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Programmatic Pesticide Evaluation Report and Safer Use Action Plan (PERSUAP): Fall Armyworm Management in Africa

Version 1*

Project Information:	
Activity/Project Title: FtF IPM Innovation Lab PERSUAP for Fall Armyworm – FAW (*Spodoptera frugiperda*)	
Date Prepared: May 10, 2017	
Geographic Location : Sub-Saharan Africa	
Is this is an Amendment to an existing IEE? **Yes**, and this will be Amendment #: 2 Original IEE Tracking #: No Tracking Number on original IEE, BEO Approval Date: 9/29/2014 Environmental Compliance Database link: File #IPM IL IEE (PDF). http://gemini.info.usaid.gov/repository/pdf/41671.pdf Title of Original document: Feed the Future Innovation Lab for Integrated Pest Management	
Implementation Start/End: April 2017 – September 2019	BFS Tracking #: BFS-17-05-002

Initial Environmental Examination (IEE) Amendment

This Programmatic PERSUAP is an Amendment of the USAID/BFS IPM IL IEE, and when used in conjunction with country-specific PERSUAPs by Agricultural, Economic Growth, Feed the Future (BFS), of Food for Peace (FFP) programs in country is intended to solely to allow for the authorization of the Pesticide Evaluation Report and Safer Use Action Plan (PERSUAP) for use in Africa for the Fall Armyworm, *Spodoptera frugiperda* (J.E. Smith) – FAW. All other conditions are unchanged and remain legally binding. The attached PERSUAP shall only be used: 1) in sub-Saharan Africa, in conjunction with existing, approved bilateral, regional or BFS or DCHA Centrally-funded project PERSUAPs valid in the affected countries and the affected crops, respectively, and 2) to support control efforts against the Fall Armyworm (*S. frugiperda*) – FAW.

APPROVAL OF ENVIRONMENTAL ACTION RECOMMENDED:

CLEARANCE:

BFS Office Director: _____ Date: 5/16/17
Sheila Roquitte

BFS AOR: _____ Date: 5/16/17
John Bowman

CONCURRENCE:

BFS BEO (William Thomas): _____ Date: 5-16-2017

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** Version 1 Note: This is a work in progress. Additional information on FAW distribution and control will be provided in the near future.*

Programmatic Pesticide Evaluation Report and Safer Use Action Plan (PERSUAP) for Fall Armyworm (FAW) in sub-Saharan Africa

Table of Contents:

1. INTRODUCTION

a) Purpose of This Document

This document is intended to assist USAID Mission in Africa support control operations of the Fall Armyworm (FAW). Herein find FAW basic biology, distribution, and a discussion of possible control methods with a focus on Integrated Pest Management (IPM).

After reviewing the basic information on this insect, here's what to do next:

1. Locate an existing PERSUAP for your partner country in Table 1, "Existing USAID PERSUAP" on page of this document.
2. Utilize the PERSUAP, along with the list of pesticides in Table 2, and Pesticide Data Sheets in Annex 5 to choose what pesticides to support with US funds.
3. In the case of an inconsistency between an existing PERSUAP and this Programmatic PERSUAP, (e.g. a pesticide product is recommended by the Programmatic but not by the existing), then an amendment of the existing PERSUAP that resolves that inconsistency should be prepared and duly approved. Most likely, this can be a simple amendment that simply cites the technical analysis of the Programmatic PERSUAP and does not restate it.
4. Develop an active Safer Use Action Plan to support FAW control operations.

Version 1 includes the information and data Missions will need to support FAW control operations in the short-term. Future versions will include updates on spread and levels of infestation, a discussion of key factors aggravating FAW spread and potential future impact on African food security, more detailed guidance on how best to manage FAW pesticide resistance, additional Pesticide Data Sheets, and further guidance on developing a SUAP.

b) The Fall Army Worm

The Fall Armyworm (FAW), *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae), is native to the tropics in North and South America. It is polyphagous (able to feed on various kinds of food) and an economically important pest of maize. Depending on the degree of infestation, FAW can cause huge losses in maize yield and in some cases, total crop loss. In North America, the FAW will move north in the late summer and early fall, which is when it does most of its damage. It then dies off in the cold weather. It affects all stages of plant development and is difficult to control. The pest can survive year round in the southeastern United States due to the warm and humid climate.

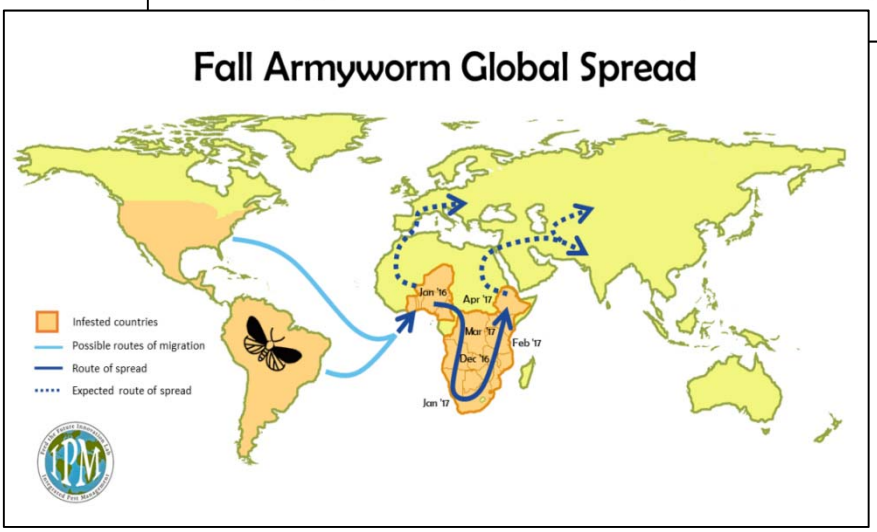
In Africa, FAW appears to have been first detected in Nigeria in January 2016 where IITA correctly identified the species. However, it is possible that multiple independent introductions have taken place across a wider time-frame. It appears to have spread to other West African countries and to Central Africa by April 2016. To date, FAW outbreaks of FAW have been reported in Angola, Benin, Botswana, Cameroon, the Democratic Republic of Congo, Ethiopia, Ghana, Kenya, Malawi, Mozambique, Namibia, Rwanda, Sao Tome and Principe, South Africa, Swaziland, Tanzania, Togo, Uganda, Zambia and Zimbabwe. The FAW strain in Togo appears to be the haplotype found in southern Florida and the Caribbean. The source of the FAW is important for two reasons: 1) different haplotypes have different host ranges, 2) different biotypes carry different pesticide resistance genes. Currently, around 330,000 hectares of crops, especially maize, have been damaged in Africa. This heavy loss of maize and cereal production due to the FAW infestation is likely to impact food security in all the affected African countries, many of which are already food insecure.

2. HOST PLANTS

The Fall Armyworm has a wide host range with over 80 plant species in over 27 families. Its preferred host plants are maize, sorghum, millet, rice, wheat, sugar cane, Bermuda grass and crabgrass. This pest also attacks other non-graminaceaous crops such as cow pea, groundnut, soy bean, cotton, potato, apple, grape, orange, papaya, peach, strawberry and a number of ornamental plants. Weeds known to serve as hosts include bentgrass, Johnson grass, morning glory, nutsedge, pigweed and sandspur.

Maize is an important cereal crop and staple food for many people around the world. It was domesticated in Mesoamerica during prehistoric times. In the late 15th century, it was brought to Europe and other countries. Maize spread to the rest of the world due to its ability to thrive in diverse climates. Maize is a very important staple crop in Africa – more than 300 million Africans depend on it as their main food source (maize is also an economic source for millions of farmers across Africa). Out of 53 countries in sub-Saharan Africa, 46 countries cultivate maize. Africa's top maize producers are South Africa, Nigeria and Ethiopia.

3. AREAS AFFECTED BY FALL ARMYWORM IN AFRICA AND THE POSSIBLE FUTURE SPREAD



Source: IPM Innovation Lab, VPI&SU

4. LIFE CYCLE

Eggs are dome shaped and are dirty white to gray in color. Eggs are laid in groups or clusters of about 10-200 eggs per egg mass. Sometimes the eggs are deposited in layers but usually eggs are laid in a single layer attached to foliage. After oviposition, the female deposits a layer of grayish scales or hairs over the eggs and covers the egg mass giving it a hairy or moldy appearance. Depending on conditions, eggs hatch in two to five days in summer.

In its native regions, FAW goes through six larval stages, with the newly hatched larvae greenish with a black head, which turns orange-brown in the 2nd instar. Newly hatched larvae feed near where the egg mass was laid then move up onto the maize plants and consume leaf tissue. The larvae can exhibit cannibalistic behavior, and under heavy infestations, larval densities can be reduced to one or two per plant. Fully-grown larvae are 3.1 – 3.8 cm long and vary in color from pale green to almost black, with three yellowish stripes running down the back. There is a wider dark stripe and a wavy yellow-red blotched stripe on each side. The FAW's head has a predominant white, inverted Y-shaped suture between the eyes. Duration of the larval stage tends to be about 14 days during the summer and 30 days during cool weather.

Figure 3: Fall Armyworm larva displaying Y-shaped suture (Holly Schwarting, Kansas State Research and Extension)

Figure 4: Fall Armyworm larva displaying yellowish stripes on side (bugguidenet).

