Fall Armyworm
(Spodoptera frugiperda)

icipe@50 1970 – 2020 Insects for Life

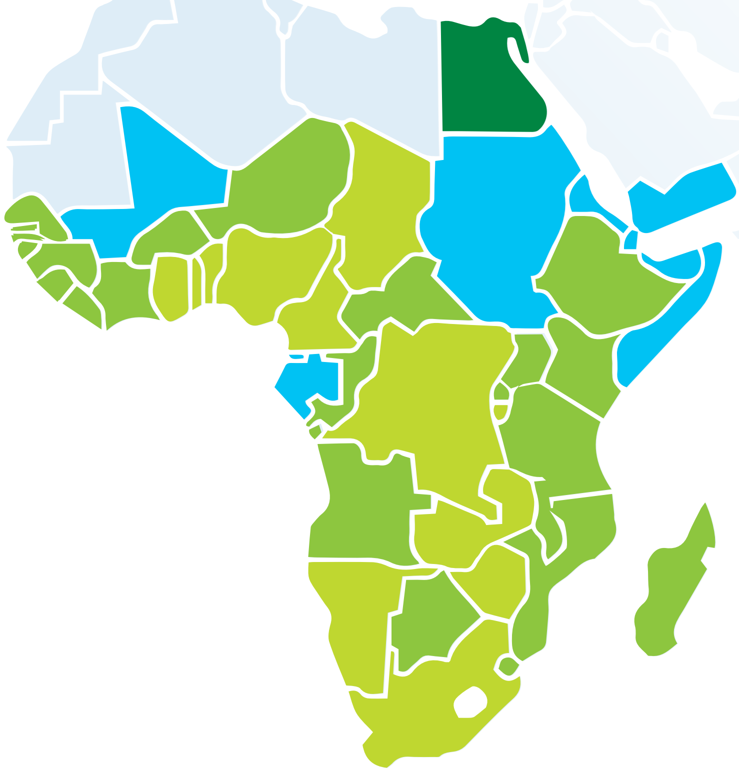
EUROPEAN UNION

What is Fall armyworm?

Fall armyworm (*Spodoptera frugiperda*) is an insect pest. It is a heavy feeder, feeding on more than 80 varieties of crops, including maize, sorghum, rice, millet, wheat, sugarcane and vegetables, but primarily affecting maize.

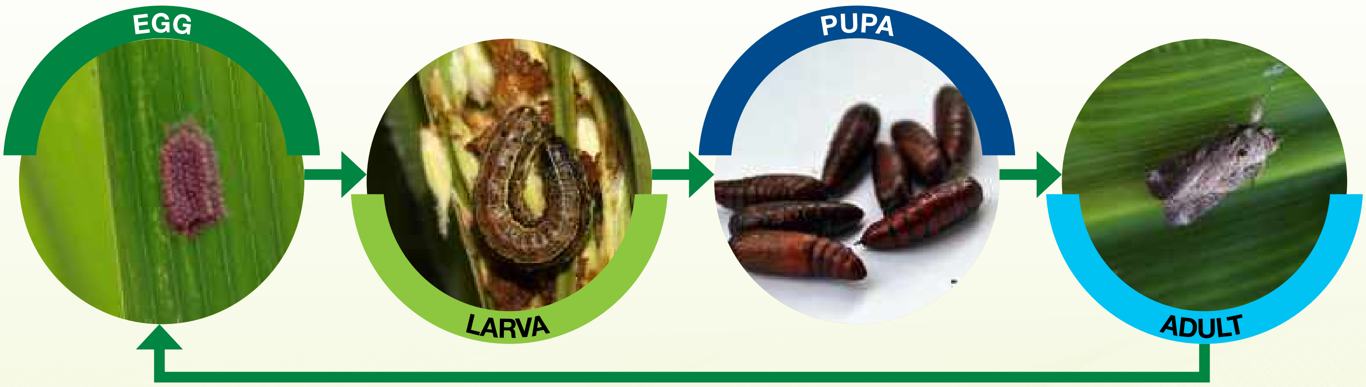
Fall armyworm's journey

Fall armyworm is an invasive pest that originated from tropical and subtropical regions of the Americas. It rapidly spread to and throughout Africa from 2016.



