Technical guidelines for sustainable management of fall armyworm along its seasonal migration pathways

Guidance note 11

Introduction

Fall armyworm (Spodoptera frugiperda) (FAW) is a major transboundary insect pest that has become a significant threat to food security and agricultural sustainability worldwide. FAW, a polyphagous pest native to tropical and sub-tropical regions of America, was first detected in Africa in 2016 and then spread to over 109 countries in Africa, the Near East and Asia.

The Food and Agriculture Organization of the United Nations (FAO) has launched the Global Action for Fall Armyworm Control, continuing from 2020 to 2022, to prevent further spread of FAW and reverse the trend of FAW infestation. The Global Action establishes a coordination mechanism that will connect national FAW response efforts directly with global, political-level support, facilitating adoption of new FAW control technology with a long-term sustainability perspective. These technical guidelines are developed as recommendations for decision-makers and extension specialists to develop national and local strategies for achieving sustainable management of FAW using practices that are environmentally-friendly and safe from a human health perspective.

FAW does not have a diapause mechanism and cannot survive low temperatures. Several studies found 13.8°C was the minimum threshold for development below which egg, larval and pupal development stops (Early et al., 2018, Li et al., 2019). However, long-range migration is a well-known behaviour of FAW that helps the moth to seasonally expand its geographic range. Year-round survival and breeding typically occurs in warmer regions where host plants are always available and temperatures rarely or never dip below certain thresholds. Long-range seasonal migration occurs in spring and summer, towards new regions that allow FAW survival during warm months. Such seasonal migration can take multiple generations. This means that FAW can arrive in an area along a seasonal migration pathway. It can then establish itself, with new generations of individual pests continuing the migration to new areas as a function of host plant availability and climatic factors.

Fall Armyworm (Spodoptera frugiperda)
In North America, for example, parts of southern Texas and southern Florida are known to be year-round breeding areas, with seasonal migration towards northern states such as Minnesota and Pennsylvania occurring in spring and summer (Nagoshi et al., 2012). Indeed, seasonally migrating FAW populations are found as far north as Canada (Mitchell et al., 1991).

In Africa, the Near East and Asia, new patterns of seasonal migration are expected. In Asia, for example, modelling studies have predicted trajectories and timing of such seasonal migration from year-round breeding areas in southern China to the north-eastern part of the country (Li et al., 2019, Wu et al., 2019). Another modelling study identified Central Asian regions, such as western Afghanistan, southern Kazakhstan, and southern Turkmenistan, as potential areas affected by seasonal FAW migration. As FAW establishes itself in North Africa, seasonal migration towards Southern Europe is also expected (Jeger et al., 2018).

By considering the seasonal migration pattern, it is possible to envision two broad approaches for FAW management: one for regions where year-round survival and breeding of FAW occurs; and another for regions along FAW seasonal migration pathways. Area-wide integrated pest management (IPM) principles, in which the management objectives and strategies adopted for one region complement those of another region, should be promoted. In this context, coordinated action among regions is crucial to ensure economical, effective and environmentally friendly management of FAW.

Scope of guidelines

These technical guidelines focus on delineating management strategies for regions in Africa, the Near East and Asia along FAW seasonal migration pathways.

Objectives

In principle, the FAW management strategies described below aim to:

- sustainably manage FAW populations to limit infestations in the region, as well as to reduce the initial size of seasonal migration populations;
- reduce crop yield losses due to FAW in the regions.

Science-based strategies for fall armyworm management along its seasonal migration pathways

FAW monitoring and early warning systems form the foundation for sustainable management strategies along the moth’s seasonal migration pathways. Such systems allow for early planning, early preparation and early IPM measures to reduce the likelihood of FAW outbreaks in these areas and minimize crop yield loss due to FAW.

Searchlight traps for monitoring of fall armyworms’ migratory flight.
Monitoring and forecasting

1. Enhance FAW monitoring and early warning systems by establishing appropriate monitoring sites or stations along FAW migratory pathways. At least one monitoring site per district or province on a migration pathway should be established and well-equipped with FAW monitoring tools, such as black lights, or high-altitude searchlights and sex pheromone traps. Such routine trapping should give information on the onset of FAW arrival and the peak activity period for the moth. A network of strategically positioned, high-altitude searchlights, for example, has been shown to be effective in systematically tracking the pest’s seasonal movement, as well as monitoring the long-term trend of migratory pests (Guo et al., 2020, Jing et al., 2019). Please refer to Guidance Note 3 Fall Armyworm Trapping for a further description of FAW trapping.

2. In addition to the moth trapping, coordinate and organize extension agents at the monitoring sites to carry out regular scouting on maize fields as well as other potential host plants such as sorghum, sugarcane and wheat during the FAW migrating season. Wherever possible, the same observers should be used, on fixed sites within the same fields throughout a season to minimize error. If it is not possible to appoint the same observers to conduct observations across a season, use a standardized protocol to synchronize a team’s methodology and reduce potential for error. Field scouting, done once or more per week, should collect field-level information, such as the incidence of plant damage and egg densities. Put together, FAW moth data from trapping, as well as egg density and plant damage incidence data from field scouting, will shed light on FAW population dynamics around the monitoring sites. This information can be used to formulate and time the dissemination of extension recommendations to farmers.