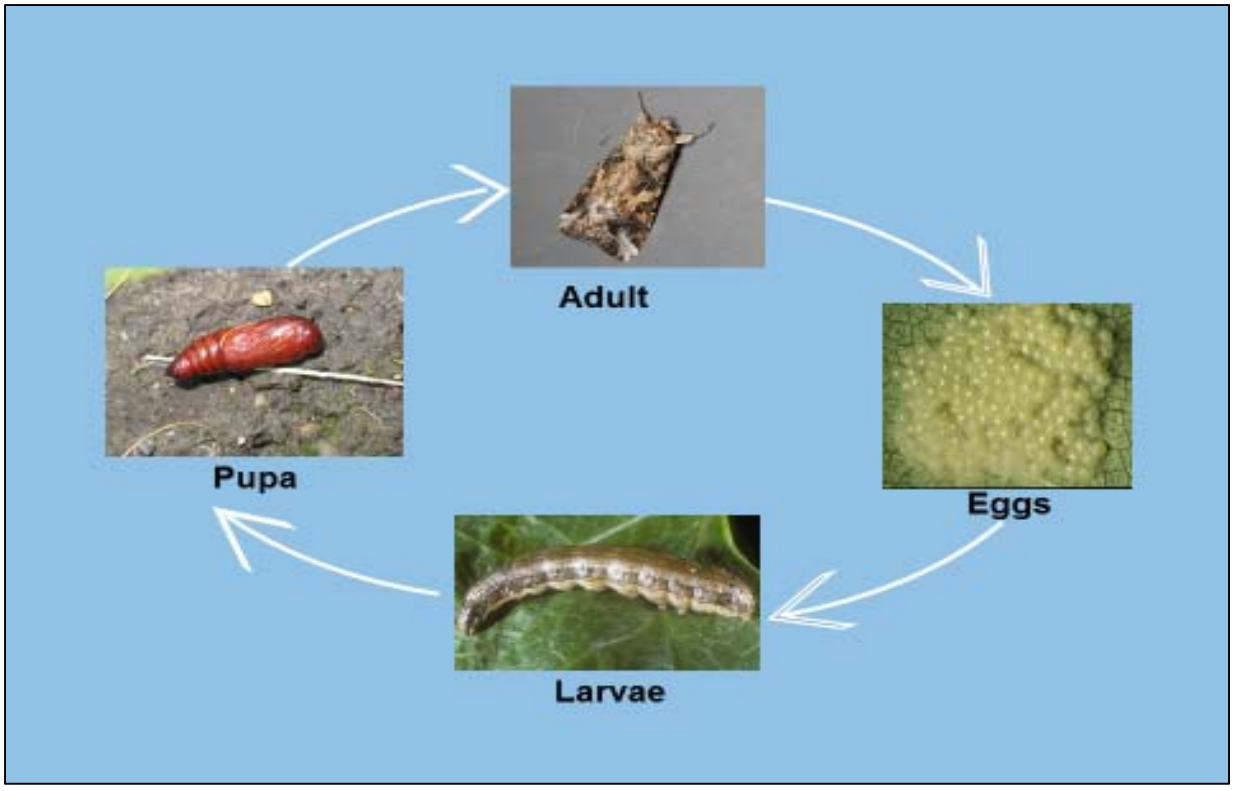


Figure 5. Fall armyworm life cycle (IPM Innovation Lab, Virginia Tech)

Pupation normally takes place in the soil at a depth of 2-8 cm. The pupa is reddish brown in color with a summer duration of 8-9 days, and longer than 2 weeks under winter conditions.

The adult moths have a wingspan of 32 to 40 mm. The male moth has dark gray and brown shaded mottled forewings with conspicuous triangular white spots at the tip and near the center of the wing. These markings are less distinct in female moths. The hind wing is iridescent silver-white with a narrow dark border in both sexes. Adults are nocturnal, and are most active at dusk for mating. Females deposit most of their eggs during the first four to five days of life, but some eggs may be laid for up to three weeks. Adults can live up to an average of 10 days but sometimes the duration extends up to three weeks. The larvae are nocturnal feeders. Unlike other armyworm species, FAW are typically found damaging maize in patches throughout a field. In the U.S. they appear in maize fields late in the season, from mid-July through the fall harvest, but the timing may be different in Africa due to climatic differences.

Figures 6 & 7: Fall armyworm adults: female, male
(John L. Capinera, University of Florida
Kansas State University)

In summer months, FAW completes its life cycle in about 30 days; however during winter months it takes 80 to 90 days to complete its life cycle in the U.S. The number of generations in an area varies with the appearance of the dispersing adults. This species does not have the ability to diapause, instead exhibits the tendency to continuously breed when conditions are favorable. It follows a typical lepidopteran life cycle of egg, larvae, pupa and adult.

Identification Aids: Easy to follow Pest Management Decision Guides, identification factsheets and a poster for use by extension officers and farmers to help identify the FAW in Africa have been produced by CABI Plantwise in conjunction with national Ministries of Agriculture Plant Protection Services. Additional information from CABI's and third party sources can be accessed through the open access Plantwise knowledge bank: click http://www.plantwise.org/KnowledgeBank/SearchResults.aspx?q=Spodoptera%20frugiperda. The CABI Invasive Species Compendium provides open access information on the pest: http://www.cabi.org/isc/datasheet/29810.

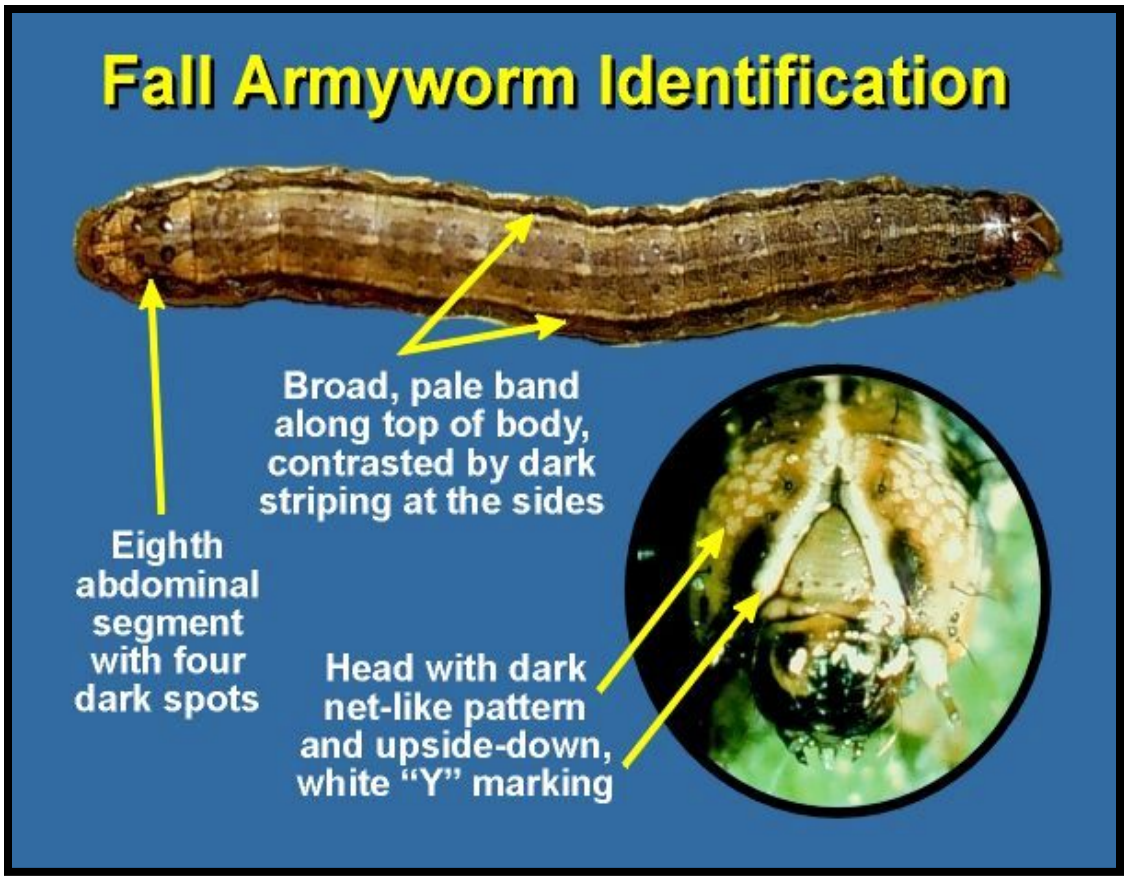


Figure 8: FAW ID info (Farmbiz Africa / University of Nebraska)

5. DAMAGE

FAW generally feeds on foliage, but during heavy infestations, larvae also feed on maize ears. Foliar damage to maize is usually characterized by ragged feeding, and moist sawdust-like frass near the whorl and upper leaves of the plant. Young larvae initially feed on one side of leaves leaving the epidermis intact on other side. Later, instars feed by making holes in leaves and eat from the edge of the leaves inward. Feeding in the whorl of maize often produces a

characteristic row of perforations in the leaves. Due to cannibalistic behavior, larval numbers are reduced to a few larvae per plant. Fully-grown larvae cause extensive defoliation, often leaving only the ribs and stalks of maize plants. Larvae can also burrow into the growing point and affect the growth of plants. In maize, larvae sometimes also bore into the ear through the husk and feed on kernels. Larvae can also cut young maize plants and kill them.

