Food and Agriculture Organization of the United Nations

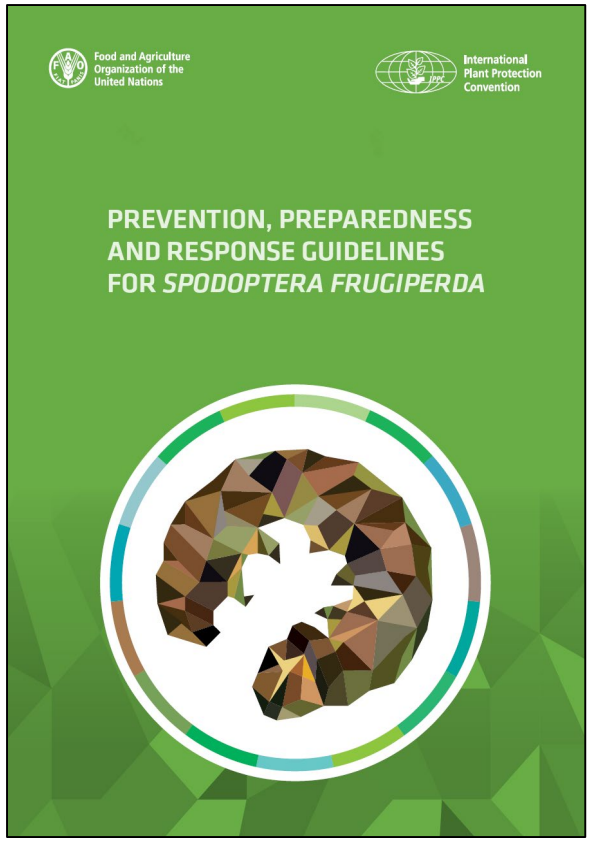
International Plant Protection Convention

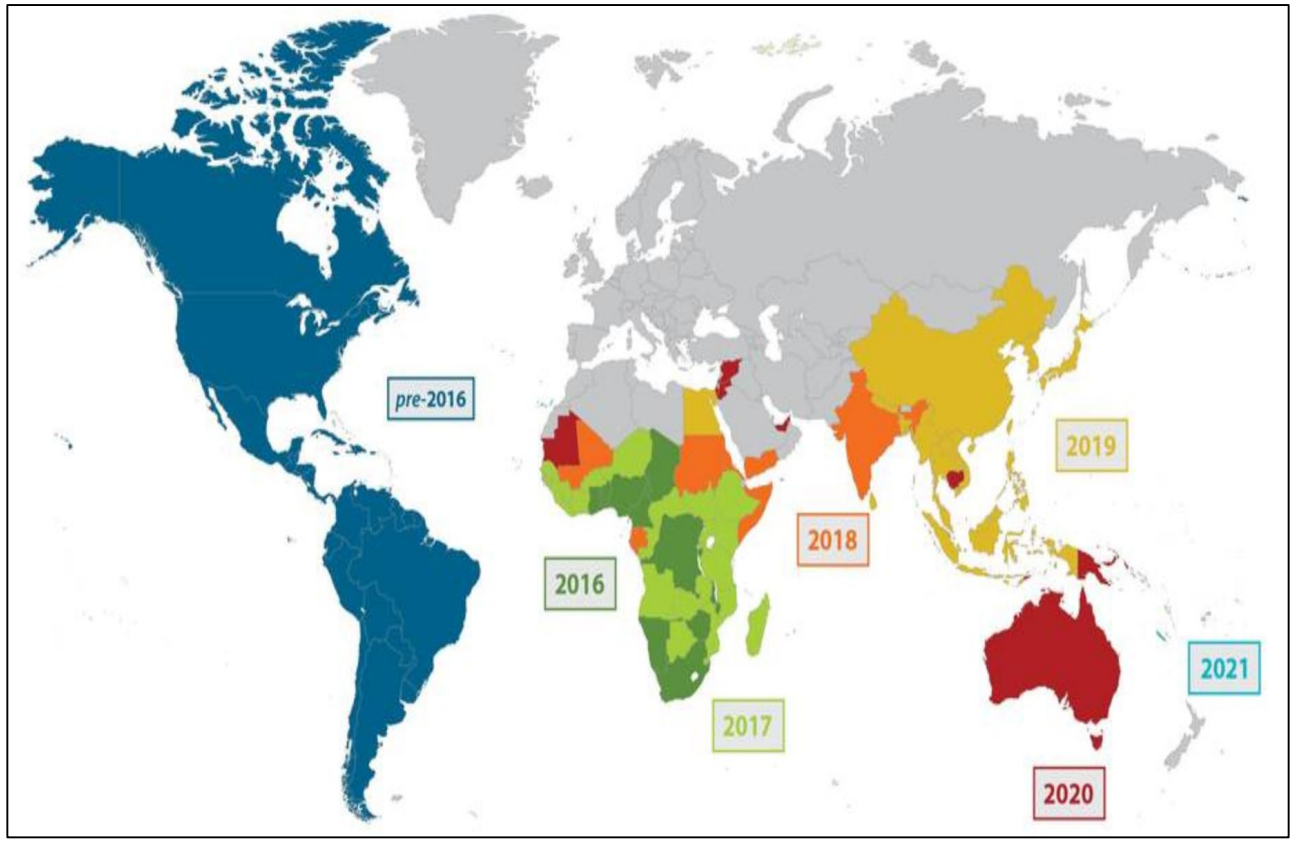
FAO/IPPC Fall Armyworm Guideline Webinar Workshop Series

Webinar Series: Fall Armyworm, a global threat to prevent

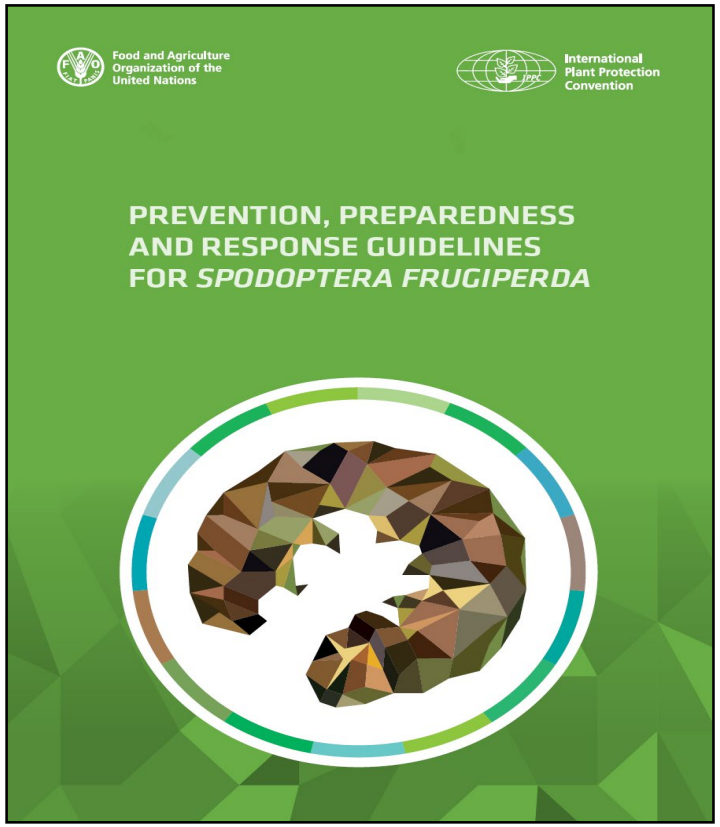
Delimiting Surveillance for Fall Armyworm- Chris Dale, FAW TWG Surveillance Lead

