Agriculture Knowledge, Learning Documentation and Policy (AKLDP) Project, Ethiopia

Technical Brief
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Fall Armyworm Control in Ethiopia: Developing Context-Specific Responses

The poor 2017 spring belg rains coupled with the invasion of a new pest—the Fall Armyworm (FAW)—could threaten household food security in the current season and for years to come.

1. Background

Following near-normal 2016 summer *kiremt* rains, most El Niño-affected smallholder farmers have produced a first post-drought harvest and are therefore on the road to recovery. Recovery typically takes between two and four years. Nevertheless, the poor 2017 spring *belg* rains coupled with the invasion of a new pest—the Fall armyworm (FAW)—threatens household food security in the current season and for years to come. If not controlled, FAW can potentially devastate hundreds of thousands of hectares of planted farmland, especially maize.

This Technical Brief contains a concise analysis of FAW—its importance in general and in the Ethiopian context specifically—using information collected from the government, UN agencies, and research institutions. In addition, the brief aims to identify FAW management gaps in Ethiopia while suggesting a number of management options that need to be carried out by different governmental and nongovernmental actors in order to mitigate the impact of the pest.

2. Key characteristics of Fall armyworm

FAW is native to the Americas and survives in temperature above 10°C.[i] Reported in February 2017 on irrigated maize fields in the Bench Maji Zone of southern Ethiopia, to date the pest has spread to six administrative regions: Southern Nations, Nationalities and Peoples, Oromia, Gambella, Benishangul, Amhara, and Tigray (see Figure 1[ii]). Although maize is the preferred crop for the pest, it also affects other major crops such as sorghum.[iii]

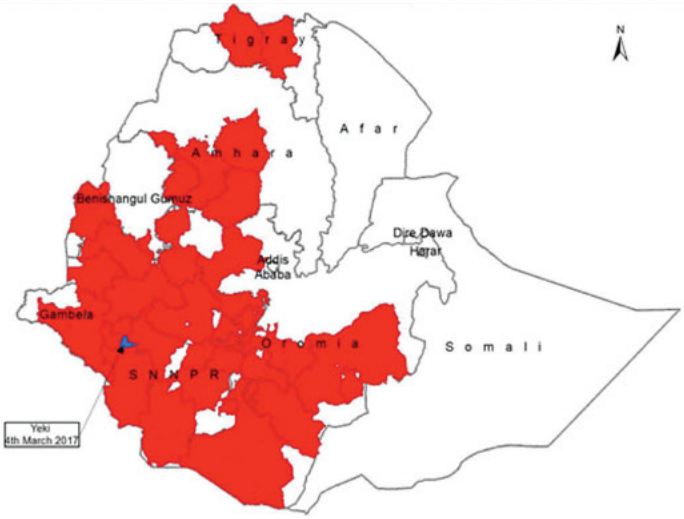

Figure 1. Status of FAW in Ethiopia, 16 June 2017[iii]

The characteristics that make the FAW infestation such a serious problem include:

- **The pest:** FAW produces several generations per year (is multivoltine), migrates over wide areas, and sometimes is gregarious i.e. live in flocks.
- **The host:** it is reported that FAW larvae feed on a wide range of plants, as many as 80–186 plant species, of 27 families. The preferred hosts are grass-based plants such as maize, sorghum, millet, rice, and sugarcane. Other hosts include cotton, alfalfa, peanuts, soybeans, cowpeas, tobacco, vegetables, potatoes, and various wild grasses such as Sudan grass. In addition, *teff* belongs to the grass family and is indigenous to Ethiopia, and could be a potential host for FAW.
- **The environment/climate:** Climatic factors can directly affect the pest and indirectly affect hosts or predators. With climate change, migratory and polyphagous insects (feeding on various kinds of food) like FAW are expected to spread, and become establish in new areas.