6. MANAGEMENT

Integrated Pest Management (IPM): IPM is the coordinated use of pest and environmental information and available pest control methods to economically prevent unacceptable levels of pest damage, with a focus on minimizing hazards to people, property, and the environment. IPM requires a thorough understanding of the pest, crop, and interrelationships within the environment. Done right, IPM requires practical research, advanced planning, balancing the costs and benefits of all control practices, as well as routine monitoring of crop and pest conditions. IPM utilizes all suitable pest management tactics, including pesticides, cultural methods, mechanical control, sanitation, natural and biological control, as well as host plant resistance. It is USAID policy to rely on an IPM framework for all activities which involve the procurement or use of pesticides. As such, it is critical to respond to clearly identified pests and their consequences, evaluate non-pesticide management options, and use the least toxic, safest pesticides and only as actually needed.

Prevention: Agricultural Production Advisors should provide education on distinguishing the **Fall armyworm** (newly introduced invasive species, *Spodoptera frugiperda*) from the historically present **African armyworm** (*Spodoptera exempta*), and should advise farmers on preventive measures in Good Agricultural Practice (GAP) training, including the following actions recommended by CABI Plantwise plant clinics for preventing African and Fall armyworm outbreaks:

For preventing **Fall armyworm**[1]:

- Avoid late planting. Plant early to avoid peak immigration of adults
- Remove and destroy all crop residues after harvest
- Deep plough the soil to bury the larvae and the pupae
- Regularly weed the field and surroundings
- Ensure optimum fertilization is used for your maize crop: Recommended fertilizer rates (4 bags or 200kg of NPK 15:15:15 per ha) to increase the growth vigour.

For **African armyworms**, the following prevention measures are recommended[2]:

- Remove weeds such as Amaranthus and wild grass species that harbour armyworm larvae
- Avoid planting close to overgrazed grasslands which provide food and refuge for caterpillars
- Grow low value grain crops such as finger millet as trap crops to attract armyworms

Remove alternate host plants such as millet, sorghum, rice, leafy vegetables etc.

Sampling: A key component IPM is monitoring pest populations. This is often done by sampling random parts of a field or, in the case of FAW, by utilizing black-light traps and pheromone traps. Pheromone traps are very efficient and should be suspended at canopy

[1] Beseh, P. 2017. (Ghana MOFA, PPRSD) Fall Armyworm Pest Management Decision Guide: Green and Yellow List, CABI, 2017, English language. Find at: http://www.plantwise.org/FullTextPDF/2017/20177800275.pdf

[2] Chipambala, F. K.; Badii, B. K.; Nuamah, H.; Braimah, H. African Armyworm Pest Management Decision Guide: Green and Yellow List, CABI, 2016, English language. Available at http://www.plantwise.org/FullTextPDF/2017/20177800134.pdf

height during the whorl stage of maize. Insect catches indicate the presence of moths in the area but are not necessarily good indicators of density. Once the moths are detected, it is recommended to search for eggs and larvae. A random sampling of 20 plants in five locations, or 10 plants in 10 locations, is generally considered to be adequate to assess the proportion of plants infested. Sampling to determine larval density often requires large sample sizes, especially when larval densities are low or larvae are young, so it is not often used.

Cultural practices: Deep plowing can destroy the FAW pupae in soil. Intercropping with beans has shown to reduce the FAW infestations by 20-30 percent.

Host plant resistance: Transgenic/ BT maize varieties have been successful in controlling FAW. There are several varieties on the market that suppress/control FAW and other lepidopteran pests.

Biological control: Biological control is considered as an ecological option in an integrated pest management approach. Among several groups of parasitoids, egg parasitoids *Telenomus* spp. (Hymenoptera: Scelionidae) and *Trichogramma* spp (Hymenoptera:Trichogrammatidae) are deemed important in several countries. They are easy to grow under laboratory conditions and they invade the egg mass. There are 11 species of *Telenomus* and 26 species of *Trichogramma*/ *Trichogrammatoidea* found in Africa (Tables 1 and 2).

Biological control using *Telenomus* and *Trichogramma* is effective in managing FAW when the pest is at the egg stage. However, the presence of scales/hairs over the egg masses act as a barrier against parasitism by *Trichogramma* spp. This difficulty in egg masses parasitized by *Trichogramma* species can be overcome by using a more aggressive parasitoid, capable of breaking the physical barrier imposed by scales on the eggs. Therefore, it is essential to know the species/strains present in the agro-ecosystem when choosing the *Trichogramma* species to be used for applied biological control of FAW. *Telenomus remus* has proved very effective in South America and Florida. Another biological control agent, *Doru luteipes* (Dermaptera: Forficulidae) has been used as an agent for the biological control of FAW eggs in Brazil.

Figure 13: Egg parasitoid T. remus on Spodoptera eggs. (Beto Peralta)

Figure 14. T. Remus adults (www.gebio.com.br)

In its native regions, Fall Armyworm larvae and pupae are attacked by several species of parasites and parasitoids. The wasp parasitoids most frequently reared from larvae in the U.S. are *Cotesia marginiventris* and *Chelonus texanus* (both Hymenoptera: Braconidae). In Argentina, larval parasitoids collected were *Campoletis grioti* (Hymenoptera: Ichneumonidae), *Chelonus insularis* (Hymenoptera: Braconidae), *Archytas marmoratus* (Diptera: Tachinidae) and/or *A*. *incertus*, *Ophion* sp. (Hymenoptera: Ichneumonidae), *Euplectrus platyhypenae* (Hymenoptera: Eulophidae), and *Incamyia chilensis* (Diptera: Tachinidae). In Mexico, 13 genera of hymenoptera larval parasitoids belonging to three families, Braconidae, Ichneumonidae and Eulophidae were recovered. Five species of Ichneumonidae: *Diapetimorpha introit*, *Cryptus albitarsis*, *Ichneumon promissorius*, *Ichneumon ambulatorius* and *Vulgicheneumon brevicinctor*, two species of Chalcididae: *Brachymeria ovata* and *B. robusta* and one Eulophid species, *Trichospilus pupivora* have also been reported on FAW pupae from U.S., Argentina and Barbados.

Although several pathogens have been shown experimentally to reduce the abundance of FAW larvae in maize, only *Bacillus thuringiensis* is currently used, and success depends on having the product on the foliage when the larvae first appear. Bt sprays tend to be short-lived as they are very susceptible to UV degradation and make require multiple sprays.

Another option for biological control of FAW is *S. frugiperda* nuclear polyhedrosis virus (SFNPV). A large number of isolates of NPV have been obtained from the field and some have been detected as promising isolates. Some studies have also shown that *Metarhizium anisopliae* and *Beauveria bassiana* have a potential as microbial control agents against FAW.

Insecticides: Insecticides are considered a main control option in response to FAW outbreaks. However, there are major limitations to the use of chemicals. The FAW are often inaccessible to insecticides because of their tendency to hide in the whorls and reproductive parts of the host plant, limiting the efficacy of spraying.

Under African conditions, insecticides can be expensive and many subsistence farmers cannot afford chemical control methods. Spraying large areas of food crops and pastures with insecticides can be problematic in low income countries, as appropriate safety procedures may not be implemented on a regular basis. Personal protective equipment may not be widely available or affordable to subsistence farmers, which increases the risk of pesticide exposure and pesticide poisoning.

Management using insecticides should be considered when substantial damage occurs on at least 25 percent of the plants. If high levels of damage are noted in isolated areas of a field, spot treatments may be warranted. For an effective control and an adequate penetration by insecticides, spraying should be done late afternoon or early evening before the larvae burrow into the whorls or ears. Various insecticides recommended for FAW include pyrethroids, carbamates and organophosphates. Granular insecticides are also applied over the young plants because the particles fall deep into the whorl. However, a reliance on chemical control to manage pest populations has become increasingly ineffective as regional populations develop resistance to several toxicological groups of insecticides.

Transgene-based Maize Resistance to FAW: Transgenic Bt maize varieties expressing Crystal (Cry) toxins isolated from the soil bacterium Bacillus thuringiensis (Bt) are one of the management options used in the Americas for controlling Lepidopteran pests including the Fall Armyworm (FAW). Several Bt maize varieties are available from a number of different commercial companies and have been used successfully in many countries for well over 20 years to control FAW. These include single gene products, e.g., Cry1Ab, Cry1F, as well as multigene products using Bt Cry protein combinations, e.g., Cry1A and Cry2A class toxins which target different insect midgut receptors and which, together, mitigate development of pest resistance (Croplife IRAC). The line-up includes both Crystal proteins and newer Bt Vegetative Insecticidal Proteins (ViP), which offer an additional Mode of Action (MOA). Benefits of Bt maize include effective management of target pest, decreased use of conventional insecticides, and reduced risks to non-target organisms, including humans. These Bt crops have a long history of safe use and have been shown safe and efficacious by regulatory authorities around the world including the US EPA, FDA and USDA as well as the OECD (CERA 2010, 2012, 2013; US EPA, 2001, 2007, 2010, 2011; OECD 2007).

Currently, Bt maize is commercially grown in South Africa. Confined field Trials (CFT) are awaiting approval in Kenya under the Water Efficient Maize for Africa (WEMA) Project. The Bt varieties used in WEMA have been fully de-regulated in the U.S. (US EPA, 2001, 2007, 2010, 2011). In principle, following deregulation, an additional two years for open-field evaluation of Bt maize hybrid varietal trials is usually required before release (this is true also for non-GM crops), and perhaps an additional two years for seed scale-up and market saturation. However,

since these requirements are country specific it is within the power of a government to expedite release for humanitarian and safety purposes.

