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MEMORANDUM

TO: **REGIONAL EXECUTIVE DIRECTORS**
Regions 1-12, CAR, CARAGA, BARMM, BPI Center Chiefs, NPQSD, NSQCSD, CRPSD

FROM: **GEORGE Y. CULASTE**
OIC-Director

DATE: **May 9, 2019**

SUBJECT: **PEST ADVISORY ON FALL ARMYWORM (*Spodoptera frugiperda*), FAW**

In view of the continuous and rapid spread of Fall Armyworm (FAW) in our neighboring countries and since the Philippine climatic condition is conducive to the preference of the devastating pest you are hereby advise to alert your staff to engage in pest surveillance. You are also advise to closely monitor the pest by conducting detection survey in your respected regions to determine its presence for immediate management.

Attached are pertinent information and possible management strategies for your information and immediate action.

GEORGE Y. CULASTE
OIC-Director
Bureau of Plant Industry

May 09, 2019

PEST MANAGEMENT ADVISORY

FALL ARMYWORM
Scientific Name: *Spodoptera frugiperda*

Overview and Importance

Fall Armyworm, *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae) is native to the Americas. Fall armyworm caterpillars are major pests of cereals and forage grasses and are recorded as eating 186 plant species from 42 families (Casmuz Augusto 2010). Fall armyworm is the most serious pests of maize in the America. Yield losses can reach 40% in Honduras (Wyckhuys and O'Neil 2006) and 72% in Argentina (Murua et al. 2006). In addition to maize, fall armyworm attacks many other economically important crops, e.g. rice, sugarcane, sorghum, beet, tomato, potato, cotton and pasture grasses (Abrahams et al. 2017; Day et al. 2017). Therefore, fall armyworm could pose a risk to subsistence and cash crops in large parts of the world.

Fall armyworm is reported in Africa in 2016, followed by an alarming distribution across the African continent. It was also reported in India and several Asia Pacific countries; Bangladesh, Nepal, Myanmar, Thailand and China. Fall armyworm poses a threat outside its range particularly in temperate regions because adult armyworm can travel several hundred kilometers in a single by flying to and maintaining an elevation of several hundred meters, at which height winds can transport them in a directional manner (Westbrook et al. 2016). As per report in Thailand, fall army worm spread-out in their country in just four (4) months.

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.
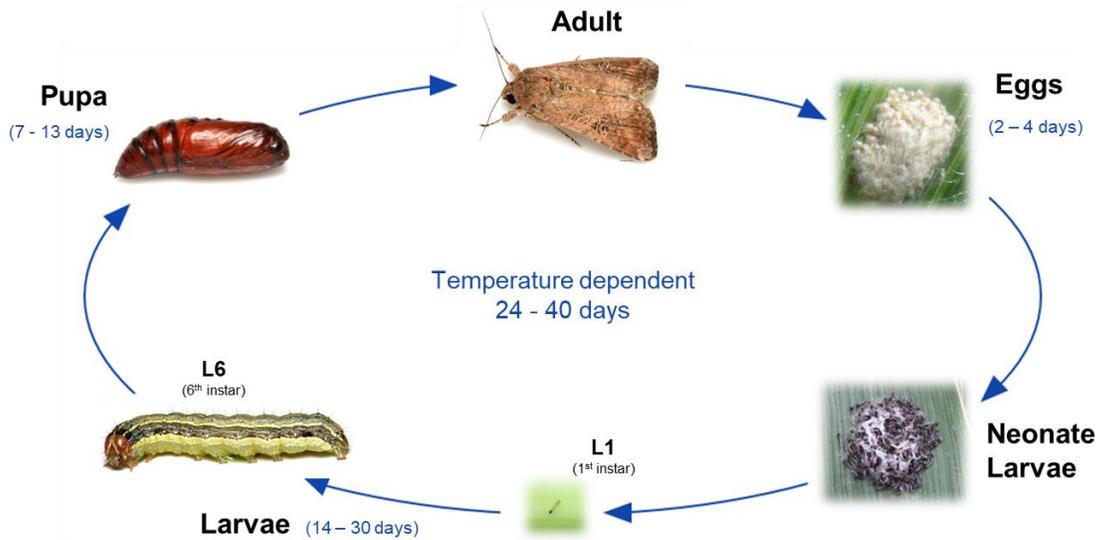
Destructive Stage: Larva
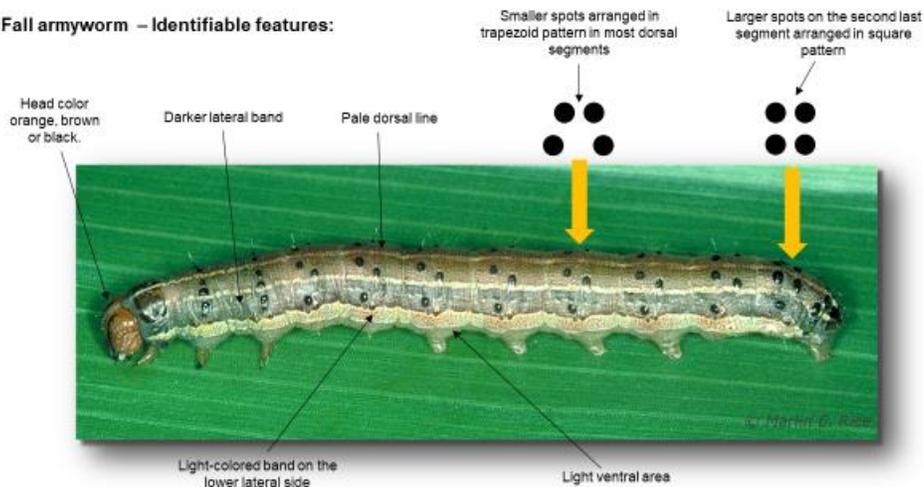