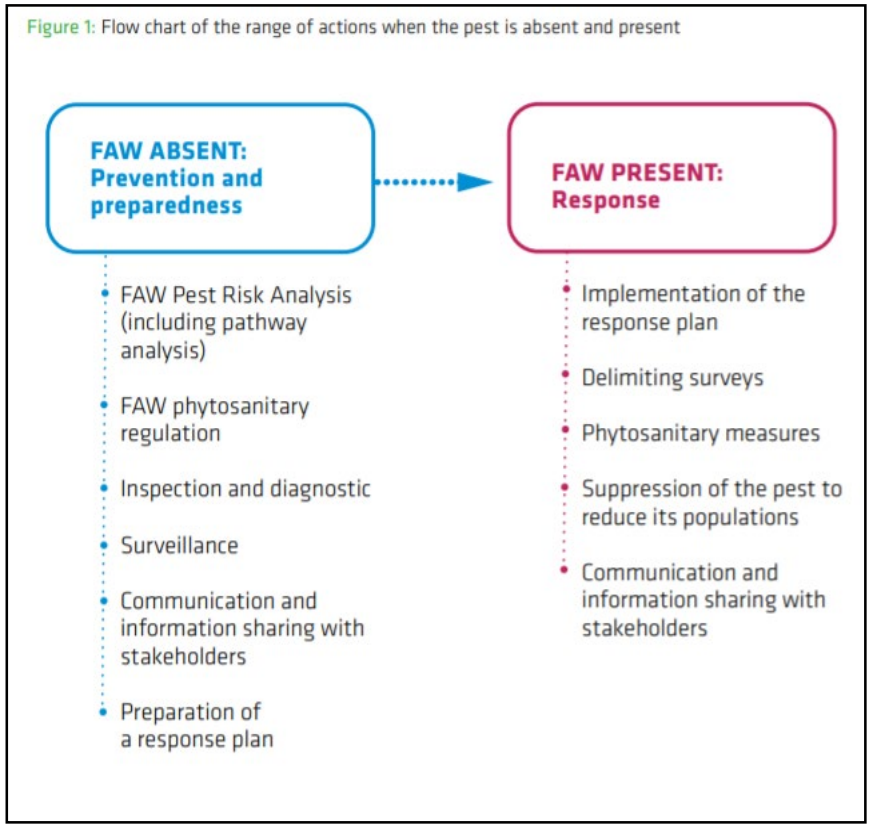
Delimiting Surveillance for Spodoptera Frugiperda





Fall Armyworm Prevention, Preparedness and Response Guidelines Surveillance Technical Resources





Sections 2.4 / 3.1

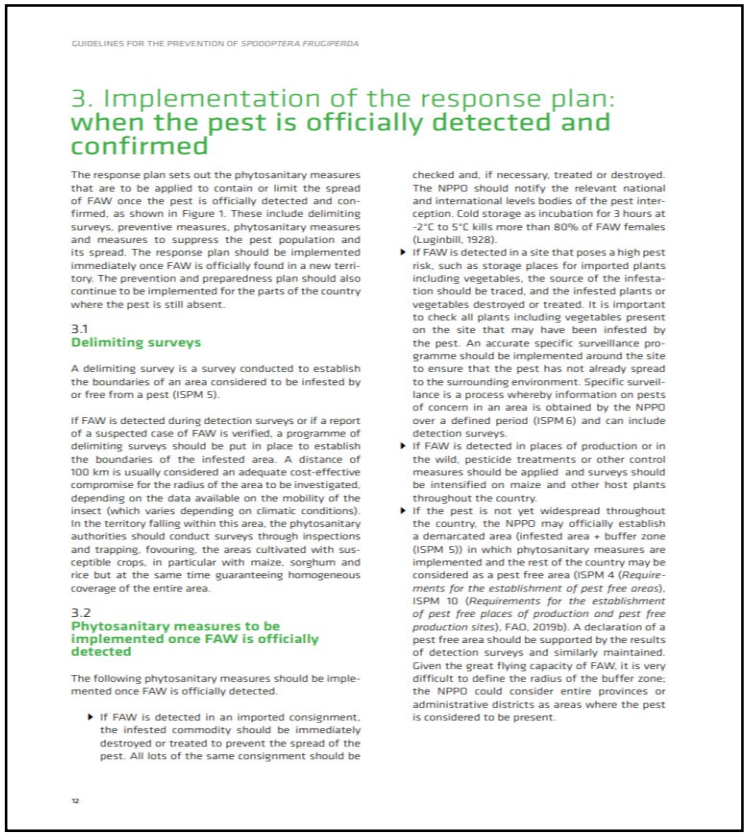
FAW Delimiting Surveillance

- Host range and part of host affected
- Symptoms and pest damage
- Delimiting Surveillance
- Trapping and lures
- Visual Examination
- Survey locations
- Survey timing and frequency
- General surveillance
- FAMEWS mobile app

https://www.fao.org/documents/card/en/c/cb5880en

Fall Armyworm Guideline – Section 3.1 Delimiting Surveillance

- A **delimiting survey** is a survey conducted to establish the boundaries of an area considered to be infested by or free from a pest (ISPM5).
- A distance of 100 km is usually considered an adequate cost-effective compromise for the radius of the area to be investigated.
- NPPO's should conduct surveys through inspection and trapping, favouring areas of susceptible crops but also guaranteeing homogenous coverage of the area.



GUIDELINES FOR THE PREVENTION OF *SPODOPTERA FRUGIPERDA*

3. Implementation of the response plan: when the pest is officially detected and confirmed

The response plan sets out the phytosanitary measures that are to be applied to contain or limit the spread of FAW once the pest is officially detected and confirmed, as shown in Figure 1. These include delimiting surveys, preventive measures, phytosanitary measures and measures to suppress the pest population and its spread. The response plan should be implemented immediately once FAW is officially found in a new territory. The prevention and preparedness plan should also continue to be implemented for the parts of the country where the pest is still absent.

3.1 Delimiting surveys

A delimiting survey is a survey conducted to establish the boundaries of an area considered to be infested by or free from a pest (ISPM 5).

If FAW is detected during detection surveys or if a report of a suspected case of FAW is verified, a programme of delimiting surveys should be put in place to establish the boundaries of the infested area. A distance of 100 km is usually considered an adequate cost-effective compromise for the radius of the area to be investigated, depending on the data available on the mobility of the insect (which varies depending on climatic conditions). In the territory falling within this area, the phytosanitary authorities should conduct surveys through inspections and trapping, favouring, the areas cultivated with susceptible crops, in particular with maize, sorghum and rice but at the same time guaranteeing homogeneous coverage of the entire area.

3.2 Phytosanitary measures to be implemented once FAW is officially detected

The following phytosanitary measures should be implemented once FAW is officially detected.