2016
2017
2018
2019

Fall armyworm life cycle



The life cycle takes 4 weeks. One maize season can be affected by 3 generations of Fall armyworm.

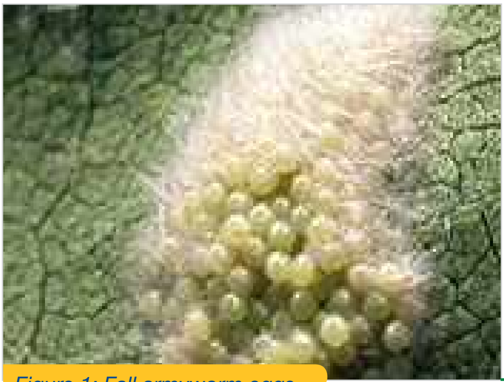


Figure 1: Fall armyworm eggs

Egg

The eggs are laid in batches and covered by whitish scales from the moth's abdomen to provide protection. Hatching occurs after 3–5 days. Eggs are the most vulnerable stage for Fall armyworm control but are difficult to monitor.

Figure 2: Distinguishing marks of Fall armyworm larva

Larva

A newly hatched Fall armyworm larva is green in colour with a black head. Older larvae have a dark head with an upside down white Y-shaped pale marking and 4 raised dots forming a square on the tail end. Young larvae spin silken threads that catch the wind and transport them to new plants. Larvae are highly destructive but resistant to synthetic pesticides.

Pupa

The Fall armyworm pupa is red-brown. Pupation mostly occurs in the soil under the host plant.

Adult

The adult moth is brown or grey and can fly over 30–200 km in one day assisted by the wind. A female moth lays 1,500–2,000 eggs in her lifetime, enabling the pest to quickly establish in new areas. Moths are easy to monitor visually and with pheromone traps.

How to identify Fall armyworm

Fall armyworm can be physically identified by spotting its egg masses, larvae, pupae or moths, or it can be identified by the damage caused by the larvae.

What damage is caused by Fall armyworm?


Figure 3: Frass (excreta) produced by Fall armyworm larvae


Figure 4: Windowing on maize leaves


Figure 5: Fall armyworm larva on maize cob

Fall armyworm larvae attack maize plants at all stages. When the larvae feed on young maize plants, they can kill the growing point and as a result no new leaves or cobs will develop. In older maize plants, the larvae tunnel into the cob and feed on developing seeds. Larger larvae reach the whorl, where they do the most damage, resulting in windowing and ragged holes in the leaves. As Fall armyworm larvae feed, they leave behind large amounts of moist sawdust-like frass near the whorl and upper leaves.

How can I differentiate Fall armyworm from other worms?


Figure 6: Spotted stemborer


Figure 7: African maize stalk borer


Figure 8: African armyworm

Fall armyworms' life cycle, ability to spread and reproduce quickly differentiates it from the African armyworm (*Spodoptera exempta*), a less destructive species. Spotted stem borer (*Chilo partellus*) enters the maize cob from the top or bottom while Fall armyworm enters the cob from the side. Spotted stem borer and African maize stalk borer pupate in the maize stem while Fall armyworm pupates in the soil.

Monitoring and scouting help to identify early infestation of Fall armyworm and quantify its damage, after which a farmer can decide on the control measures to use.

How to monitor Fall armyworm using a pheromone trap

Pheromones are chemicals produced by female moths to attract male moths. Pheromones can travel by air over long distances and are useful for monitoring Fall armyworm presence. Adult male moths are attracted to pheromones and will get stuck on the sticky insecticide pad when they enter a pheromone trap.