Transgenic crops, predominantly cotton, maize and soybean, expressing *Bacillus thuringiensis* (Bt) insecticidal proteins, have been widely planted globally since 1996. GM crops are scale-neutral and most adopters both in terms of surface area and the number of farmers (up to 90% were small holder farmers) are in the developing world (ISAAA, 2016). In 2016 alone, 185 million acres, an area equivalent to the total land mass of China, was planted in transgenic crops. Bt crops are particularly effective in controlling target insect pests while causing negligible harm to non-target beneficial biocontrol organisms. In addition, transgenic crops are grown with reduced chemical insecticide use. In the maize cropping system, Bt proteins have become a primary tool in pest management.

Resistance Management in GMO maize: Insects' development of resistance to pesticides, including biological control agents like Bt, is a well-understood process, and technology developers go to great lengths to develop processes to prevent and mitigate resistance, especially with transgenic crops expressing Bt toxins. Generally speaking, a common strategy is to deploy multiple toxins, with differing sites or modes of action, to delay resistance. Early GE maize varieties only expressed a single resistance gene and in rare cases resistance was selected in some insects in some geographies. Intensive use of one variety of Bt maize expressing a single Cry1F protein led to selection for resistance to FAW in Puerto Rico, Brazil, and the southeastern U.S. (Yang et al., 2016). Resistance to this single Cry1F protein also led to cross resistance to other closely related Cry1 proteins. Current crop varieties are engineered to have mutagenic redundant (3 to 5 genes) independent modes of action. These varieties, notably, Cry1Ac/Cry2Ab, Cry1Ac/Cry1F/Vip3A, Cry1Ab/Cry2Ae, or Cry1Ab/Cry2Ae/Vip3A, and the single-gene Cry2Ae plants, are all able to control the FAW. In some cases even Cry1Ac/Cry1F were effective in controlling FAW, which were partially resistant to Cry1F. Key to effectively controlling resistance to germplasm incorporating Bt toxins is: use of an integrated resistance management plan, primarily built around the use of a small "refugia" -- comprised of susceptible plants on which non-resistant pest insects may develop and breed with any rarely resistant pest insects produced in the Bt crop itself. These practices are variety- and crop-specific and are implemented through guidance collaboratively developed by standards-setting organizations such as Croplife IRAC and Excellence Through Stewardship (ETS).

8. Safer Use Action Plan (SUAP)

The SUAP summarizes what the conditions are for the safer use of the pesticide a.i.'s recommended in this PERSUAP. Specific safety requirements are provided for each pesticide a.i. individually in Pesticide Data Sheets (end of this document).

At a minimum, the SUAP should contain: 1) a list of implementation team members, their duties, and overall implementation timeline; 2) a description of planned training program for farmers, agricultural extension agents, handlers, applicators; 3) a description of a plan to establish and enforce pesticide quality, use of labels or other guidance, and container standards; 4) a description of a plan to ensure that pesticide-appropriate PPE is sustainably used and supplied; a description of a plan to apply location-specific good practice methods for safe pesticide transport, storage, handling, use, and disposal, as well as safe management and disposal of empty pesticide containers.

SUAP Conditions for Implementing Partners (IPs):

1. All IPs will develop a SUAP that is specific to the intervention area and implementing partner organizations.
2. Only pesticides with approved (by USEPA and host-government or a designated body where applicable) active ingredients can be procured, used or recommended for use with USAID funds.
3. Pesticide products procured, used or recommended for use must be labelled in a national language and include the following essential information:
    - name and concentration of active ingredient, type of formulation, instructions for use, user safety information, safety periods for re-entry and harvest, Manufacturer and country of origin.
4. Basic training in safer use must be provided broadly
5. Advanced training required for certain AIs and products
6. Pesticides for plant protection must be part of an IPM scheme
7. Appropriate Personal Protective Equipment (PPE) must be available.
8. Observance of label instructions and safe pesticide purchase, handling, storage and disposal practices.
9. Record-keeping & resistance monitoring
10. Regular implementation reporting
11. Pass-down to subcontractors and grantees

SUAP Conditions for USAID staff:

- All relevant staff should work with the Implementing Partner to receive appropriate training on the information requirements established by the governing PERSUAP.
- The USAID Mission must put in place effective internal procedures to review pesticide procurement requests submitted by IPs. The MEO must review and approve all procurement requests before the AOR/COR can clear.

Illustrative SUAP Template: The following template can be used to implement a robust Safer Use Action Plan (SUAP).

Project Title:					
Pesticide(s):			Crops:		
Location Common Name(s):			Target Pests:		
Required Compliance Mitigation Measures		Compliance Dates	Actions to achieve compliance	Responsible Party	Status
Capacity Building	Technical Assistance for Trainers				
	Development and Distribution of Educational Material				
	Training of Pesticide Handlers				
Local Issues	Establish Pesticide Quality Standards				
	Require Good Packaging and Clear, Adequate Labeling				
Safer Pesticide Use	Ensure Accessibility of Personal Protective Equipment				
	Define Appropriate Procedures for Safe Pesticide Transport				
	Define Appropriate Methods for Safe Pesticide Storage				
	Define Disposal Provisions for Used Pesticide Containers				
Long-Term Program	Coordination, Collaboration, Awareness raising, Surveillance, Control Management, Research				

9. Pesticide Discussion / Information

Pesticides are chemical substances intended to kill, inactivate, or repel pests. The pest in this case is *Spodoptera frugiperda,* and there are a number of pesticides which can be used to control this insect. However, many chemical pesticides can also poison human beings and other life forms and contaminate the environment. When using pesticides, it is critical to be aware of the toxicological and environmental hazards associated with a particular material. Using the least toxic material makes sense in terms of human health and environmental protection. The attached Pesticide Data Sheets (PDS) contain key information on each of the pesticides approved under this PERSUAP for use against *Spodoptera frugiperda* in USAID sponsored projects, and should be consulted prior to use.

In addition, all pests, including *Spodoptera frugiperda,* can develop resistance to a chemical pesticide that is used repeatedly and inappropriately. It is critical that pesticides be alternated to minimize the occurrence of pesticide resistance.

Other critical elements regarding the use of chemical pesticides include:

1) Training those who will handle and apply pesticides;
2) Use of appropriate Personal Protection Equipment (PPE);
3) Appropriate storage of pesticides and empty pesticide containers;
4) Safe disposal of unused pesticide and empty pesticide containers;
5) Environmental precautions.

Resistance to pesticides: Insecticide resistance in FAW was first noted in 1979 when a population of FAW collected from a maize field in Tifton, Georgia (U.S.) was shown to be resistant to carbaryl. A strain of FAW collected from maize in northern Florida (U.S.) showed resistance to commonly used insecticides in 1991. It has also shown some resistance to current chemical pesticides, limiting the effects of a carbamates, organophosphates and pyrethroid group of insecticides.

The following table lists existing Pesticide Evaluation Report and Safer Use Action Plan (PERSUAP) documents relevant to the control of the Fall Armyworm (FAW) in Africa. These PERSUAPs should be used as appropriate to assist USAID Missions in efforts to support the control of FAW.

Table 1 Existing bilateral, regional or DCHA Agricultural, Economic Growth, Feed the Future Sector and DCHA Food for Peace PERSUAPs in sub-Saharan Africa, valid in 2017, and relevant to the Fall Armyworm – FAW (Spodoptera frugiperda) management.

Country / Region	Approving Bureau	Crop Target Pest	PERSUAP Title and Link
Africa, Asia	AFR, DCHA	Target outbreak pests on all crops: Locusts, grasshoppers, African armyworm, rodents.	**Emergency Transboundary Outbreak Pest Management in Africa/Asia PEA** http://gemini.info.usaid.gov/repository/pdf/47321.pdf
Burkina Faso	AFR, SRO	Cow pea, onion, sorghum, tomato, livestock (goat, poultry, sheep), stored commodities (Corn-soy blend, rice, yellow/green split peas, beans, vegetable oil)	**Burkina Faso Victory Against Malnutrition PERSUAP** http://gemini.info.usaid.gov/repository/pdf/46326.pdf
Burkina Faso, Chad, Mali, Niger, Senegal, Benin, Cote d'Ivoire, Ghana, Liberia	AFR, WA	Rice; Maize/Sorghum; Millet; Wheat; Soybean; Cowpea; Pigeon Pea; Dolique Bean; peanut/ Groundnut; Bambara Nut; Cassava; Tiger Nut; Sweet potato; Yam; Tomatoes; Peppers; Eggplants; Onions; Garlic; Shallots; Leeks; Chives; Okra; Melons; Cucumbers; Squashes; Lettuce; Cabbage; Collards; Cotton; Sesame; Henna Bush (Niger); Hibiscus (aka Bissap, Jamaican Sorrel, Roselle); Moringa/Cabbage Tree (Niger); Cocoa; Cashew fruit & nut; Shea Nut; Mango; Banana; Turkeys, Geese, Ducks, Chickens, Guinea Fowl, Pigeons; Camels, Cattle, Sheep & Goats for meat, milk & hides	**West Africa Regional Programmatic PERSUAP** http://gemini.info.usaid.gov/repository/pdf/42966.pdf
Cameroon, Cote I'Ivoire, Ghana, Nigeria	BFS	Cocoa	**African Cocoa Initiative (ACI) PERSUAP** http://gemini.info.usaid.gov/repository/pdf/39896.pdf
DRC	AFR	maize, legumes cassava, rice and reforestation trees	**DRC Food Production, Processing & Marketing Activity (FPPM)** [*FYI: update pending approval*] http://gemini.info.usaid.gov/repository/pdf/39743.pdf