- If FAW is detected in an imported consignment, the infested commodity should be immediately destroyed or treated to prevent the spread of the pest. All lots of the same consignment should be checked and, if necessary, treated or destroyed. The NPPO should notify the relevant national and international levels bodies of the pest interception. Cold storage as incubation for 3 hours at -2°C to 5°C kills more than 80% of FAW females (Luginbill, 1928).
- If FAW is detected in a site that poses a high pest risk, such as storage places for imported plants including vegetables, the source of the infestation should be traced, and the infested plants or vegetables destroyed or treated. It is important to check all plants including vegetables present on the site that may have been infested by the pest. An accurate specific surveillance programme should be implemented around the site to ensure that the pest has not already spread to the surrounding environment. Specific surveillance is a process whereby information on pests of concern in an area is obtained by the NPPO over a defined period (ISPM 6) and can include detection surveys.
- If FAW is detected in places of production or in the wild, pesticide treatments or other control measures should be applied and surveys should be intensified on maize and other host plants throughout the country.
- If the pest is not yet widespread throughout the country, the NPPO may officially establish a demarcated area (infested area + buffer zone (ISPM 5)) in which phytosanitary measures are implemented and the rest of the country may be considered as a pest free area (ISPM 4 (*Requirements for the establishment of pest free areas*), ISPM 10 (*Requirements for the establishment of pest free places of production and pest free production sites*), FAO, 2019b). A declaration of a pest free area should be supported by the results of detection surveys and similarly maintained. Given the great flying capacity of FAW, it is very difficult to define the radius of the buffer zone; the NPPO could consider entire provinces or administrative districts as areas where the pest is considered to be present.

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https://www.fao.org/documents/card/en/c/cb5880en

Fall Armyworm Guideline – Section 2.4 Surveillance Technical Guidance

fication of FAW. Larvae of (primarily) Poaceae-feeding species, like *S. cilium*, *S. exempta* and *S. mauritia*, *S. exigua* but also *S. ornithogalli*, are easily confused with *S. frugiperda*. Larvae of several other noctuid genera, for instance *Agrotis*, are highly similar to *S. frugiperda*. Early larval stages of most other noctuid species are very difficult to distinguish morphologically from those of FAW.

2.4 Surveillance

Surveillance is an official process which collects and records data on pest presence or absence by survey, monitoring or other procedures (ISPM 5). ISPM 6 (*Surveillance*) and the IPPC guide on *Plant pest surveillance* (FAO, 2016b) are useful general references to be consulted. EFSA Pest survey card on *Spodoptera fugiperda* (EFSA, 2020) could also be consulted.

Host range and part of host affected

Fall armyworm is extremely polyphagous. A recent review suggests it has been recorded on over 350 host species from more than 75 families, although it prefers for monocotyledons, mainly Poaceae, and also for Asteraceae and Fabaceae (Montezano *et al.*, 2018). A detailed host list is provided by EPPO (2020c). Fall armyworm causes substantial damage to crops of maize, rice, sorghum, cotton (*Gossypium* spp.), soybean (*Glycine max*) and sugarcane (*Saccharum officinarum*) around the world and its range extends to potatoes (*Solanum tuberosum*), tomatoes (*Solanum lycopersicum*), cucurbits (Cucurbitaceae) and several other vegetable and fruit crops (Casmuz *et al.*, 2010). Damage can severely reduce production, particularly when FAW is present in high population numbers. Fall armyworm can be found on almost all types of commodities of plants or above-ground plant parts. Fruits can also be infested by eggs or, more often, by larvae. Young seedlings are usually targeted as larvae emerge at the beginning of the growing season, but mature plants are also attacked as larvae age. Larvae begin feeding in the whorl and feeding extends to leaves, stems and reproductive parts; larger larvae may cut the plant at the base. Effects on plants in the natural environment are less well known.

Symptoms and pest damage

The larval stage is the only life stage that causes crop damage. Feeding begins after hatching, though the damage from young larvae on leaves is superficial. The larvae are mainly external feeders, especially in or on young plants, while later-instar larvae can completely destroy all plant parts including stems, branches, leaves and reproductive structures (Czepak *et al.*, 2019; EPPO, 2020a). In Zea mais, as the larvae move into the whorl they begin feeding more, and as they develop they skeletonize the leaves. If the plant is older, larvae may travel to the cob or fruit and feed on the developing seeds. It is noteworthy that plant damage due to FAW infestation does not necessarily result in yield loss; pest injury can be inflicted to a certain degree without resulting in significant loss in yield (Juarez, Twigg and Timmermans 2004). In addition, plant damage incurred at some growth stages does not translate to yield loss.

Symptoms of the presence of larvae are holes in fruits or leaves along with the presence of excrement. Early stages are likely to be found by scraping the epidermis of the underside of the leaves, but this is not always the case: for instance in cut flowers such as rose, larvae tend to migrate to the flowers very soon after hatching. Symptoms caused by the larvae are not specific to *Spodoptera* but are generic for most, primarily foliage-feeding, lepidopteran species. Under natural conditions, pupation takes place in the soil where the pupae are difficult to detect. However, pupae can occasionally be found in commodities without soil, since fully grown larvae will always pupate, regardless whether or not soil is present.

Recovery of plants is dependent on FAW population numbers, but where infestation is high, the damage from larvae is often too extensive and plant death is common. In maize, FAW destroys silks and tassels, limiting the plants' ability to fertilize. Damage in a field attacked by FAW has been compared to that of hailstorm damage (CABI, 2019a) and feeding damage will often lead to secondary infections such as from fungi.

The FAW Monitoring and Early Warning System (FAMEWS) app and global platform provides a way to pool and visualize surveillance information (see below).

Detection surveys

A detection survey is a survey conducted in an area to determine if pests are present (ISPM 5). Detection surveys should be conducted regularly to rapidly identify individuals or populations of FAW which have been accidentally introduced or have spread naturally.

These detection surveys can be conducted by collecting FAW samples by trapping or visual inspections for identification.

There are many FAW surveillance protocols available; for example, the FAO and CABI (2019b) instructions, the protocols outlined by Kearns *et al.* (2020), and the EFSA FAW surveillance guidelines (Kinkar, Delbianco and Vos, 2020) that detail specific objective-oriented considerations. The Australian Government provides detailed operational instructions on selecting a site, placing and maintaining a trap, submitting samples and managing data (Britton and Greenwood, 2020; see also Government of Western Australia, 2018). Field scouting protocols can also be found in the FAO Farmers Field Schools guide for FAW management (FAO, 2018).

Adults of *S. frugiperda*, specifically females but also 'older' males having lost part of the scales, have a non-descript external appearance. They may be overlooked easily if mistaken for common noctuid species, especially in areas where the presence of *S. frugiperda* is not (yet) expected. This may hamper early detection in the field, if growers are not aware of the possible introduction of S.frugiperda (e.g. through natural dispersal). Together with the fact that also the larvae are easily misidentified, this is the reason why surveying with pheromone traps in areas neighbouring areas where *S. frugiperda* is present is extremely important.

