FALL ARMYWORM

Spodoptera frugiperda

Surveillance and Management Protocol

DEPARTMENT OF AGRICULTURE
Regional Field Office No.5
San Agustin, Pili, Camarines Sur

Fall Armyworm (FAW), or ***Spodoptera frugiperda***, is an insect that is native to tropical and subtropical regions of the Americas. In its larva stage, it can cause significant damage to crops, if not well managed. It prefers maize, but can feed on more than 80 additional species of plants, including rice, sorghum, millet, sugarcane, vegetable crops and cotton. *(http://www.fao.org)*

Studies show that it is a major pest to cereals and forage grasses. FAW eats 186 plant species from 42 families including maize, rice, sugarcane, sorghum, beet, tomato, potato, cotton, millet and pasture grasses.

FAW can also affect important crops like cotton, soybean, wheat, barley, alfalfa, peanut, oat, clover, tobacco, tomato, potato, cabbage, lettuce, beet, onion, apple, grape, peach, papaya, orange and ornamental crops.

Two strains of FAW

Maize strain and Rice strain

- Both are morphologically similar but with different host ranges, mating behaviour and pheromone composition. They are also capable of crosshybridization.
- The Maize strain prefers maize, cotton, sorghum, and other similar crops.
- The Rice strain prefers rice and pasture grasses such as Bermuda grass and Johnson grass.

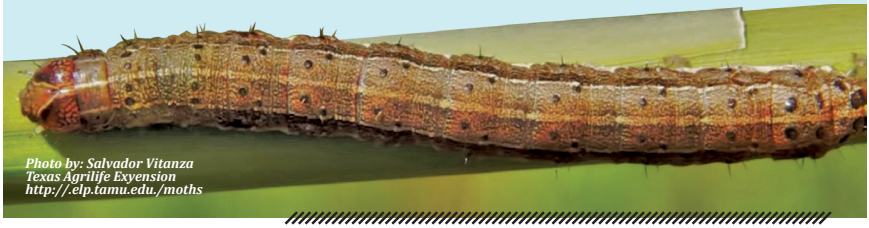


Photo by: Salvador Vitanza
Texas Agrilife Exyension
http://.elp.tamu.edu./moths

In 2016, FAW is reported to be in Africa, India and several Asia Pacific countries, Bangladesh, Nepal, Myanmar, Thailand and China. It poses a threat outside its range particularly in temperate regions because it can travel several hundred meters which transports them in a directional manner. Research showed that it is difficult to control because it has natural levels of tolerance to some

insecticidal proteins and demonstrated ability to develop resistance to insecticides and traits. *(Bureau of Plant Industry Pest Management Advisory)*

Local Situation

Suspected fall army worm infestation in the Philippines was first reported at Piat, Cagayan on June 20, 2019.

(Source: https://www.ippc.int/en/countries/philippines/pestreports/2019/10/report-of-first-detection-of-fall-army-worm-faw-in-the-republic-of-the-philippines/)

As of September 2020, corn areas in 19 municipalities in Bicol were reported to be affected by FAW. These are:

ALBAY	CAMARINES SUR	CAMARINES NORTE	SORSOGON	MASBATE
Oas	Pili Ragay Ocampo Sangay Balatan Nabua Baao Bula San Jose Libmanan	Mercedes	Pilar Juban	Cataingan Monreal San Fernando San Jacinto Pio V. Corpuz

These FAW infestation incidence were recorded, monitored and resolved by the Regional Crop Pest Management Center.

FAW-INFESTED CORN AREAS	ACTION/S TAKEN
ALBAY *(25.98 hectares)*	Chemical application
CAMARINES SUR Ragay *(1.5 hectares)* Pili Ocampo Sangay Balatan Nabua Baao Bula San Jose Libmanan	 Chemical application Chemical application, Spray Therapist Chemical application, Spray Insecticide Chemical control Given pesticide Physical control Spray Insecticide With chance of recovery Spray Insecticide Provision of insecticide
MASBATE Cataingan *(305.2 hectares)* Monreal *(78.4 hectares)* San Fernando *(83.20 hectares)* San Jacinto *(48.99 hectares)* Pio V. Corpuz *(0.85 hectares)*	 Chemical application Physical and chemical control Early morning spraying of systemic insecticide Chemical application Spraying chemicals