Country / Region	Approving Bureau	Crop Target Pest	PERSUAP Title and Link
Ethiopia	AFR	Oilseeds and pulses, coffee, vegetables, fruits, summer flowers, hides, skins, leather	**Ethiopia Agribusiness and Trade Expansion (ATEP) PERSUAP** http://gemini.info.usaid.gov/repository/pdf/47181.pdf
Ethiopia	AFR	Maize; wheat; chickpea; sesame; coffee	**Agricultural Growth Program- Agribusiness and Market Development (AGP-AMDE)** http://gemini.info.usaid.gov/repository/pdf/40013.pdf
Ethiopia	AFR	High priority crops: Maize, sorghum, wheat, field pea, haricot bean, tomatoes, onions, cabbages, citrus	**Ethiopia Commercial Farm Service Program (CFSP)** http://gemini.info.usaid.gov/repository/pdf/40018.pdf
Ethiopia	DCHA	Wheat (Hard, Red, Winter); Yellow Split Peas; green peas or lentils	**Productive Safety Net Program (PSNP) Title II Development Food Assistance Food Assistance Program (DFAP)** http://gemini.info.usaid.gov/repository/pdf/42326.pdf
Ghana	AFR	Rice, maize, soybean	**Agricultural Development and Value Chain Enhancement Feed the Future Activity (ADVANCE II)** http://gemini.info.usaid.gov/repository/pdf/38543.pdf
Ghana	AFR	rice, maize, soybean	**Ghana Feed the Future Agricultural Technology Transfer (ATT) IEE** http://gemini.info.usaid.gov/repository/pdf/39950.pdf
Kenya	AFR	Brinjals, Irish Potatoes, tomatoes, cabbage, cauliflower, kale, field beans, maize, bananas, sweet potatoes, millet, sorghum	**Kenya Asset-based financing of Smallholder Farmers Project (ABSFS)** http://gemini.info.usaid.gov/repository/pdf/39195.pdf
Kenya	AFR	Livestock (camels, cattle, sheep, goats); sorghums, millets, grain legumes, cassava, sweet potato	**Resilience and Growth in Arid Lands- Increased Resilience (REGAL-IR)** http://gemini.info.usaid.gov/repository/pdf/41596.pdf

Country / Region	Approving Bureau	Crop Target Pest	PERSUAP Title and Link
Kenya	AFR	Maize; potatoes; beans; pulses (cow peas, green grams, chick peas, pigeon peas); sorghum; tomatoes; onions; french beans; peas; cows	**Kenya Agricultural Value Chain Enterprises (KAVES)** http://gemini.info.usaid.gov/repository/pdf/40016.pdf
Kenya, Zambia and Malawi	BFS	Cowpea; pigeon pea; green grams (mung bean)	**Strengthening Agriculture Input and Output Markets in Africa (SAIOMA) Amendment** http://gemini.info.usaid.gov/repository/pdf/41496.pdf
Liberia	AFR	Rice, cassava, Cucurbitaceae, Brassiceae, Compositae, Solanaceae, Alliaceae, Malvaceae	**Food and Enterprise Development (FED) Program** http://gemini.info.usaid.gov/repository/pdf/38545.pdf
Liberia	AFR	Cocoa	**People, Rules and Organizations Supporting the Protection of Ecosystem Resources (PROSPER)** http://gemini.info.usaid.gov/repository/pdf/41071.pdf
Malawi	AFR	Tea; coffee; groundnut; macadamia; paprika and chili peppers; maize; rice; tomatoes; potatoes; onions/garlic; cucumbers; mango; pineapple; banana; citrus; papaya; strawberries; cassava; sweet potato; dairy cattle	**Malawi Sustainable Economic Growth Portfolio** http://gemini.info.usaid.gov/repository/pdf/39286.pdf
Mali	AFR	Sorghum; millet; rice; maize; vegetables; potato; peanuts/groundnuts; cowpeas; cattle; small ruminants; fish farming/rice fish farming	**Mali Accelerated Economic Growth (AEG) PERSUAP** http://gemini.info.usaid.gov/repository/pdf/43861.pdf
Mozambique	AFR	Traditional and specialty export vegetables; Cassava; Banana; Mango & Fresh Fruits; bananas; cashews; cotton; groundnuts; maize; soybean, sesame, cashew; improved seed and production of pigeon peas, cowpeas by small-scale farmers; maize; Mango & Fresh Fruits pigeon pea; sesame; soybeans; stored maize & beans; sunflower; sweet potato, potato; traditional and specialty export vegetables; vegetables like tomato, cabbage, carrots, peppers, cucumber & okra	**Field Crop an d Livestock Production Programs, Agriculture Research Programs and Food Security Programs of USAID/Mozambique** http://gemini.info.usaid.gov/repository/pdf/39013.pdf

Country / Region	Approving Bureau	Crop Target Pest	PERSUAP Title and Link
Niger	DCHA	Millet/sorghum, groundnut, cowpea, okra, tomato, peppers, eggplant, Irish potato, sweet potato, onion/garlic, cabbage/lettuce, cucurbits, sesame, carrot, moringa, apple of the Sahel, hibiscus	**FFP PASAM-TAI, Sawki, LAHIA – PERSUAP** http://gemini.info.usaid.gov/repository/pdf/46041.pdf
Nigeria	AFR	Cocoa, cassava, maize, rice, sorghum, soybeans	**Nigeria MARKETS II PERSUAP** http://gemini.info.usaid.gov/repository/pdf/43056.pdf
Rwanda	AFR	Commercial cash crops: coffee, tea; Grains/food security crops: rice, maize/seed corn, sorghum, finger millets, wheat, plantain; Pulse crops: beans, cowpeas, peas, soya, groundnut; Commercial export and local use crops: snow peas, sugar snaps, French beans; Root crops: Irish/seed potatoes, cassava, taro root, beets, radishes, carrots and sweet potatoes; Vegetables: tomatoes, greenhouse tomatoes, eggplant, peppers: chili, sweet, lettuce, celery; Fruits: banana, passion fruit, tree tomato, mango, avocado, pineapple, watermelon, papaya, jackfruit; Oil crops: sunflower, soya, used for oil and seed; Alliums: onions, garlic, leeks; Cole crops/brassicas: broccoli, cauliflower, Chinese cabbage, collard greens, cabbage; Cucurbits: cucumbers, cornichons (commercial export and local use), pumpkins, zucchini; Herbs/spices: parsley, dania, basil, coriander/cilantro, ginger root; Mushrooms: oyster and other mushrooms; Indigenous crops: amaranth, African nightshade/managu, spider plant, Moringa; Livestock fodders: Rhodes grass, Desmodium, Oxalis, Sudan grass, alfalfa, lupine, Kikuyu grass	**Rwanda Private Sector Driven Agricultural Growth (PSDAP) PERSUAP** http://gemini.info.usaid.gov/repository/pdf/46391.pdf
Rwanda	GDL	rice, maize, wheat, cassava, irish potatoes, climbing beans	**Rwanda Agriculture Extension for Smallholder Farmers Project** http://gemini.info.usaid.gov/repository/pdf/45011.pdf
Senegal	AFR	Mango, banana, millet, sorghum, rice, maize, tomato, cabbage, pepper, okra, lettuce	**Senegal Increased Economic Growth** http://gemini.info.usaid.gov/repository/pdf/38624.pdf

Country / Region	Approving Bureau	Crop Target Pest	PERSUAP Title and Link
Senegal, Mali, Burkina Faso, Niger, Liberia, Cote d'Ivoire, Ghana, Togo, Benin, Nigeria, Sierra Leone		Rice; Sorghum; Maize; Livestock; Milk	**West and Central African Council For Agricultural Research and Development (CORAF/WECARD)** http://gemini.info.usaid.gov/repository/pdf/39908.pdf
Somalia	AFR	Livestock fodder crops, maize, cowpea, spinach, livestock, cabbage, peppers/chilis, melons, onions, tomato, okra, mung bean,	**Partnership for Economic Growth (PEG) PERSUAP** http://gemini.info.usaid.gov/repository/pdf/43821.pdf
South Sudan	AFR, DCHA	Cabbage, cassava, dry beans, groundnut, kale, maize, millet, okra, onions, pigeon peas, sesame, sorghum, tomatoes, upland rice	**Food, Agribusiness and Rural Markets (FARM) PERSUAP** http://gemini.info.usaid.gov/repository/pdf/39495.pdf
Tanzania	AFR	Maize, rice (nafaka in Swaheli is cereal, food or grain)	**Tanzania NAFAKA Project** http://gemini.info.usaid.gov/repository/pdf/38800.pdf
Tanzania	AFR	African eggplant, amaranth, baby corn, brassica, capsicums, carrot, cucurbits, eggplant, fine beans, peas, cowpeas, garlic, irish potatoes, okra, onion, nightshade, tomato, sweet potatoes, avocado, banana, citrus, mango, papaya, passionfruit, pineapple, black pepper, cardamom, cinnamon, cloves, ginger, lemongrass, vanilla, cashew, summer flowers, rosella	**Tanzania Agriculture Productivity Program PERSUAP** http://gemini.info.usaid.gov/repository/pdf/38806.pdf
Uganda	DCHA	Banana, beans, cassava, coffee, cowpea, groundnut, Irish potato, maize, sesame, sorghum, soybean, sunflower, sweet potato, upland rice, vegetables (cabbage, tomato, onion, etc.), warehouse commodities, livestock	**FFP A-V SUAP to Mission PERSUAP** http://gemini.info.usaid.gov/repository/pdf/46421.pdf

