a result no new leaves or cobs will develop.

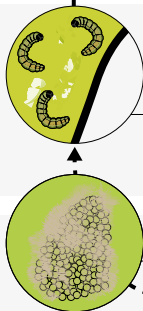
If the plant is older and has already developed cobs, then the caterpillar will eat its way through the protective leaf bracts into the side of the cob, where it begins to feed on the developing kernels (seeds).



DAY 3–6

LARVAL GROWTH STAGES 1–3

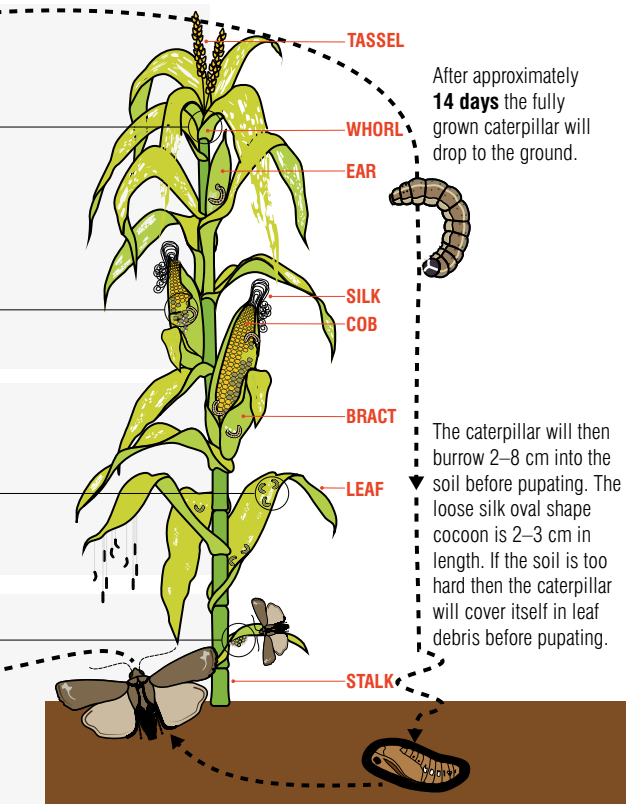
After hatching, the young caterpillars begin feeding, which creates patches on the leaves called windows. Young caterpillars can spin silken threads that catch the wind and transport the caterpillars to a new plant.



DAY 1–3

Batches of **100–200 eggs** are laid on the lower leaves.

After around **8–9 days** the **adult moth emerges** to restart the cycle.



Suitable conditions and crops for fall armyworm development

Caterpillars will develop in temperatures between 11°C and 30°C, but their optimum temperature is 28°C. In cooler conditions, there may only be one or a few generations per year. Heavy rains may wash off eggs and young caterpillars from the leaf, reducing populations.

Fall armyworm mainly attacks maize. It has also been reported on crops such as rice, sorghum, vegetable and cotton, but to date there has been little damage recorded on these crops.

How to identify fall armyworm damage on maize

Caterpillars feed on maize at nearly all stages of growth from when the plant is young (only three leaves: Figure 16), and also on the cob. Caterpillar damage on the leaves can sometimes be significant and disrupt the plants ability to form good grain and healthy cobs.

**16**



Window panes © Diedrich Visser, ARC

Leaf feeding causes extensive “window pane” damage on maize (Figure 17).

Large irregular and elongated holes on the leaves are caused by the big caterpillars while feeding.

Small caterpillars cause the clear or window-like patches while larger caterpillars cause irregular elongated holes on leaves.

Window panes are the most common damage symptoms at early whorl stage; however, they can be confused with damage caused by other stem borers. Look for the actual larvae that is eating the leaves to confirm if its fall armyworm.

**18**

Migrating caterpillars © Diedrich Visser, ARC

Usually, many small caterpillars will be present on the same plant, but only one or two bigger caterpillars will be found on a single plant. Others will migrate to feed on neighbouring plants (Figure 18).

**19**

Larval droppings © CABI

Bigger caterpillars make larger holes when feeding, causing ragged whorl leaves and producing sawdust-like material called “frass”. Fresh feeding produces big lumps of frass (Figure 19).

**20****Badly infested field © CABI**

Badly infested fields will have damage on the leaves similar to that caused by a hailstorm (Figure 20).

**21****Whorl damage © CABI**

During the day, caterpillars hide deep in the whorls (funnel). They feed inside whorls and can destroy silks and developing tassels on older crops, thereby limiting fertilization of the ear and leading to poor grain development (Figure 21).

**22****Cob damage © CABI**

Caterpillars move to the ear zone/funnel and start feeding after tassel emergence. Damage to cobs may lead to fungal infection, aflatoxin contamination and loss of grain quality (Figure 22).

**23****Cobs from infested field © CABI**

Cobs that were attacked in the field will have many of the seeds eaten up by the caterpillar (Figure 23).