Trapping

In the field and in production-, storage-, handling- and other facilities, adults can also be detected with the aid of light traps and pheromone traps. Pheromone traps allow adult males to be caught, although this may include non-target species. Light traps are species-nonspecific and catch both female and male adults.

Sensitivity and specificity. Trap–lure combinations can differ significantly in both sensitivity and specificity, depending on strain and geographical variation within FAW populations. Intraspecific variation in FAW is well recognized and there are corresponding strong, intraspecific variations in the composition and response to pheromones. This became apparent in central and South America, when there were poor responses to traps containing lures from North America (Andrade, Rodriguez and Oehlschlager, 2000; Malo *et al.*, 2001).

Subsequent sex-pheromone characterization has revealed considerable differences between North and South American populations (Batista-Pereira *et al.*, 2006), and lure compositions have been adjusted for use in these regions. Recent research from populations in Togo has also shown differential responses to trap–lure combinations (Meagher *et al.*, 2019).

Given this variability, it may be necessary to conduct field trials of trap–lure combinations for early detection to optimize trapping success for previously unmonitored populations. These trials should be carried out in areas where the pest is already present, and therefore this information can be used for early detection in areas that are still free of the pest.

Lures. Although FAW lure composition varies, it can be refined easily within known populations through comparative studies. All lure types trialled for FAW in various studies around the world have captured FAW moths, but the efficiency has varied and as an early-detection indicator in low populations this efficiency may be crucial to meeting programme objectives. These lures cannot be used for in-crop monitoring. Because there would not be a correlation between the number of moths trapped adjacent to a host crop and intensity of FAW infestations in the crop. Ref: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0089255

Lures should be replaced every three to five weeks, depending on the weather as heavy or prolonged rain or strong winds may degrade the lures' efficacy faster. Lures are dispensed on a rubber septum, which is hung in the selected trap design and pierced to release the pheromone.

Traps. The trap height is commonly 1.5 m but always just above the canopy level of the grasses. Traps are placed at a minimum of 20 m apart for monitoring. Most trap types are likely to be suitable during the dry season. However, to be effective across seasons they must also be durable during the high rainfall events of the wet season, which is when high numbers of moths are likely to be present. The trap types described below have been used successfully in various places around the world, but durability and cost vary. Both trap type and lure composition influence by-catch numbers. Overall bucket traps (preferably yellow – Gilson *et al.*, 2018) are the most suitable for FAW monitoring and delta traps are the most effective for FAW detection surveys. However, the design of the trap is very likely to need refining to withstand high rainfall events.

Visual examination

Visual examination is an examination using the

unaided eye, lens, stereoscope or other optical microscope (ISPM 5).

The larvae of FAW are nocturnal and commonly feed deep in the parts of plants where they cannot be easily seen, making visual surveillance time-consuming. Nevertheless, the plants should be examined visually for FAW if any of the following conditions apply:

- the damage includes skeletonizing of leaves or large borer-type holes;
- the damage occurs overnight;
- the damage occurs after rainfall or irrigation events.

The damage caused by FAW is not specific to this species but is similar to that of other foliage-feeding lepidopterans. Nevertheless, when FAW is present, large amounts of frass that resembles sawdust when dry are obvious and skeletonizing of leaves is common. Depending on the crop, surveillance may require plant parts such as new leaves to be pulled apart; in maize, for instance, the whorl, ear, cob and tassels should be examined for damage.

Survey locations

Trapping surveys for FAW should be conducted in regions where the pest has not been detected previously and could establish (endangered areas according to the PRA conducted) or in regions where migratory populations can be expected. This can be supported by surveillance in those parts of the region with susceptible crops. If entry of FAW is thought to be most likely by human action (travel, trade), surveys should concentrate on points of entry of freight and travelers. Countries bordering on countries/areas where FAW is present, and if natural spread is thought to be most likely, surveys should concentrate on the border area. Also locations where imported commercial commodities may be handled, selected or repacked, and inferior quality may be discarded pose a higher risk for entry.

Survey timing and frequency

According to the best estimates for entry by natural pathways, winds blowing FAW adults into an area are most likely to occur during the wet season in tropical areas. However, FAW is likely to reproduce all year round in tropical areas and is likely to take advantage of wet microclimates, including irrigated areas, during the drier months. Trapping surveillance in tropical areas should therefore be conducted all year long, although trapping may be periodic, rather than continuous, depending on logistical constraints. Visual surveillance should coincide with the growing season and high rainfall or irrigation events.

In cooler regions where seasonal incursions are expected, trapping and visual surveillance should coincide with migratory patterns in the FAW populations.

General surveillance

In addition to detection surveys, useful information on FAW presence can also be obtained by conducting general surveillance. General surveillance is a process whereby information on pests of concern in an area is gathered from various sources (ISPM 6). A citizen-science programme may be coordinated to encourage relevant stakeholders and the general public to watch out for FAW, as done in Australia. Simple FAW identification and information resources may be provided to importers, growers and home gardeners to encourage them to report suspected cases of FAW and hence help authorities to identify and report FAW incursions (e.g. Australian Government, 2020). See also section 2.5. More detailed information and training programmes should be offered to those involved in the production and handling of herbaceous and horticultural crops to promote and support the reporting of cases of suspected FAW presence.

The FAMEWS mobile app

The FAW Monitoring and Early Warning System (FAMEWS) mobile app (FAO, 2020a) is an application provided by FAO for smartphones. It can be used as a tool in both detection and delimiting surveys (see section 3.1), and could be used every time a field is scouted and pheromone traps are checked for FAW. It also allows surveillance information to be pooled and visualized.

The app has the following parts:

- data entry – to collect, record and transmit:
  - basic farm data
  - scouting data (collected manually or using artificial intelligence)
  - trap data
  - immediate advice from field officers to stakeholders (farmers, growers, industry representatives);
- integrated pest management (IPM) education;
- digital library;
- chat to share experiences;
- expert resources.

https://www.fao.org/documents/card/en/c/cb5880en

When FAW has been officially detected and identified in a country, NPPO delimiting actions should include;

- Conducting **specific surveillance** by delimiting surveys for FAW, based on visual examination and the use of pheromone lures and traps.

- Conducting **general surveillance** through public education and awareness-raising initiatives addressed to stakeholders, particularly maize producers as maize is the most attractive crop for FAW.

2. FIND

Knowing when and how to look for signs of FAW

1. Early detection is critical to ensure effective timing of control measures.
2. The first indicators of FAW arrival in your area is the presence of migrating moths in Zones 2 and 3 and the emergence of adult moths from pupation in Zone 1 and 2.
3. Use pheromone-baited traps, suspended at canopy level, to detect early moth arrival and activity in the region in accordance with APVMA permit requirements.
4. There are a number of commercially available bucket or pheromone traps (Figure 2) that attract male adult FAW. These can be sourced together with lures and insecticide cubes online *via* retailers. Not an exhaustive list, but some examples include Bugs for Bugs, www.bugsforbugs.com.au/product/bucket-trap and Grochem Australia, www.au.grochem.com
5. Place a dry cellulose sponge in the bottom of the trap to absorb rainwater that may enter the trap, keeping the moths reasonably dry.
6. Consider establishing a trapping and reporting network with neighbours to detect and record the spread of FAW into new regions. Sharing information between growers and agronomists can provide an early-warning of fall armyworm activity and trigger crop monitoring.
7. Traps are best suited to signalling the arrival of significant peaks or influxes in moths over broad areas. They are unreliable indicators of level of egg-laying intensity or infestation of nearby crops. Scouting is required to determine egg-laying intensity (percent infested plants).