Country / Region	Approving Bureau	Crop Target Pest	PERSUAP Title and Link
Uganda	DCHA	Banana, beans, cassava, coffee, cowpea, groundnut, Irish potato, maize, sesame, sorghum, soybean, sunflower, sweet potato, upland rice, vegetables (cabbage, tomato, onion, etc.), warehouse commodities, livestock	**FFP MC Safe Use Action Plan for Mission PERSUAP** http://gemini.info.usaid.gov/repository/pdf/46416.pdf
Uganda	AFR, DCHA	Banana, beans, cassava, coffee, cowpea, groundnut, Irish potato, maize, sesame, sorghum, soybean, sunflower, sweet potato, upland rice, vegetables (cabbage, tomato, onion, etc.), warehouse commodities.	**USAID Uganda DO1 Economic Growth & DCHA FFP PERSUAP** http://gemini.info.usaid.gov/repository/pdf/43631.pdf
Zambia	AFR	Maize, sunflower, groundnut, soybean, tomato, onion, Alliums (green, yellow and red onions, garlics, leeks), Cucurbitaceae (pumpkins, squashes, watermelon, cucumbers), Brassicaceae (broccoli, cabbage, cauliflower, Brussels sprouts), Leafy greens (lettuce, spinach), Leguminosae (green beans, bean sprouts), Root crops (beets, turnips), Maize (sweet corn, green maize), Umbelliferae (baby carrots, celery), Solanaceae (tomato, potato, eggplant, sweet pepper), rutaceae/citrus (orange, lemon), imiaceae/ mints (basil), banana, papaya, strawberry, and flowers (carnations, gladiolas).	**Zambia DO2 Economic Growth** http://gemini.info.usaid.gov/repository/pdf/39400.pdf
Zimbabwe	AFR	Bananas, green beans, dry beans, soybeans, broccoli, cabbage, cauliflower, cowpeas, cucurbits, groundnuts, maize, sweet corn, baby corn, peas, peppers, paprika, irish potatoes, sweet potatoes, tomatoes	**Zimbabwe Economic Growth Portfolio 2012 PERSUAP** http://gemini.info.usaid.gov/repository/pdf/38807.pdf
Zimbabwe	AFR	Bananas, green beans, dry beans, soybeans, broccoli, cabbage, cauliflower, cowpeas, cucurbits, groundnuts, maize, sweet corn, baby corn, peas, peppers, paprika, Irish potatoes, sweet potatoes, tomatoes	**2016 Zimbabwe Economic Growth Portfolio Amendment** http://gemini.info.usaid.gov/repository/pdf/48336.pdf
Zimbabwe	AFR DCHA	Zimbabwe Crop Development Program: Pesticide Safer Use Action Plan & Compliance Tracker	**Zimbabwe Crop Development Program PERSUAP** http://gemini.info.usaid.gov/repository/pdf/48326.pdf

A wide variety of pesticides are available on the market in Africa, some of which are highly toxic. Because these products are often inexpensive and easily available, farmers may be tempted to buy and utilize such products without being aware of the potential risks involved. The purpose of this document and the following list of pesticides, as well as the existing Africa PERSUAPs, is to provide essential information on the pesticides which are effective against FAW and have relatively low human health and environmental risks.

In agreement with applicable country-specific regulatory policies and procedures, the following pesticides will be appropriate for USAID sponsored projects. Utilize this list (as well as the Pesticide Data Sheets in Annex 5) in conjunction with an existing PERSUAP and local expertise in the use of pesticides as part of an overall Integrated Pesticide Management (IPM) program.

Table 2 Pesticides Recommended in this FAW Programmatic PERSUAP

Active ingredient/ Chemical (accepted common name) & Illustrative Trade Name	**Toxicity** EPA (signal word) [WHO]	**Pre-Harvest Interval** (# of days after last pesticide application)	**Acute/Chronic Toxicity (human hazards**	**Eco-toxicity**	**Groundwater Contamination Potential**	**Other Comments/Crops**
abamectin Trade name: Abba	EPA: II (Warning), GUP, RUP [WHO: Not listed]	28	May cause slight to moderate eye and skin irritation. Not readily absorbed through the skin	Highly toxic to crustaceans and bees. Low toxicity to fish	Very low potential for groundwater contamination	Abamectin is a natural fermentation product of a soil bacterium *Streptomyces avermitilis*. It is an Insecticide/ miticide/ acaricide with stomach and contact mode of action. It is used to control insect and mite pests of a range of agronomic, fruit, vegetable and ornamental crops.
Acetamiprid Trade name: Gazelle	EPA: III (Caution) [WHO: Not listed]	7	Harmful if swallowed. inhaled or absorbed through skin. Causes moderate eye irritation. Not likely a carcinogen.	Extremely toxic to fish and aquatic invertebrates. highly toxic to bees		Systemic insecticide with translaminar activity and with contact and stomach action. Neonicotinoid.

Active ingredient/ Chemical (accepted common name) & Illustrative Trade Name	**Toxicity** EPA (signal word) [WHO]	**Pre-Harvest Interval** (# of days after last pesticide application)	**Acute/Chronic Toxicity (human hazards**	**Eco-toxicity**	**Groundwater Contamination Potential**	**Other Comments/Crops**
acetamiprid + lambda-cyhalothrin	EPA: II (Warning), GUP, RUP [WHO: Not listed]	21	May cause slight irritation of the eye and skin. Could cause gastrointestinal disorders if swallowed.	Highly toxic to aquatic organisms	unknown	
Bacillus thuringiensis (Bt) var. kurstaki Trade Name: Thuricide	EPA: III (Caution) GUP [WHO: Not acute hazard]	0	Practically non-toxic, could cause moderate eye irritation	Selective for caterpillars only, not toxic to other organisms	None	A bacterium selectively toxic to many moth and butterfly larvae (caterpillars). Insects stop feeding and die within 2 – 3 days of ingestion. This product may be applied up to the day of harvest.
Bifenthrin Trade name: Capture (See attached Pesticide Data Sheet, Annex 5)	EPA: II (Warning), RUP [WHO: Moderately hazardous]	30	Fatal if swallowed. Harmful if inhaled or absorbed through skin. Causes moderate eye irritation. May be a possible carcinogen.	Extremely toxic to fish and aquatic invertebrates. Highly toxic to bees. Do not apply this product or allow to drift to blooming crops if bees are visiting the treatment area.	Little impact on aquatic systems under field conditions.	Also registered for use on cotton, citrus, ornamentals and vegetables. It is a member of the pyrethroid class with contact and stomach action. It acts on the nervous system of insects, disturbs the function of neuron by interaction with sodium channels.

Active ingredient/ Chemical (accepted common name) & Illustrative Trade Name	**Toxicity** EPA (signal word) [WHO]	**Pre-Harvest Interval** (# of days after last pesticide application)	**Acute/Chronic Toxicity (human hazards**	**Eco-toxicity**	**Groundwater Contamination Potential**	**Other Comments/Crops**
Beauveria bassiana (See attached Pesticide Data Sheet, Annex 5)	EPA: III (Caution) GUP [WHO: Not acute hazard]	0	Causes moderate eye irritation. Harmful If absorbed through the skin, inhaled or swallowed. May produce an allergic reaction. No expected long-term risks.	May be toxic to bees, fish and aquatic organisms. Potentially pathogenic to honey bees.	No potential for groundwater contamination.	*Beauveria bassiana* is a naturally occurring fungal insecticide that is commonly found in soils worldwide and is used as a pesticide for controlling many kinds of insects. Also registered for use on potatoes, peppers, and eggplants, ornamentals, fruits, turf.
Carbaryl Trade name: Sevin (See attached Pesticide Data Sheet, Annex 5)	EPA: II (Warning), GUP [WHO: Moderately hazardous]	48	Harmful if swallowed, inhaled or absorbed through skin. Overexposure can result in convulsions, coma, and death. Likely to be carcinogenic in humans.	Extremely toxic to estuarine and aquatic invertebrates, highly toxic to bees. Do not apply this product or allow to drift to blooming crops if bees are visiting the treatment area.	Potential ground water contaminant.	Also registered for use on cotton, citrus, ornamentals and vegetables. It is a member of the carbamate class with contact and stomach action and slight systemic properties.

Active ingredient/ Chemical (accepted common name) & Illustrative Trade Name	**Toxicity** EPA (signal word) [WHO]	**Pre-Harvest Interval** (# of days after last pesticide application)	**Acute/Chronic Toxicity (human hazards**	**Eco-toxicity**	**Groundwater Contamination Potential**	**Other Comments/Crops**
chlorantraniliprole (See attached Pesticide Data Sheet, Annex 5)	EPA: III (Caution) GUP [WHO: Not acute hazard]	21	Not a possible carcinogen.	Toxic to aquatic invertebrates, oysters and shrimp.	Potential ground water contaminant.	Also registered for use on cotton, citrus, ornamentals and vegetables. It acts primarily through ingestion and also through contact. Affected insects rapidly stop feeding, general lethargy, paralysis and ultimate death.
chlorantaniliprole + lambda-cyhalothrin Trade name: Besiege (See attached Pesticide Data Sheet, Annex 5)	EPA: III (Caution) GUP [WHO: Not listed]	21	Fatal if swallowed. Harmful if absorbed through skin. Causes moderate eye irritation, may cause allergic skin reactions. Not a possible carcinogen.	Extremely toxic to fish, aquatic invertebrates and wildlife. Highly toxic to bees. Do not apply this product or allow drifting to blooming crops if bees are visiting the treatment area.	Potential ground water contaminant.	Also registered for use on canola, vegetables. cereal crops. Broad-spectrum insecticide providing both rapid knockdown and long lasting residual control of lepidopteran, sucking and chewing insect pests. It has dual modes of action and provides control by contact, ingestion and ovicidal action.