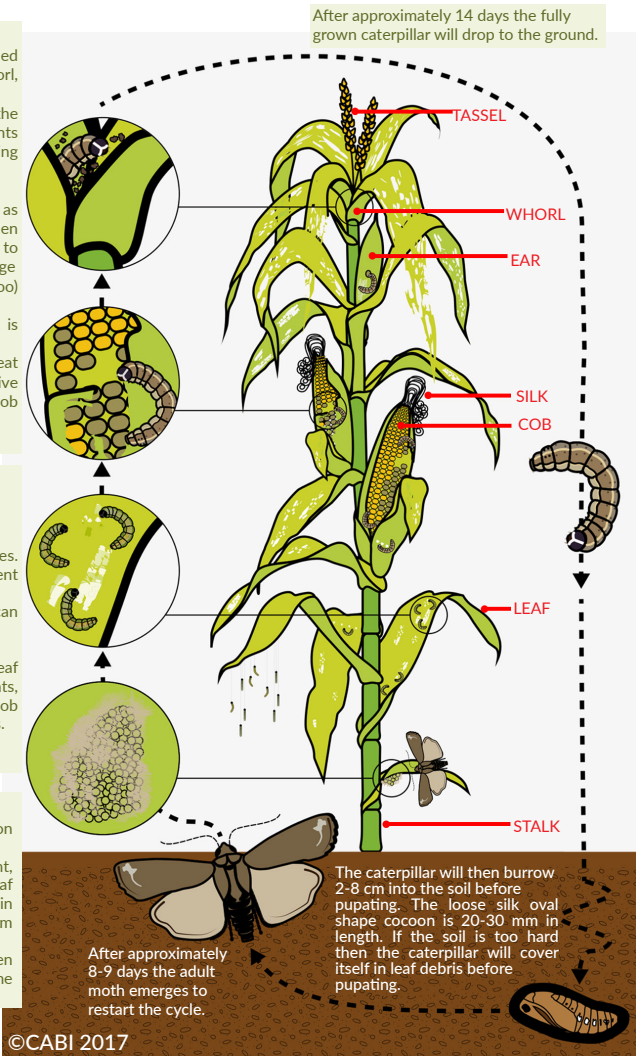
(Source: Fall Army Worm Monitoring Form)

Fall Armyworm: Life Cycle and Damage to Corn

DAY 6-14
By stage 3-6 it will have reached the protective region of the whorl, where it does the most damage, resulting in ragged holes in the leaves. Feeding on young plants can kill the growing point resulting in no new leaves or cobs developing. Often only 1 or 2 caterpillars found in each whorl, as they become cannibalistic when larger and will eat each other to reduce competition for food. Large quantities of frass (caterpillar poo) present. When this dries it resembles sawdust. 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
GROWTH STAGES 1-3
After hatching the young caterpillars feed superficially, usually on the undersides of leaves. Feeding results in semitransparent patches on the leaves called windows. Young caterpillars can spin silken threads which catch the wind and transport the caterpillars to a new plant. The leaf whorl is preferred in young plants, whereas the leaves around the cob silks are attractive in older plants. Feeding is more active during the night.

DAY 1-3
100-200 eggs are generally laid on the underside of the leaves typically near the base of the plant, close to the junction of the leaf and the stem. These are covered in protective scales rubbed off from the moths abdomen after laying. When populations are high then the eggs may be laid higher up the plants or on nearby vegetation.



This diagram illustrates the lifecycle, showing where the Fall Armyworm is usually found on maize plants at any given stage.

The Fall Armyworm life cycle includes egg, 6 growth stages of caterpillar development (instars), pupa and moth.

Source: Integrated management of the Fall Armyworm on maize
A guide for Farmer Field Schools in Africa
Retrieved from: Food and Agriculture Organization of the United Nations

ATTRIBUTES
THAT MAKE FALL ARMYWORM A DEVASTATING PEST

Key pest status
Maize yield loses over 70% reported in Central America when the pest was not controlled. Crop destruction (100%) in Brazil reported when late instars act as seedling cutworm. Damage across the globe estimated in billions of dollars.

Highly polyphagous
Reported on 353 host plant species from 76 plant families.

High reproductive rate
Females capable of producing 2000 eggs in their lifetime.

Highly migratory pest
Adults able to travel 100 km per night and 500 km prior to oviposition when assisted by strong winds. Larvae occasionally relocate to nearby suitable crops.

Transboundary pest
Reported in more than 90 countries, capable of dispersing further via commercial trade or strong migratory flight behavior.

Persist year around in tropical environments
Eight to ten generations per year in some regions and lack of diapause allow pest to infest crops at any time of year.

Cryptic feeding and behavior
Adults hide during daytime; ground migrating larvae hide under crop cover; deep whorl feeding. These behaviors allow pest go undetected, avoid predation and make it difficult to reach with foliar sprays.