3. Fall armyworm and the Ethiopian context

Unlike many other countries in Africa, Ethiopia is a country of great diversity in terms of agro-ecology, biodiversity, and climatic conditions, which could positively or negatively affect the occurrence, spread, and survival of FAW. These factors should be taken into consideration when developing appropriate responses to the FAW problem, along with Ethiopia's marketing practices, and planting material exchange practices.

3.1. Agro-climatic condition

- *Temperature*

  FAW is a tropical species adapted to the warmer climates with temperatures between 10.9°C to 30°C. At lower temperatures, all stages of FAW are killed. Above 30°C, the wings of the adult FAW tend to be deformed.

  In much of Ethiopia, the temperature drops twice in a year, during summer (June–August) and winter (October–January). Nonetheless, except in the extreme highlands where the temperature can sometimes fall below 0°C (and where maize is not widely grown), the minimum average temperature remains above 10°C throughout the year, creating favorable conditions for the development of FAW.

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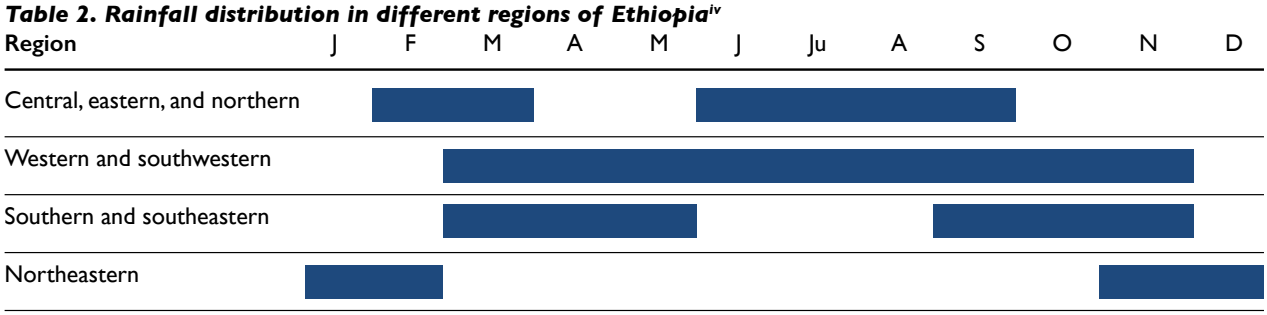
- *Wind regime and rainfall patterns*
  Ethiopia has four major rainfall zones (see Tables 1 and 2). Apart from December and January, when there is little or no rain anywhere in the country, it rains in at least one location during the rest of the year. Rainfall patterns relate to wind patterns, and these patterns in Ethiopia will favour the establishment of FAW. Specifically, once the summer *kiremt* rains are over and the crops are harvested, the winds that cause the spring *belg* rains would likely change the course of FAW, which currently reaches northernmost Ethiopia, sending it back to central, southern, and western parts of the country and causing re-infestation or augmenting a population that might have already established in those areas.

Table 1. Ethiopian wind regime and rainfall patterns[iv]

Region	Rainfall pattern	Period	Source
Central, eastern, and northern	*bimodal*	June to September; February and May	Big rains mainly from Atlantic Ocean; light spring rains from Indian Ocean
Western and southwestern	*unimodal*	Continuous rain from March or April to October or November	Indian Ocean; merge with those from the Atlantic Ocean
Southern and southeastern	*bimodal*	March to May; September to November	Indian Ocean
Northeastern	*unimodal*	Only a little rain falls in the north; anytime between November and February rain/mist	Winds from Asia cross the Arabian Peninsula

Table 2. Rainfall distribution in different regions of Ethiopia[iv]



- *Cropping calendar*
  Related to the rainfall pattern, different crops are sown and grown in the country all year long. This situation creates a continuum of crops year-round, from crops grown in the summer *kiremt* season to irrigated fields to crops grown in the spring *belg* season and to perennial crops. This means that FAW can continue to survive and breed through from season to season, migrating from one area to another.