Figure 2. A) Bucket or pheromone trap; B) FAW adult male captures; C) Insecticide strips to kill adult moths

8. Conduct crop scouting regularly when pest migration is imminent. At least fortnightly at vegetative stage and increase to weekly if larvae are detected.
9. Early detection of FAW larvae before they become entrenched in the crop (e.g. whorl of maize, sweet corn or grain sorghum) or before they become later instars is essential for effective management.
10. Using a repeatable pattern, scout entire crops for FAW eggs and larvae as during early infestation (or directly after egg hatch) they are often unevenly distributed and can be confined to small patches within the crop (Figure 3).

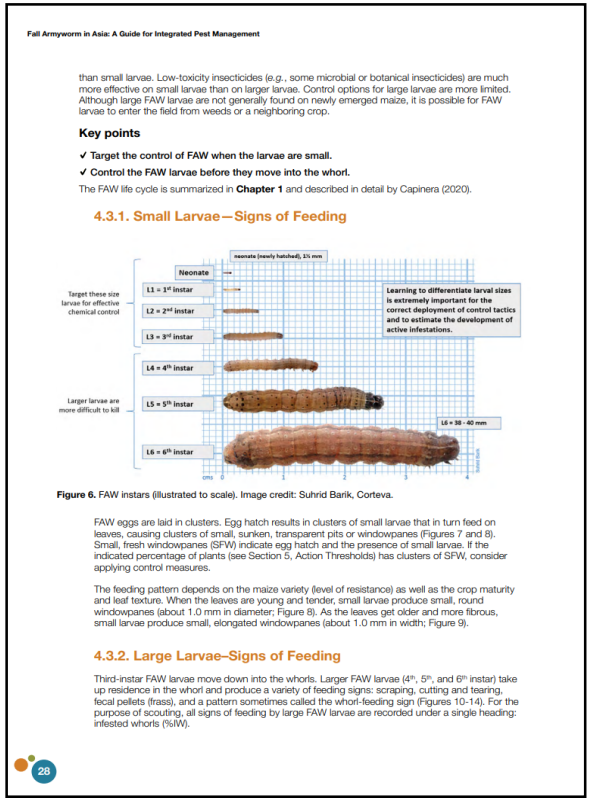
FALL ARMYWORM CONTINUITY PLAN – GRAIN | PAGE 5

https://www.planthealthaustralia.com.au/wp-content/uploads/2020/11/Fall-Armworm-Continuity-Plan-2.pdf

National Level Delimiting Surveillance of Fall Armyworm

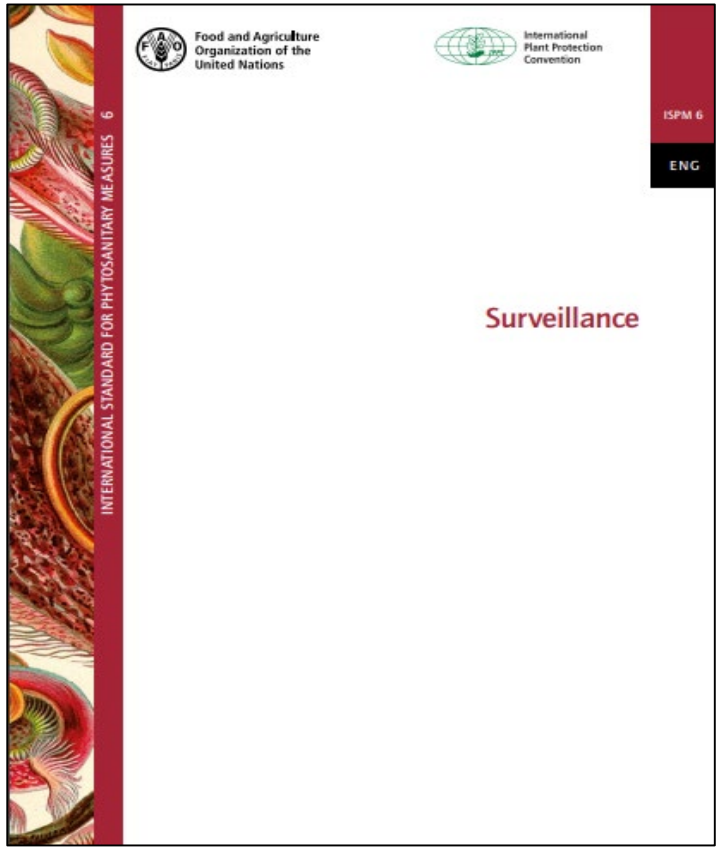
- Delimiting surveillance programs for **Fall Armyworm** may be carried out by governments, industries and the wider community.
- Delimiting surveillance programs to establish the range of new **Fall Armyworm** incursions before they become widely established, may increase the chance of successful management or containment responses of Fall Armyworm.
- Delimiting surveys also provide information on the distribution and spread of **Fall Armyworm** for use in response management activities or to confirm the successful eradication of the pest.

https://www.planthealthaustralia.com.au/wp-content/uploads/2020/11/Fall-Armworm-Continuity-Plan-2.pdf



https://www.cgiar.org/research/publication/fall-armyworm-in-asia-a-guide-for-integrated-pest-management/

IPPC Surveillance Standard and Plant Pest Surveillance Guide



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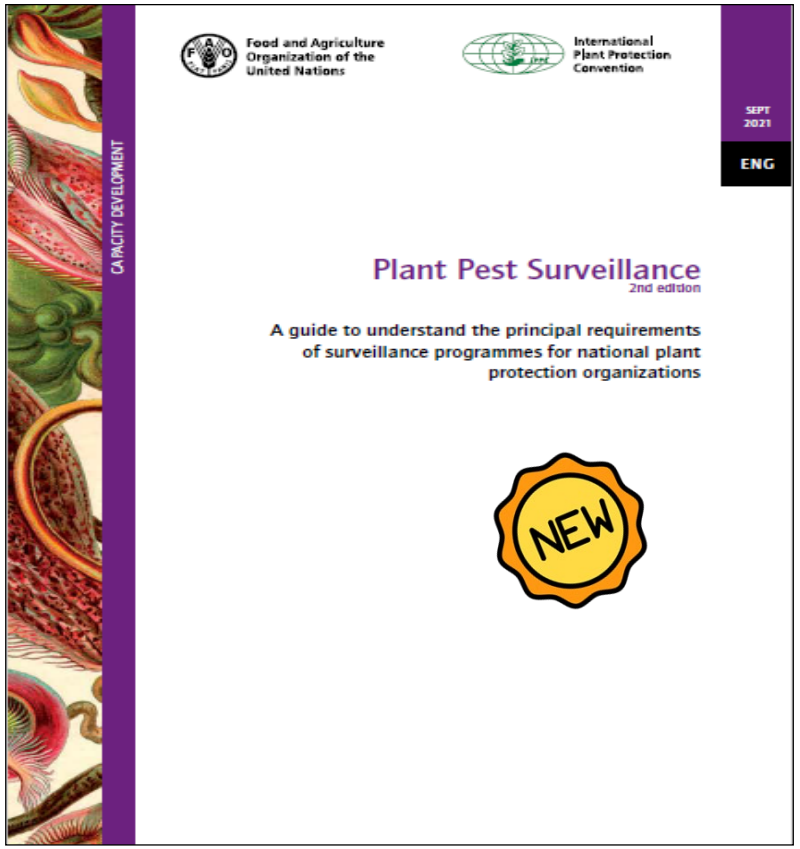