How to establish a pheromone trap

- The universal bucket trap is normally used.
- Establish the pheromone trap one month before planting.
- Place the trap in or next to a maize field so that the scent of the pheromone is carried across the tops of the plants by the wind.
- Hang the trap vertically from a long pole (3–4 metres) so that the trap is approximately 1.25 metres off the ground.
- As the maize plants grow taller, move the trap up the pole so that the bottom of the trap is always about 30 cm above the plants.

How to record data from a pheromone trap

Check and empty the trap every week. Sort out, count and record the number of moths confirmed to be Fall armyworm and the number of non-Fall armyworm moths. Moth counts indicate the presence of Fall armyworm in the area but do not indicate the level of infestation. Scouting is required to determine the percentage of infested plants.

Note: There may be no moths in the pheromone trap even though a significant percentage of plants are infested with Fall armyworm.

Figure 9: Field scouting and counting of moths from pheromone trap

How to carry out scouting

For effective control, start scouting every 3–4 days as soon as your maize emerges, early in the morning or late in the evening. Walk through your maize farm in a 'W' pattern and check 50 maize plants (5 groups of 10 plants) across the field for signs of infestation. Note down how many plants are affected by Fall armyworm.

During scouting, look out for:

- General health of the plant (leaf color, soil moisture, presence of weeds)
- Physical signs of Fall armyworm, any other pest (egg masses, larvae, pupae, moth) or disease symptoms
- Signs of Fall armyworm damage, such as windowing; frass; ragged and torn leaves; and silk, tassel and ear damage.

How can Fall armyworm be controlled?

Fall armyworm can only be effectively controlled while the larvae are small. Controlling larger larvae after they are hidden under the frass is much more difficult and costly.

Control measures include:

- Cultural control to suppress Fall armyworm damage before infestation occurs.
- Control measures for Fall armyworm once infestation occurs e.g mechanical, biological and chemical control, habitat management and use of botanicals.

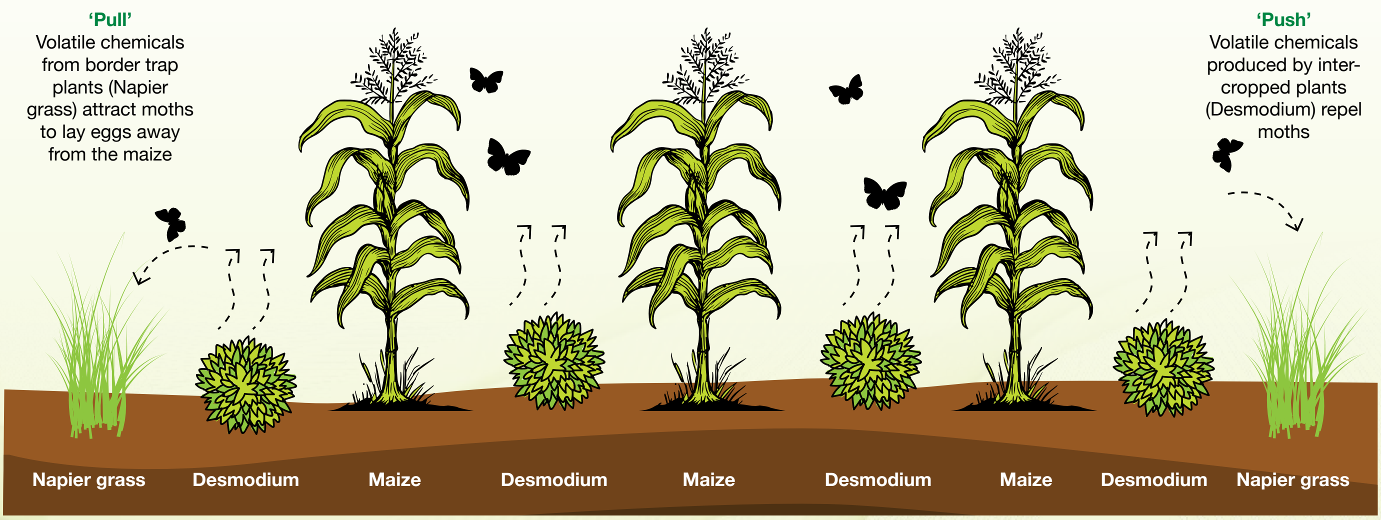
Cultural control

Cultural control is the practice of modifying the crop environment to make it less friendly for Fall armyworm establishment. Examples of cultural control:

- Prepare land and plant early, use good quality seeds, and avoid staggered planting.
- Apply good agronomic practices such as balanced fertilization of maize, frequent weeding, and ensuring adequate soil moisture.
- Increase crop diversity through intercropping maize with legumes such as beans, groundnuts and desmodium. Intercropping with legumes disrupts the movement of larvae by masking host recognition or by releasing repellants.
- Practice crop rotation and agroforestry.
- Provide an enabling environment for natural enemies which suppress Fall armyworm eggs and larvae e.g. predators (ladybird beetles, ants, earwigs), parasitoids (wasps), and entomopathogens (viruses, bacteria, fungi and nematodes).

Habitat management

Push-pull technology involves planting Napier or Brachiaria grass as a border crop along the edges of the farm while intercropping maize with Desmodium. To enhance the effectiveness of Push-pull, farmers are advised to plant Desmodium and Napier or Brachiaria grass before planting maize.



Mechanical control

Mechanical control is the management of Fall armyworm using physical means e.g.

- Crushing egg masses
- Handpicking and crushing larvae, handpicking and drowning larvae in soapy water, or handpicking and feeding larvae to chicken
- Pouring wood ash, soil, sand or chilli pepper down the maize whorl so as to kill larvae
- Use of sugary sprays, oil or lard, 'fish soup' or other material to attract ants and wasps to the maize plants, which also find and eat the Fall armyworm larvae.

Mechanical control is effective for small maize plots but uneconomical for large maize plots because it is labour intensive.

Biological control

Biological control is the use of naturally-occurring organisms also known as 'farmers' friends' or 'natural enemies' to reduce Fall armyworm populations.

Biological control agents include:

- Predatory insects and mites which eat their prey
- Parasitoids, which are organisms that live at the expense of their host and results in the death of the hosts
- Entomopathogens, which are micro-organisms (e.g. nematodes, fungi, bacteria, viruses and protozoa) which cause lethal infections to Fall armyworm.

Figure 10: Parasitoids which are natural enemies of Fall armyworm

Figure 11: Fungal based bio-pesticides

Bio-pesticides are a form of pesticide based on micro-organisms or natural products.

Botanicals are sprays made from plant extract e.g neem, chilli, jatropha, onion or tithonia.

Chemical control

Use of synthetic pesticides is highly discouraged because they are ineffective (larvae are protected inside the maize whorl), expensive and toxic to the environment and to human health.

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icipe – Working in Africa for Africa…

International Centre of Insect Physiology and Ecology (*icipe*) – was established in 1970 in direct response to the need for alternative and environmentally-friendly pest and vector management strategies. Headquartered in Nairobi, Kenya, icipe is mandated to conduct research and develop methods that are effective, selective, non-polluting, non-resistance inducing, and which are affordable to resource-limited rural and urban communities. icipe's mandate further extends to the conservation and utilisation of the rich insect biodiversity found in Africa.

icipe contributes to sustainable food security in Africa through the development of integrated pest management systems for major agricultural and horticultural crops. Such strategies include biological control and use of behaviour-modifying and arthropod-active botanicals. icipe puts emphasis on control approaches that have no detrimental impact on the environment. These options are always designed to fit the needs of the farmers and are developed on-farm and with farmers' participation. In addition to fruit flies, other key areas of icipe's research include pests of tomato, brassicas, beans, and staple food crops such as maize and sorghum.

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