- *Farming systems*
  Much of Ethiopian farming is mixed crop-livestock systems in the highlands, and agro-pastoralism or pastoralism in the lowlands. In all cases, grazing lands, pastures, and rangelands are abundant and widely used for livestock production. Therefore, in seasons when the preferred host crops are less available or absent, FAW could infest pastures and rangelands. Furthermore, some crops e.g. sugarcane, are available year-round and can be a permanent host for the pest.

- *Agro-biodiversity*
  Ethiopia is known to be the center of origin and diversity for several crops. Often, great biodiversity is considered important to reduce pest and disease incidence, especially for pests of a limited or narrow host range. However, FAW is an indiscriminant pest and infests a wide range of plants.

3.2. Areas of agro-ecological consistency

Agricultural and natural landscapes that create a congenial condition for FAW in Ethiopia may include large-scale farms, emerging agricultural commercialization clusters, and pastures and rangelands. All of these areas have an element of landscape uniformity, which creates an ideal condition for FAW development.

3.3. Trade and planting material exchange

In Ethiopia, there is both a formal and informal movement of crop products and planting materials (e.g. green cobs, maize stalks) from one area to another, within a region, between regions, and even with neighboring countries. This could potentially further disseminate the pest.

4. FAW management options in Ethiopia

At present, the major problems affecting FAW management efforts in Ethiopia are:

- Lack of adequate knowledge of the pest and its management options in the Ethiopian context;
- Lack of sound contingency and long-term plans;

- Lack of coordinated research and development interventions;
- Scarcity of financial and material resources;
- Delayed response.

FAW's ability to breed rapidly, to migrate, and to feed on a wide range of host plants makes it is very difficult to control. Nonetheless, there are several ways of managing the pest reported in other parts of the world that can potentially be adapted and/or validated and used in Ethiopia (see Table 3).

Table 3. FAW management options in Ethiopia

FAW management options	Limitations/setbacks	Recommendations
Cultural option		
• Diagnosis and monitoring (and scouting approaches) • Phytosanitary measures (disking or deep plowing) • Planting date adjustment (synchronized early planting) • Mechanical control (hand picking and squashing of caterpillars)	• Farmers' inability to properly scout and detect the early instars and take the necessary control measures in time • Unsynchronized planting due to farmers varying plans, lack of resources such as oxen, lack of understanding • Reluctance to kill the larvae because of disgust and the speculative belief that the population builds up as larvae are killed	• Use of pheromone/light traps; frequent field inspection and monitoring • Clean cultivation and weeding • Use of early maturing varieties, early planting, intercropping, and crop rotation with non-host crop • Bird combing of the pupae and larvae from the soil • Livestock grazing on infested pastures • Developing tools for crushing the larvae
Chemical option		
• Insecticide application (pyrethroids, carbamates, and organophosphates category)	• Chemicals in use are general-purpose ones; no specific chemical recommended for FAW • Potential for resistance development from inappropriate use of pesticides • No pest threshold level on issuing chemical options • Improper timing and application of pesticides, leading to ineffective control, significant human health problems, livestock poisoning, plant damage, environmental pollution, high expenditures	• Urgent need for fast-track testing and identification of soft pesticides targeting FAW and if need be emergency registration and recommendation of more efficient pesticides • Chemical control options should be based on threshold-level determination • Schedule safe chemical sprays matching the pest's active feeding time at twilight, and proper guidance to be given concerning chemical application (dosage, protective equipment, etc.) • Use of spray windows, swath application, alternating different mode-of-action insecticides, etc.
Biological option		
• Botanicals like Neem, Thephrosia, Tagetes, Chrysanthemum • Classic biological control, especially parasitoid (Telenomus remus) • Bio-pesticides	• Lack of rapid efficacy • Risk of attacking non-targets • May take longer time to control	• Use botanicals as part of integrated pest management (IPM) • Rapid efficacy testing and risk analysis needed
Integrated pest management		
• A combined use of all available pest management options	• Farmers inclination towards chemical control as a first choice	• Use a combination of pheromone traps, cultural, mechanical, and biological options, and host plant resistance (if found) • Integrate affordable soft chemicals as a last resort