Multiple feeding behaviors
Defoliator, ear and flower feeder, seedling cutter. The fall armyworm feeds on almost any above-ground plant part.

Difficult to control
Natural levels of tolerance to some insecticidal proteins and demonstrated ability to develop resistance to insecticides and traits.

TYPES OF FEEDING INJURY

A. Feeding injury by young larvae - Growth stages L1, L2, and L3

Damage to maize plants:

Young larvae feed on the surface on one side of the leaf on small irregular-shaped or elongated patterns, leaving the opposite epidermal layer of the leaf intact, a type of feeding injury often referred to as "window pane" damage.

Importance:

Window-pane feeding injury does not lead to economic yield loss.

- Learning to recognize early signs of fall armyworm feeding is critical when managing this pest in maize.
- Most effective economic thresholds for fall armyworm in maize are based on a visual estimation of feeding damage by young larva.

B. Feeding injury by older larvae - Growth stages L4, L5 and L6

Damage to maize plants:

Larger larva consumes more tissue. Stronger mandibles allow them cut large chunks of plant tissue and consume hard plant structures

- Larger larvae feed on most above-ground parts of the maize plant including seedlings, foliage, tassels, cobs, husks, and developing kernels.

Importance:

If not controlled, feeding injury at this stage may lead to severe yield loss and crop destruction.

C. Plant defoliation

Most common and visible feeding behavior during maize vegetative stages.

- During mid-season infestations (maize vegetative stage), larvae feed inside unfurled whorl leaves, leaving large amount of brown-colored frass (larva excrement) behind.
- Large amount of larval frass accumulate at the entrance of the unfurled whorl leaves, protecting larvae from predators and from the action of most common insecticide sprays.
- When whorl tissue is destroyed, larvae start

feeding on expanded leaves, consuming large amounts of tissue along the leaf blade.

- Severe, non-controlled infestations result in ragged plants, stunted plant development, destruction of growing points and reproductive tissue, and complete plant destruction.
- Large, protected larvae are difficult to control and reaching this level of damage across a maize field leads to significant yield loss.

D. Tassel feeding

This feeding behavior occurs when maize plants begin reproductive stage.

- Larvae feed and destroy the unopened, developing tassel before pollen shedding.
- Causes tassel loss, uneven tassel emergence and significant pollination issues.

E. Ear feeding

Occurs later in the crop season under high pest population densities.

- Large larvae feed on all ear parts with preference on developing kernels, but also feed on husk leaves, silk, cob and even stalks.
- Causes direct impact on grain yield and quality.
- Secondary fungal contamination results in significant quality loss and severe food safety issues.

F. Seedling cutting

Occurs when larvae are present at plant emergence.

- Common in tropical regions where warmer weather allows sequential maize plantings. Mid to large larvae migrate from a maturing crop to a new emerging crop.
- It also occurs when fall armyworm larval populations survive on host weeds in and around new crops, eventually migrating to maize once plants start to emerge.
- Larvae cut off leaves and stem above soil level, similar to cutworm damage.
- Causes drastic plant stand reduction. Complete destruction (100%) of newly emerging maize crop reported in tropical areas.

- Larvae are active at night, hiding under plant residues and weeds during daytime to avoid predators.

FALL ARMYWORM MANAGEMENT

1. Integrated pest management (IPM) for fall armyworm

IPM is the use of a combination of multiple tactics with the goal of suppressing pests below economic levels and to avoid pest outbreaks.

IPM tactics, if used as a combination of Best Management Practices (BMPs) and Insecticide Resistance Management (IRM), can make pest control economical and sustainable.

2. Preventative and Avoidance: Regulatory strategies

Tactics to prevent or avoid the arrival of the pest to a particular area

The spread of fall armyworm across large regions is facilitated by its high-migratory behavior and by international trade and human travel.

Regulatory control refer to the role played by multiple government agencies in conjunctions with other regulatory agencies and governments to stop the spread of fall armyworm via inspection, quarantine, and destruction of infested material.

It includes the critical role of governments in implement scientific review panels and streamlined processes to review and approve new tools to manage the fall armyworm in a new country.

3. Preventative and Avoidance: Cultural methods

Manage to enable a healthy maize crop, minimizing plant stress and avoiding crop or field characteristics that invite fall armyworm infestations:

Early planting to avoid heavier pest densities in late season.

Weed management-Eliminate weed hosts that sustain larval populations before their migration to a new maize crop.

Avoid adjacent sequential planting to prevent migrations of larvae from a maturing crop to new fields.