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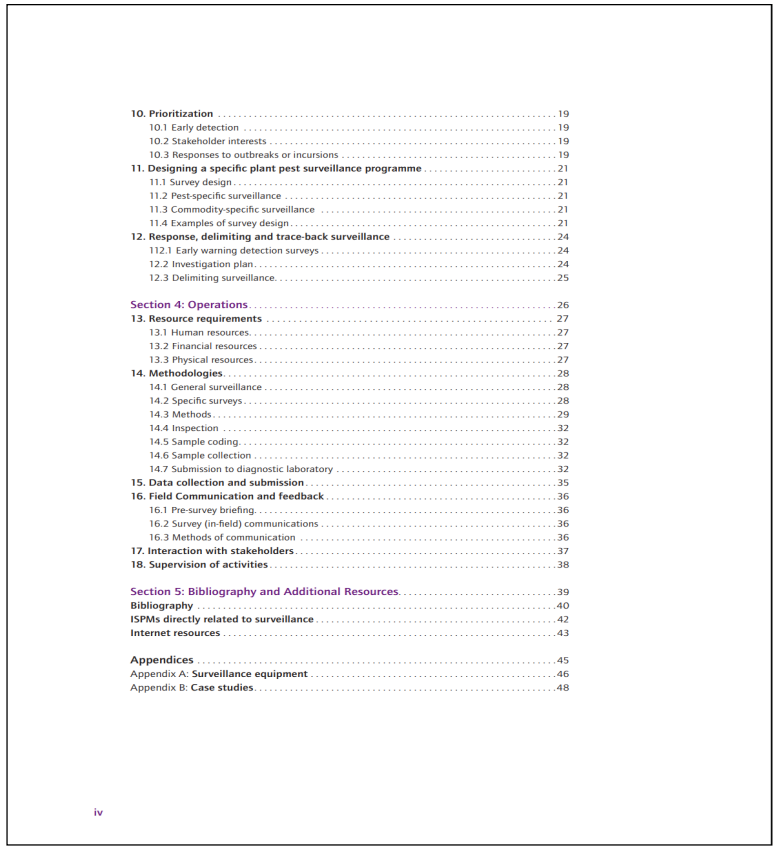

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IPPC Reporting Standard and National Reporting Obligations Guide

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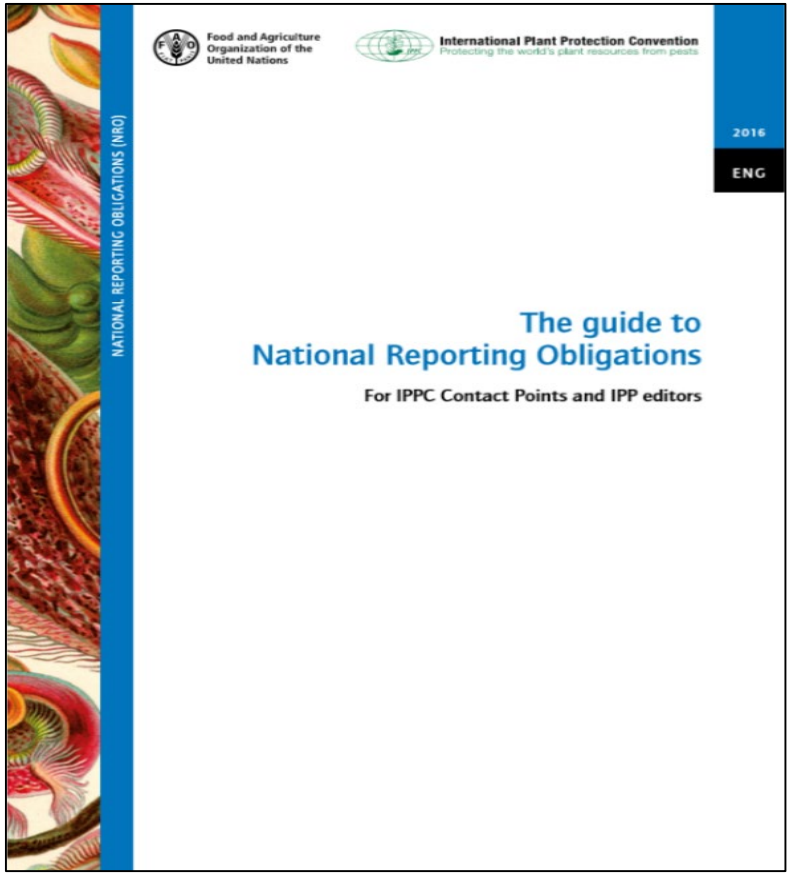

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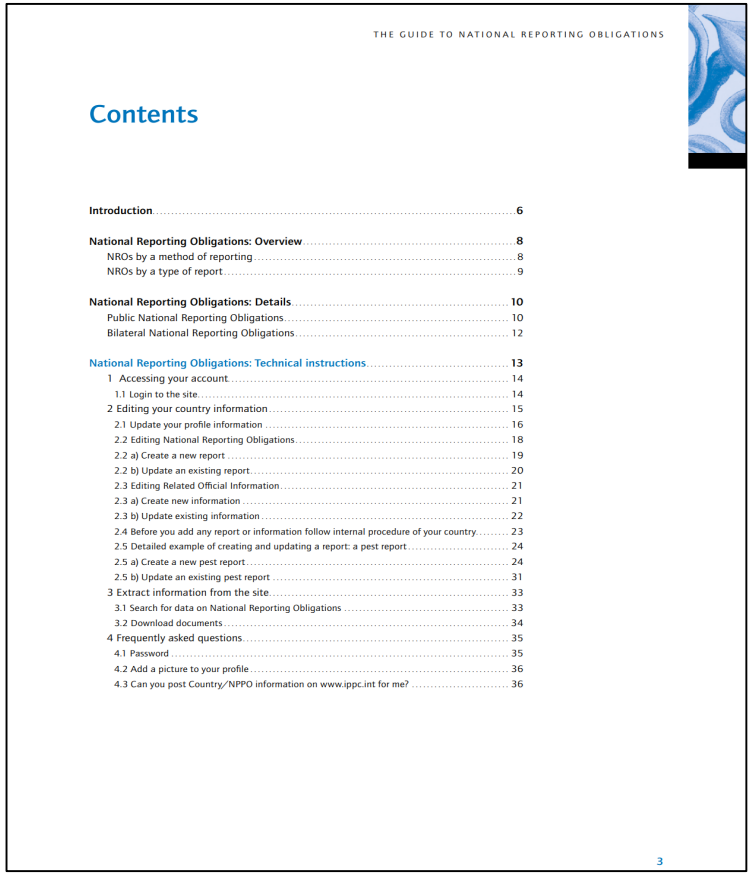

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National Fall Armyworm Surveillance Protocols (Early Detection and Delimiting)

Subcommittee on National Plant Health Surveillance

National Surveillance Protocol

for

Fall and Southern Armyworms (*Spodoptera frugiperda* and *Spodoptera eridania*)

SAW has been known to cause high damage to tomato fruit. Damage in a field attacked by FAW has been compared to that of hail storm damage (CABI 2019) and feeding damage will often lead to secondary infections such as fungus.