Table 3 suggests that all options have their advantages and disadvantages. Therefore, a judicious combination of different options, including *cultural, chemical,* and *biological* ones, i.e., integrated pest management (IPM), needs to be considered. This helps to minimize use of insecticides and hence tackle resistance development challenges, while it reduces socio-economic and environmental impacts[v]. Most importantly, maize is a cheaper-priced commodity in Ethiopia, so only reduced use of and efficient application of chemicals is economically viable.

5. Action points for the management of FAW in Ethiopia

Following the accidental introduction and rapid spread of FAW in Ethiopia, interventions are being undertaken, including awareness creation, mass mobilization, monitoring, mechanical and chemical control, etc. Nonetheless, for better-informed decision making and effective and sustainable control of the pest, the following action points are suggested at different levels (see Table 4).

Table 4.Suggested action points

Institutions	Actions to be taken
Ministry of Agriculture and Natural Resources, and Ministry of Livestock and Fisheries	• Develop a national strategic plan for FAW management, offering technical and operational guidance, and taking account of Ethiopia diverse ecology • Create awareness and build capacity at all levels • Disseminate uniform and standardized information on FAW via various media • Conduct regular monitoring and surveillance, including of pastures and rangelands • Develop an early warning system • Mobilize farmers for mechanical control and synchronized action • Coordinate actions among government and development partners, and institutionalize government –led FAW coordination platforms • Establish a national FAW research consortium • Establish intra-country coordination and networking
Development partners/donors	**Short term** • Facilitate global experience sharing to Ethiopian experts and researchers as well as policy makers • Provide financial and material support • Conduct experience sharing and learning workshops • Develop communication materials for awareness raising **Medium to long term** • Strengthen the capacity and capability of Plant Protection Departments • Conduct FAW research and studies

Ethiopia is a country of great diversity in terms of agro-ecology, biodiversity, and climatic conditions, which could positively or negatively affect the occurrence, spread, and survival of FAW.

6. Conclusion

The 2015/16 El Niño-induced drought left more than 10 million households in Ethiopia in need of food assistance. Farmers were beginning to recover from the drought, but then Maize Lethal Necrosis Disease (MLND) affected the maize crop, and FAW was introduced and reported as major problem in February 2017. As FAW is a new pest in Ethiopia, and because of its capacity to spread, reproduce quickly, and feed on a range of host plants, the early identification of effective management options is critical. The Ethiopian context points to the need for integrated pest management to control FAW, comprising cultural, biological, and chemical control measures. Early involvement of key governmental institutions and development partners, with joint identification of short- to medium- term goals can help to limit the impacts of FAW on food security.

This Policy Brief was produced by the USAID/Ethiopia Agriculture Knowledge, Learning, Documentation and Policy (AKLDP) project, implemented by the Feinstein International Center, Friedman School of Nutrition Science and Policy, Tufts University. For more information about the AKLDP, contact Dr. Berhnau Admassu, email: berhanu.admassu@tufts.edu

Endnotes

[i] Financial Times, 2017, Invasion of FAW Ravages Crops in 20 African Countries, https://www.ft.com/content/93222f52-2b46-11e7-9ec8-168383da43b7.

[ii] As seen on the map the pest that was on a small spot at Yeki on 4th March covered most part of the country on 16th June

[iii] CYMMIT, 2017, Updates on Fall Armyworm (FAW) Outbreak, presented at Emergency Crop Working Group Meeting, June 20, 2017, FAO, Ethiopia.

[iv] https://www.nationalparks-worldwide.com/eaf/ethiopia/ethiopia-weather.html

[v] AllAfrica, 2017, Africa: Experts Call for Multi-Pronged Approach to Fight Fall Armyworm in Africa, http://allafrica.com/stories/20170509001l.html