3. A centralized database with an easy-to-use mechanism to upload data from the monitoring and scouting sites is crucial in accumulating standardized data. Mobile apps such as the FAO Fall Armyworm Monitoring and Early Warning System (FAMEWS) platform can be used for this.

4. Develop big data solutions to translate the collected information in the database into a FAW forecasting and early warning system.

Early warning and information dissemination

1. Establish channels to communicate FAW management recommendations by building or enhancing the information dissemination system in rural areas. Various channels such as extension services, TV, radio, print publications and others should be included in the system. Early warning information and management recommendations can be disseminated widely through these channels.

2. Mobile applications such as FAMEWS should also be used to send early warning notifications.

Hotspot treatments

Early control of hotspots, especially during FAW arrival in a new location along the migration pathway, may keep the moth’s population low before it establishes itself. Such efforts require rapid action supported by an efficient monitoring and early warning system, plus well-coordinated and well-equipped control teams. Coordinate and organize plant protection specialists, farmers, or cooperatives and professional pest control services to carry out area-wide field surveys on FAW infestations of crops (especially maize fields) as soon as it arrives. The objective is to find FAW hotspots early in its arrival period and immediately organize farmers or professional pest control services to use efficacious control methods to treat such hotspots and eradicate FAW. Effective and selective biopesticides such as Spodoptera frugiperda nucleopolyhedrovirus (NPV) viruses are especially relevant for hotspot application. These viruses self-propagate and thus, continue to inflict mortality in the FAW immigrant populations and dampen population growth.

Integrated pest management measures

Once FAW completes one or two life cycles in an area along its migration pathway, well-coordinated IPM measures must be taken to minimize the crop yield loss caused by their infestations. Please refer to Guidance Note 9 Technical Guidelines for Sustainable Management of Fall Armyworm in its Year-Round Breeding Areas, for details on the following measures.

- Agronomic practices. Best agronomic practices that will improve general plant and soil health, such as use of quality seeds, balanced fertilization, intercropping, crop mulching and no- or low tillage, will help in reducing crop yield loss due to FAW (Harrison et al., 2019). Avoid staggered planting as the practice provides continuous habitat for FAW and may lead to increased overall FAW populations in an area. Staggered planting also exposes the late-planted fields to higher FAW infestations. Crop rotation patterns such as maize followed by paddy rice or flooding the fields after maize season can contribute to reducing FAW populations. Flooding kills FAW pupae in the soil. Please note that FAW may be able to survive and reproduce on numerous other hosts around the fields. Smallholder farmers often conduct egg crushing and hand-picking of fall armyworm caterpillars as this is an option that is available to them, especially in the time of outbreaks.
Conservation biological control. In nature, a number of predators and parasitoids feed on FAW eggs and caterpillars. Even in the newly invaded regions, such as Africa and Asia, a number of indigenous natural enemies have been found to regulate FAW populations. It is possible to conserve these natural enemies and enhance their functions in natural pest regulation; typically, by increasing habitat diversity on the farm. Leaving strips of wild flowers on the field margin, for example, increases the availability of supplementary food for natural enemies. Additionally, conservation of natural enemies also requires avoiding adverse agricultural practices, such as indiscriminate use of pesticides, that can harm arthropod natural enemies and other beneficial organisms.

Augmentative biological control and other biorational approaches. Such measures include mass releases of natural enemies, use of sex pheromones for FAW mating disruption, and use of selective microbial and botanical pesticides (Bateman et al., 2018). Examples of microbial and botanical pesticides against FAW include neem extract, Azadirachta indica, and entomopathogenic fungus and virus, Beauveria bassiana and NPV.

Low-risk synthetic pesticides are a measure of last resort: it is important to optimise the best agronomic practices and biological control before considering systemic pesticides. Scouting and economic thresholds should be used to guide decisions on applying synthetic pesticides (please refer to Guidance Note 2 on Fall Armyworm Scouting for more information). Indiscriminate use of synthetic pesticides can result in the disruption of natural enemy-pest populations in FAW habitat and lead to pest outbreaks. To avoid this scenario, deploy selective synthetic pesticides (Jepson et al., 2020) that affect the target pest only, and not its natural enemies. If the use of synthetic pesticides is deemed necessary – for example, due to a population that is higher than an economic threshold – select products with the lowest risk to human, environmental and non-target organisms from the available registered products that are effective against FAW. Ensure proper use of the selected products for approved applications and comply with international standards (e.g. FAO/World Health Organization (WHO) International Code of Conduct on Pesticide Management and the technical guidelines for its implementation). Finally, rotate the active ingredients among the selected synthetic pesticides to avoid the development of pesticide resistance among FAW populations. Rotating synthetic pesticides with one or two biopesticides will also help to avoid resistance development.