9 Surveillance methodology

9.1 Survey locations

Trapping surveillance should be conducted in regions where the pests have not been detected previously, or in regions where migratory populations can be expected. This can be supported by visual surveillance in susceptible crop regions.

9.2 Surveillance methods

9.2.1 Trapping surveillance

Trap-lure combinations can differ significantly in both sensitivity and specificity, depending on strain and geographic variation within fall armyworm populations. Intraspecific variation in FAW is well recognised and there is corresponding strong intraspecific variations in the composition and response to pheromones. This became apparent in central and South America, when there were poor responses to traps containing lures from North America (Andrade *et al.* 2000, Malo *et al.* 2001). Subsequent sex pheromone characterisation has found considerable differences between North and South American populations (Batista-Pereira *et al.* 2006), and lure compositions have been adjusted for use in these regions. Recent research from populations in Togo have also shown differential responses to trap-lure combinations (Meagher *et al.* 2019).

It may be necessary to field test trap-lure combinations for early detection, to optimise trapping success for previously unmonitored populations.

Lures

As noted, FAW lure composition varies but can be refined easily within known populations through comparative studies. All lure types tested for FAW in various studies around the world have captured moths, but efficiency has varied and as an early detection indicator in low populations this efficiency may be crucial to meeting program objectives.

SAW lures are species specific and available commercially.

Lures should be replaced every 3-5 weeks dependent on rainfall or high winds which may degrade the lures' efficacy faster. Lures are dispensed on a rubber septa, which is hung in the selected trap design and pierced to release the pheromone.

The table below attempts to organise the most relevant lure information. For FAW, 4C lures are recommended in the United States only – they also are non-specific and attract other *Spodoptera* species. 3C lures perform the best in Central and South America and parts of Africa (Togo and Zambia). 2C lures had good responses in Togo, and decreased by-catch of *L. forejt*, (which is present in Australia). Overall 3C lures are consistently recommended in populations outside of North America. Nagoshi *et al.* (2019), observed genetic homogeneity of FAW between African and Indian populations

Figure 9 (left) Late instar FAW larvae on corn cob with characteristic borer hole (*Source: bugwood.org*) (right) Windowing damage on sorghum leaves (*Source: Clemson University, USDA*)

9.3 Survey timing and frequency

According to best estimates for entry in northern Australia, winds blowing FAW adults into the region are most likely to occur during October to April, coinciding with the wet season. However, FAW are likely to reproduce all year round in this region and will likely take advantage of wet microclimates, including irrigated areas, during the drier months. Trapping surveillance in these areas should be placed all year long although trapping could be periodic, rather than continuous, depending on logistical constraints. Visual surveillance should coincide with the growing season and high rainfall or irrigation events.

In cooler regions where seasonal incursions are expected, trapping and visual surveillance should coincide with migratory patterns in the northern populations.

9.4 Survey design

FAW survey design considers known regulated and unregulated pathways, and establishment and spread potentials. Although eradication is not feasible, knowledge of when FAW arrives in a new area through the pathways most likely to lead to establishment is essential, to develop and instigate appropriate control options in response to further spread. Trapping surveillance is the best option to achieve these objectives and can be supported by visual surveillance in produce areas where high concentrations of hosts are available.

9.5 Sample handling

Samples should be collected carefully to prevent spread and preferably under the direction of a biosecurity officer, general sample collection instructions are available from Plant Health Australia (2014) or through the Emergency Plant Pest hotline, 1800 084 881. Diagnostic laboratory contact, preparation and sample submission information is provided below in **Table 3**, these laboratories

International Fall Armyworm Technical Surveillance Resources (Delimiting)

PEST SURVEY CARD

efsa European Food Safety Authority

APPROVED: 26 June 2020

doi:10.2903/sp.efsa.2020.EN-1895

Pest survey card on *Spodoptera frugiperda*

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Abstract

This pest survey card was prepared in the context of the EFSA mandate on plant pest surveillance (M-2017-0137), at the request of the European Commission. Its purpose is to guide the Member States in preparing data and information for *Spodoptera frugiperda* surveys. These are required to design statistically sound and risk-based pest surveys, in line with current international standards. *Spodoptera frugiperda* is a regulated priority Union quarantine pest in the EU and Member States are therefore required to perform annual surveys. Emergency measures are in place to prevent the introduction into and the spread within the EU. *Spodoptera frugiperda* is not known to occur in the EU, but it could become established in some coastal Mediterranean regions that remain frost-free all year. Climate is therefore a limiting factor for the establishment of the pest. The optimum temperature for development from egg to adult is 28°C. *Spodoptera frugiperda* is a polyphagous pest and detection surveys should mainly target maize, rice and sorghum, while delimiting surveys should cover all host species in the survey area. Due to the high spread capacity of the adults, detection of the moth at low levels of population is crucial to avoid further spread of the pest. Detection surveys to substantiate pest freedom should be based on a trapping strategy. After a finding, trapping should be intensified in the neighbouring fields and combined with the visual examination of host plants for the symptoms and early stages of *S. frugiperda*. Morphological and molecular procedures are both available for the identification of *S. frugiperda*. If experience is lacking or the purpose is to identify the early stages of the pest, molecular methods are preferred over the morphological ones.

Keywords: corn leafworm, fall armyworm (FAW), grass worm, *Laphygma frugiperda*, plant pest, survey, risk-based surveillance