Active ingredient/ Chemical (accepted common name) & Illustrative Trade Name	**Toxicity** EPA (signal word) [WHO]	**Pre-Harvest Interval** (# of days after last pesticide application)	**Acute/Chronic Toxicity (human hazards**	**Eco-toxicity**	**Groundwater Contamination Potential**	**Other Comments/Crops**
beta-cyfluthrin Trade name: Baythroid (See attached Pesticide Data Sheet, Annex 5)	EPA: II, III (Warning, Caution) RUP, GUP [WHO: Not listed]	21	Harmful if swallowed, inhaled or absorbed through skin. Causes substantial but temporary eye injury. May be a possible carcinogen.	Extremely toxic to fish and aquatic invertebrates. Highly toxic to bees. Do not apply this product or allow to drift to blooming crops if bees are visiting the treatment area.	Potential ground water contaminant.	Also registered for use on cotton, citrus, ornamentals and vegetables. It is a non systemic insecticide with contact and stomach action. it causes rapid knock down and has long residual activity. It acts on the nervous system of insects, disturbs the function of neuron by interaction with sodium channels.
gamma-cyhalothrin Trade name: Proaxis (See attached Pesticide Data Sheet, Annex 5)	EPA: II, III (Warning, Caution) RUP, GUP [WHO: Not listed]	21	Harmful if swallowed, inhaled or absorbed through skin. Causes moderate eye irritation. May be a possible carcinogen.	Extremely toxic to fish and aquatic invertebrates and wildlife. Highly toxic to bees. Do not apply this product or allow to drift to blooming crops if bees are visiting the treatment area.	Potential ground water contaminant.	Also registered for use on some row crops and vegetables. It is a non-systemic insecticide with contact and stomach mode of action. It acts on the nervous system of insects, disturbs the function of neuron by interaction with sodium channels. Pyrethroid.

Active ingredient/ Chemical (accepted common name) & Illustrative Trade Name	**Toxicity** EPA (signal word) [WHO]	**Pre-Harvest Interval** (# of days after last pesticide application)	**Acute/Chronic Toxicity (human hazards**	**Eco-toxicity**	**Groundwater Contamination Potential**	**Other Comments/Crops**
lambda-cyhalothrin Trade name: Warrior II (See attached Pesticide Data Sheet, Annex 5)	EPA: II, III (Warning, Caution) RUP, GUP [WHO: Not acute hazard]	21	Fatal if swallowed. Harmful if absorbed through skin. Causes moderate eye irritation. May be a possible carcinogen.	Extremely toxic to fish and aquatic invertebrates and wildlife. Highly toxic to bees. Do not apply this product or allow to drift to blooming crops if bees are visiting the treatment area.	Potential ground water contaminant.	Also registered for use cotton, ornamentals and vegetables. It is a non-systemic insecticide with contact and stomach mode of action and repellent properties. It acts on the nervous system of insects, disturbs the function of neuron by interaction with sodium channels. it gives rapid knock down and has long residual activity.
zeta-cypermethrin Trade name: Respect (See attached Pesticide Data Sheet, Annex 5)	EPA: II, III (Warning, Caution) RUP, [WHO: Not acute hazard]	30	Harmful if swallowed, inhaled or absorbed through skin. Causes moderate eye irritation. Avoid contact with eyes and breathing spray mist May be a possible carcinogen.	Toxic to aquatic invertebrates, oysters and shrimp. Highly toxic to bees. Do not apply this product or allow to drift to blooming crops if bees are visiting the treatment area.	Potential ground water contaminant.	Also registered for use on cotton, citrus, ornamentals and vegetables. It is a member of the pyrethroid class with contact and stomach action. It acts on the nervous system of insects, disturbs the function of neuron by interaction with sodium channels.

Active ingredient/ Chemical (accepted common name) & Illustrative Trade Name	**Toxicity** EPA (signal word) [WHO]	**Pre-Harvest Interval** (# of days after last pesticide application)	**Acute/Chronic Toxicity (human hazards**	**Eco-toxicity**	**Groundwater Contamination Potential**	**Other Comments/Crops**
dimethoate Trade name: Dimethoate	EPA: II (Warning) [WHO: Moderately hazardous]	15	Moderate to severe skin irritation. Severe irritation of eyes.	Slightly toxic to fish, HT to amphibians and crustaceans and VHT to bees	Potential groundwater contaminant	Systemic insecticide and acaricide with contact and stomach action. It is a cholinesterase inhibitor.
imidacloprid Trade name: Admire Pro	EPA: II, III (Warning, Caution) RUP, GUP [WHO: Not acute hazard]	0	Harmful if swallowed or absorbed through skin. not listed as carcinogen; unknown as dev/reproductive toxin	Not acutely toxic to fish; Extremely toxic to insects, and honeybees, expressed in pollen and nectar	Potential ground water contaminant	It is a systemic insecticide with translaminar activity and with stomach and contact action. It can be applied as soil, seed and foliar treatment for the control of sucking insects as well as soil insects. Avoid flowering crops in bloom!
indoxacarb acetamiprid	EPA: III (Caution) [WHO: Not acute hazard]	21	It may cause mild eye irritation with tearing, & blurred vision. May cause skin sensitization with allergic rashes. Not likely a carcinogen.	Moderately toxic to bees, Highly toxic to fish and crustaceans.	No data found	It is a contact poison. Affected insects stop feeding with poor coordination and paralysis and ultimate death. Effective against lepidopteran pests of cotton, vegetable and fruits.

Active ingredient/ Chemical (accepted common name) & Illustrative Trade Name	**Toxicity** EPA (signal word) [WHO]	**Pre-Harvest Interval** (# of days after last pesticide application)	**Acute/Chronic Toxicity (human hazards**	**Eco-toxicity**	**Groundwater Contamination Potential**	**Other Comments/Crops**
Metarhizium anisopliae (See attached Pesticide Data Sheet, Annex 5)	EPA: III (Caution) [WHO: Not acute hazard]	0	Harmful if swallowed, inhaled or absorbed through skin. Causes moderate eye irritation. No expected long-term risks.	No major threats to non-target ecosystems	May be a potential groundwater contamination.	Also registered for use on potatoes, peppers, and eggplants. *Metarrhizium anisopliae* is a natural biopesticide based on the naturally occurring fungus. It is effective against a variety of pests. It should be applied when the temperature is between 18-28°C/65-82°F and the relative humidity is approximately 80%.
malathion Trade name: Malathion	EPA: II (Warning) [WHO: Slightly hazardous]	7	Harmful if swallowed or absorbed through skin. Causes substantial but temporary eye injury. Not likely a carcinogen and mutagen.	It is toxic to aquatic organisms, including fish and invertebrates. Highly toxic to bees. Do not apply this product or allow drift in to blooming crops if bees are visiting the treatment area.	Potential ground water contaminant	Non-systemic insecticide and acaricide with contact and stomach and respiratory action. Used on potatoes, vegetables, cotton and rice.

Active ingredient/ Chemical (accepted common name) & Illustrative Trade Name	**Toxicity** EPA (signal word) [WHO]	**Pre-Harvest Interval** (# of days after last pesticide application)	**Acute/Chronic Toxicity (human hazards**	**Eco-toxicity**	**Groundwater Contamination Potential**	**Other Comments/Crops**
Methoxyfenozide Trade name: Intrepid (See attached Pesticide Data Sheet, Annex 5)	EPA: III (Caution) [WHO: Not acute hazard]	21	Harmful if absorbed through skin. Avoid contact with eyes and skin or clothing. Avoid breathing spray mist.	May be hazardous to aquatic invertebrates.	Potential ground water contaminant.	It belongs to the diacylhydrazine class and mimics the action of molting hormone of lepidopteran insects. It is an ecdysone agonist, caused cessation of feeding and lethal premature molt. complete mortality of insect may take several days but the affected larvae becomes lethargic. It does not have any systemic properties.
Permethrin Trade name: Ambush (See attached Pesticide Data Sheet, Annex 5)	EPA: III (Caution) [WHO: Moderately hazardous]	30	Harmful if swallowed, inhaled or absorbed through skin. Causes skin irritation. May be a possible carcinogen. Avoid contact with eyes and breathing spray mist	Extremely toxic to fish and aquatic invertebrates. Highly toxic to bees. Do not apply this product or allow to drift to blooming crops if bees are visiting the treatment area.	Potential ground water contaminant.	Also registered for use on cotton, citrus, ornamentals and vegetables. It is a non systemic insecticide with contact and stomach action and some repellent properties. It acts on the nervous system of insects, disturbs the function of neuron by interaction with sodium channels