Avoid plant stress – Proper fertilization, irrigation, cultivation, etc. Healthier plants tend to recover faster and recover from some yield loss.

Crop rotation – This is limited to a farmer's flexibility to plant a non-host crop, if available, or a crop where fall armyworms are not important pest problems.

4. Monitoring and Scouting: Monitor adult populations

Activities to monitor and detect an infestation for prompt action using threshold levels.

Track the flight migration of fall armyworm adults to allow growers prepare ahead of a potential infestation.

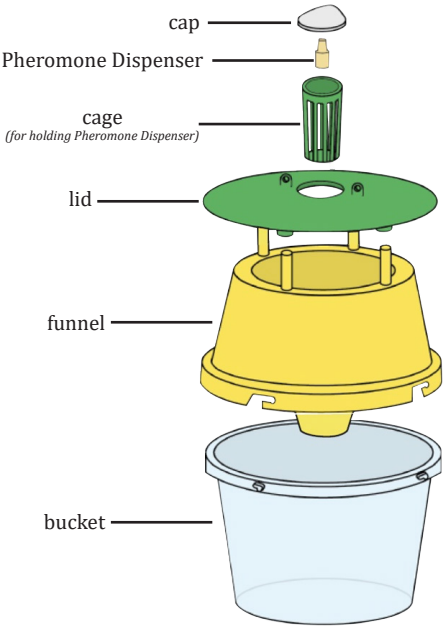
Adult pheromone trapping:

Pheromones are volatile natural molecules produced by insects. They stimulate a behavioral response from individuals of the same species.

Pheromone communication is effective in fall armyworm to attract members of the opposite sex.

Synthetic pheromones or lures are compounds that mimic natural pheromones. They are used extensively in traps to attract adult male moths.

Research data indicates the green lid/yellow funnel/white bucket unitrap is one of the most efficient trapping methods for adult fall armyworm.



Green lid/yellow funnel/ white bucket unitrap

BUREAU OF PLANT INDUSTRY AND DA-BICOL'S FALL ARMYWORM MANAGEMENT

BUREAU OF PLANT INDUSTY

The Bureau of Plant Industry is currently coordinating/implementing the National Fall Armyworm Action Plan, with the following activities:

- ☑ **Quarantine inspection and disinfestation at the ports** *(sea, air, land)*
- ☑ **Cultural management strategies** *(seed treatment, synchronous planting, weed management, plow-under after harvest, intercropping, crop rotation)*

- ☑ **Monitoring and detection** *(use of pheromone lures/traps)*
- ☑ **Scouting and validation**
- ☑ **Awareness and capability building** *(information dissemination, trainings, coordination with LGU partners, farmers and other stakeholders)*
- ☑ **Use of biological control agents and lures**
- ☑ **Use of organic and inorganic pesticides**
- ☑ **Research and development**

Source: Report of first detection of Fall Army Worm (FAW) in the Republic of the Philippines Retrieved from: (https://www.ippc.int/en/countries/philippines/pestreports/2019/10/report-of-first-detection-of-fall-army-worm-faw-in-the-republic-of-the-philippines/)

Department of Agriculture Bicol Regional Quick Response Team (RQRT)
for Fall Armyworm and other Plant Pests and Diseases

1. **Coordinate with Local Government Units (LGUs)**
2. **Conduct initial investigation in the event of pest infestation;**
3. **Identify priority areas which are at risk for plant and pest disease infestation;**
4. **Submit weekly reports of incidence and Pest Infestation Surveillance Form to the database/GIS Team;**
5. **Institute proper infestation control measures;**
6. **Prepare action and contingency plan;**
7. **Provide necessary resource and response capabilities;**
8. **Maintain updated planting database; and**
9. **Mapping of standing crops**

REGIONAL CROP PEST MANAGEMENT CENTER-BICOL

- ☑ **Provision of chemicals**
- ☑ **Physical and chemical control**
- ☑ **Chemical application**
- ☑ **Spray insecticides**
- ☑ **Late afternoon application of insecticide on infected areas**
- ☑ **Early morning spraying of systemic insecticide**

Source: Rice Crop Pest Management Center FAW Monitoring Report

REGIONAL QUICK RESPONSE TEAM (RQRT)
FOR FALL ARMYWORM AND OTHER PLANT PESTS & DISEASES

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Sources:

>Bureau of Plant Industry Pest Management Advisory
>Rice Crop Pest Management center FAW Monitoring Report
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"A food-secure and resilient Philippines with prosperous farmers and fisherfolk"

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