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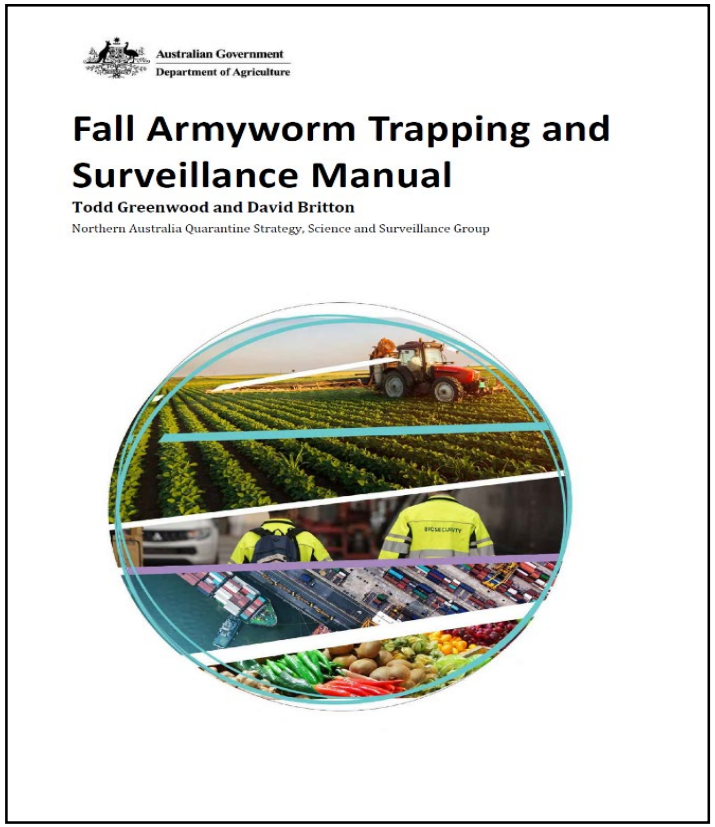
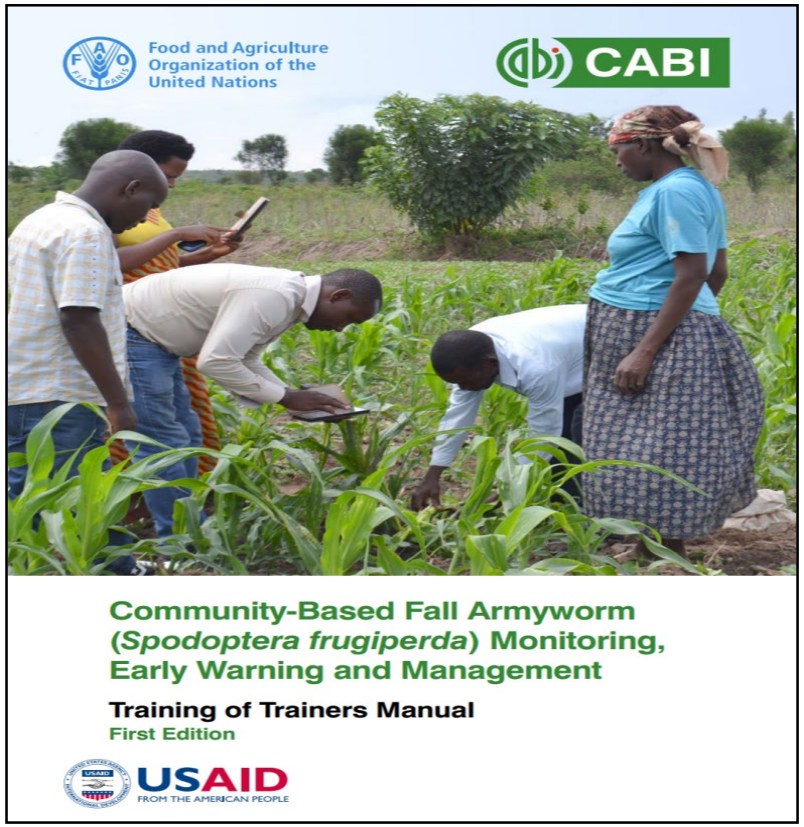


Australian Government
Department of Agriculture

Fall Armyworm Trapping and Surveillance Manual

Todd Greenwood and David Britton

Northern Australia Quarantine Strategy, Science and Surveillance Group



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CABI

Community-Based Fall Armyworm (*Spodoptera frugiperda*) Monitoring, Early Warning and Management

Training of Trainers Manual

First Edition

USAID FROM THE AMERICAN PEOPLE

https://www.cabi.org/isc/FullTextPDF/2019/20197200157.pdf

IPPC Pest Report Bulletin

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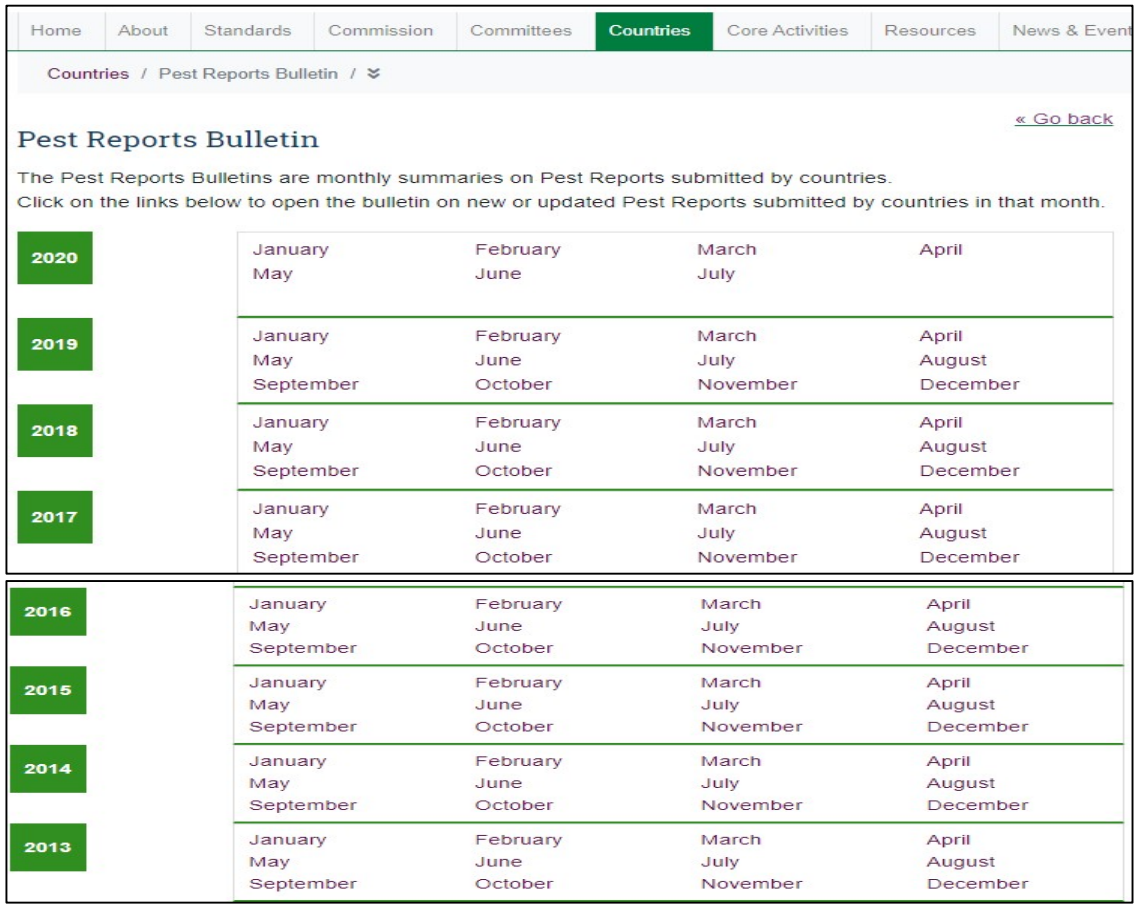

https://www.ippc.int/en/countries/reportingsystem-summary/all/

Reporting Fall Armyworm Detections and Range Extensions (IPPC National Reporting Obligations)

https://www.ippc.int/en/countries/reportingsystem/all/2021/05/

Food and Agriculture Organization of the United Nations

International Plant Protection Convention

Thank you

FAO/IPPC FAW Technical Working Group & IPPC Secretariat

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