Fall armyworm larva

Host plants

- Polyphagous pest, reported on 353 plant species in 76 plant families.
- It has a preference for grasses such as maize, sorghum, millet, sugarcane, and grassy weeds with a marked strong preference for sweet maize and baby maize.
- Two known fall armyworm strains*, morphologically similar but with different host range, mating behavior and pheromone compositions:
  - ✓ Maize strain - Prefers maize, cotton, sorghum, etc.
  - ✓ Rice strain – Prefers rice and pasture grasses such as Bermuda grass and Johnson grass.
- Both strains are capable of cross-hybridization in the field, which may explain a lack of "purity" of strains with respect to their host. Both strains occur in Africa on maize:
  - ✓ Most larvae tested from Africa were 72% rice strain, yet ALL were collected from maize*.
- Other important crops affected include cotton, soybean, wheat, barley, alfalfa, peanut, oat, clover, tobacco, etc. Vegetable crop hosts include tomato, potato, cabbage, lettuce, beet, onion, etc. It also feeds on apple, grape, peach, papaya, orange, numerous ornamental crops, etc.

Life cycle

Pupa (7 - 13 days) → **Adult** → **Eggs** (2 – 4 days) → **Neonate Larvae** → **L1** (1st instar) → **Larvae** (14 – 30 days) → **L6** (6th instar) → Pupa

Temperature dependent 24 - 40 days

Identification of Larva

Fall armyworm – Identifiable features:

- Head color orange, brown or black.
- Darker lateral band
- Pale dorsal line
- Smaller spots arranged in trapezoid pattern in most dorsal segments
- Larger spots on the second last segment arranged in square pattern
- Light-colored band on the lower lateral side
- Light ventral area

Fall armyworm: Identifiable body marks

- Smaller spots arranged in trapezoid pattern in most dorsal segments
- Larger spots on the second last segment arranged in square pattern

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Fall armyworm: Identifiable head features

Upside down white "Y" on dark head

Fall armyworm: The two most common features used for identification

1. Large spots on the second last segment arranged in square pattern

2. Upside down white "Y" on dark head
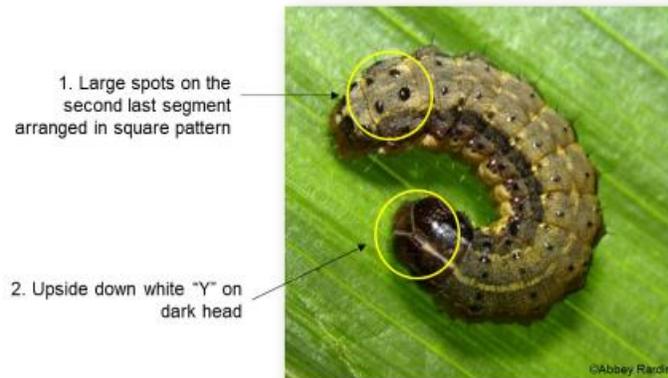
TYPES OF FEEDING INJURY

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

An integrated pest management approach

Effective fall armyworm management requires multiple approaches, including:

- Tactics to prevent or avoid the arrival of the pest to a particular area (preventative and avoidance).

- Activities to monitor and detect an infestation for prompt action using threshold levels (monitor and scouting).

- Actions to suppress and control the pest once it is detected in a field (suppression and control).

The highly migratory behavior of this pest means that effective and sustained control requires **area wide management implementation**:

- Extensive training and communication campaigns.

- Commitment from all stakeholders (growers, industry, government, researchers, academia, crop advisors, etc.)

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.

Preventative and Avoidance: Regulatory strategies

- 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

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.

Monitoring and Scouting: Monitor adult populations

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.

Importance:

- Pheromone traps alert growers of the arrival of fall armyworms adults to an area.
- An increase in adult fall armyworm trapping does not trigger an insecticide application and should not be used as an action threshold. However, this information helps farmers understand when to increase field scouting.

Notes:

- There are numerous lures and trap designs for fall armyworm. Instructions for use vary by manufacturer. It is important to standardize trapping methods when the intention is to use for community-wide forecasting.
- Adult data collected over several season provide an indication of when peak adult trapping are normally expected to occur in an area.
- When handling lures, wear disposable rubber gloves or wash your hands immediately. Not doing so may cause contamination of bait stations.
- Do not leave used lures or lure wrappings near traps. The small amount of lure left in them may compete with baited traps.
- Never place more than one lure at a time in a trap.

Monitoring and Scouting: Field scouting

Designed to detect fall armyworm presence in a field and assess feeding damage

- Field scouting is one of the most important activities a farmer can do to manage infestations based on informed decisions.
- It consists of entering the maize field and looking for presence of fall armyworm eggs, larvae, etc. and feeding signs.
- Relies on the ability to identify correctly the fall armyworm, understand its biology and behavior and recognize early feeding.
- It helps farmers understand ecological factors that favor or delay a potential infestation such as natural insect mortality, plant stressors, alternate hosts, plant phenology, etc.
- Fields should be "scouted" at a minimum of once per week or more often when conditions favor infestations, e.g. field entering vegetative stage, increase in male moth trapping, presence of egg masses, etc.

REFERENCES

- CORTEVA Agriculture Division of DowDupont

- Croplife Philippines

- Food and Agriculture Organization

- https://www.researchgate.net/publication/328848240_Forecasting_the_global_extent_of_invasion_of_the_cereal_pest_Spodoptera_frugiperda_the_fall_armyworm