Active ingredient/ Chemical (accepted common name) & Illustrative Trade Name	**Toxicity** EPA (signal word) [WHO]	**Pre-Harvest Interval** (# of days after last pesticide application)	**Acute/Chronic Toxicity (human hazards**	**Eco-toxicity**	**Groundwater Contamination Potential**	**Other Comments/Crops**
Spinetoram (Delegate) Trade name: Delegate (See attached Pesticide Data Sheet, Annex 5)	EPA: III (Caution) [WHO: Not acute hazard]	1	**Causes Moderate Eye Irritation** **Avoid contact with eyes or clothing. May be a possible carcinogen.**	This product is toxic to bees exposed to treatment during the 3 hours following treatment. This product is toxic to aquatic invertebrates.	Potential ground water contaminant.	Also registered for use on cotton, citrus, ornamentals and vegetables. Fermentation product of *Saccharopolyspora spinosa*, and an analogue of spinosad. It acts as contact and stomach poison and causes paralysis. [Fermentation product of *Saccharopolyspora spinosa*, and an analogue of spinosad, a spinosyn]
Spinosad Trade name: Success	EPA: III (Caution) [WHO: Not acute hazard]	1	May cause slight irritation to eyes	Slightly toxic to earthworms, Moderately toxic to fish, Highly toxic to bees.	Very low potential for ground water contamination	Spinetoram is toxicologically identical to spinosad

ANNEXES

Annex 1. Ghana Fall Armyworm Pest Management Decision Guide (Dec. 2016), produced by Ghana MOFA PPRSD & CABI Plantwise (Dec. 2016/March 2017), Link: http://www.plantwise.org/FullTextPDF/2017/20177800275.pdf

PEST MANAGEMENT DECISION GUIDE: GREEN AND YELLOW LIST

plantwise

Fall armyworm on maize

Spodoptera frugiperda

Fall armyworm larva and frass on maize tassle (J. Crozier, CABI)

Damage cause to cob by larva (J. Crozier, CABI)

Top - Damage on maize leaves (J Crozier, CABI); Bottom - Egg mass on cotton leaf (©Ronald Smith/Auburn University/ Bugwood.org - CC BY 3.0 US)

Prevention	Monitoring	Direct Control	Direct Control	Restrictions
• Avoid late planting. Plant early to avoid peak immigration of adults • Remove and destroy all crop residues after harvest • Deep plough the soil to bury the larvae and the pupae • Regularly weed the field and surroundings • Ensure optimum fertilization is used for your maize crop: Recommended fertilizer rates (4 bags or 200kg of NPK 15:15:15 per ha) to increase the growth vigour	• Start monitoring for presence of the pest or symptoms from the 2-3 week stage • Look for cream or grey egg masses on the underside of leaves covered in a felt-like layer of grey-pink scales from the female moth • Check for light green to dark brown larvae with 3 thin yellowish white stripes down the back and a distinct white inverted "Y" on head • Monitor the whorl for larvae covered with a plug of yellowish brown frass • Look for patches of small shot holes "window pane" to large ragged and elongated holes in the leaves emerging from the whorl • Monitor damage on 10 consecutive plants in 10 randomly selected sites. Take control measures if 20% of plants are infested with larvae	• On small-scale farms, handpick and destroy the egg masses and larvae • Put a handful of sand (mixed with lime or ash), sawdust or soil in the whorl of the attacked plants to kill the larvae	• When using a pesticide or botanical, always wear protective clothing and follow the instructions on the product label.	
			• Do not use chemicals with the same mode of action year after year as this can lead to resistance.	
			• Always consult the most recent list of registered pesticides of MOFA, Ghana	
			• Apply Acetamiprid (20g/l) + Lambda-cyhalothrin (16g/l) (E.g. K-Optimal, Blast 60EC). Acetamiprid: systemic neonicotinoid IRAC group 4A. Lambda-cyhalothrin: contact, ingestion pyrethroid IRAC group 3A	• WHO class II (moderately harzardous). Apply 60-80mls per 15 litre knapsack. REI is 24hours. Stop application when the cobs are well formed. Apply 3 times at 2 week intervals
			• Apply Dean 62EC (Imidacloprid 60g/l) + Emamectin benzoate (12g/l)). Imidacloprid: systemic neonicotinoid IRAC group 4A. Emamectin benzoate: contact, IRAC group 6	• Imidacloprid. WHO class II (moderately harzardous). Apply 60-80mls per 15 litre knapsack. REI is 24hours. Stop application when the cobs are well formed. Apply 3 times at 2 week intervals
			• Apply Emamectin benzoate 1.9EC IRAC group 6.	• Apply 60-80mls per 15 litre knapsack. REI is 24hours. Stop application when the cobs are well formed. Apply three times at two week intervals. Pirimiphos methyl is an organophosphate and persistant in the environment
			• Apply biopesticides Bacillus thuringiensis (e.g. Ecopel or Bypel1) at a rate of 25g/15ltr knapsack	• WHO Class III - (slightly hazardous). Apply 3x at two week intervals

MOFA

Ghana

CREATED/UPDATED: December 2016 / March 2017
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Annex 2. Safer Use Action Plan (SUAP) Example
Ghana Comprehensive Action Plan for Management of the Fall Armyworm (May 8, 2017) (source: CABI Plantwise)

Theme	Activities	Who is involved	Who already has plans	Time Line
SHORT-TERM ACTIVITIES				
Coordination and collaboration	Identify key stakeholders and establish a steering committee with balanced representation of men, women and youth	PPRSD/MOFA-Lead/CABI/ Farmers(men, women and youth)/Researchers/Input dealer/solution providers/ Development partners/Civil societies/Non-governmental org/The media/District assemblies/Funding agents/Private sector groups	MOFA/PPRSD CABI ACDI/ADVANCE (USAID) GIZ ETC	21st to 30th April,2017
	Networking with all stakeholders to enhance information flow. Who to contact, how to organize the information, dissemination, how regular is the information flow, where to locate this platform	Policy makers (PPBD,PPRSD,EPA,CSD and DAES), NGO's, FBO's, GAIDA, CSO's, ECOWAS, Donors, AU, CSIR, Farmers AEAs, General public and the Universities	PPRSD/CABI, ADVANCE, AGRA, FAO, USAID	End of May
	Organize stakeholder fora Identify roles and responsibilities of the various responsibilities(TOR)	PPRSD -MOFA/ CABI	PPRSD-MOFA CABI	1ST -2ND WEEK OF MAY

Theme	Activities	Who is involved	Who already has plans	Time Line
	Identify collaborating institutions such as EPA, GSA, GES, Information services, NGO's, Funding Partners, (Ghana should consider public funding of armyworm control for maize growers. (Example: partial subsidy for biologically rational pesticides like Bt and Spinosad.)Ghana should consider public funding for armyworm insecticide spray trials.)	PPRSD-MOFA/CABI	PPRSD-MOFA CABI	1ST -2ND WEEK OF MAY
	Develop an Action Plan. Formation of operational committees to implement the action plan. Field activities (trials)	Steering Committee	Steering Committee	Periods within the next six months.
Awareness raising	Capacity building (training and equipping) for various competency levels (frontline/extension staff, data analyst, farmers, etc) on identifying the moths (with or without pheromone traps), identifying early damage (field scouting) and checking field edges (sweep net sampling).	MoFA-PPRSD, Dept of Agriculture, Regional Agric Dept, CSIR, Universities, NGOs (ADVANCE, GIZ, etc), Data Analyst	MoFA-PPRSD, ADVANCE (USAID), CABI	Q2 2017 onwards
	Talk show/jingles on radio (and TV if possible) programs in English and major local languages	Farmers, General public, AEAS, ADVANCE, Farm Radio, PPRSD, CABI ADVANCE, DADU, RADU,NADU, CABI, PPRSD	ADVANCE (USAID) have plans to do jingles on 8 radio Stations in 11 local languages; CABI could potentially organize some radio	End of May

Theme	Activities	Who is involved	Who already has plans	Time Line
			announcement	
	Announcement using information vans and during public meetings including worship programs (churches, mosque etc.), similar to plant health rallies from Plantwise	MoFA, DA, CABI, PPRSD, (PPBD, EPA,CSD and DAES), media partners NGO's, FBO's, CSO's, AU, CSIR, Farmers AEAs and Universities		Organized before October 2017
	Develop and disseminate identification, monitoring/ field scouting guide on FAW and its management(including resistance management.	MoFA-PPRSD, CABI, DAES, Dept of Agriculture, Regional Agric Dept, CSIR, Universities, NGOs (ADVANCE, GIZ, etc), Data Analyst /ADVANCE/Solidaridad West Africa, NGOs/Research	ADVANCE (USAID) have plans to do jingles on 8 radio Stations in 11 local languages; CABI could potentially organize some radio announcement	
	Short articles in selected newspapers (electronic or print)on social and economic implications of FAW in Ghana	Scidev.net; local media partners; international media outlets, international newsletters PPRSD, CABI	Scidev.net, GNA; Graphic business	All year round
	Workshops and seminars for farmer groups and AEAs, country reps and organizations in all regions:	Solidaridad W/A, CABI, ECOWAS,FAO, CYMMIT, ADVANCE, PPRSD, Farmers, FBOs and AEAs; international donors and organizations	ADVANCE (USAID) training for monitoring traps, CABI/MoFA/ECOWAS & CIMMYT have international meetings planned	June to October

Theme	Activities	Who is involved	Who already has plans	Time Line
	Establish a user-friendly feedback system (communication mechanisms) for extension officials in various communities. WhatsApp, Facebook groups/platforms. Media (Radio+ICT)	Steering committees, All stakeholders, Operational committee members, etc.	From all angles, specifically; Farmers, Media, Etc.	Apr-17
Surveillance	**Set up reporting channel** (from frontline staff to regional to national level and back)	MoFA-PPRSD, DAES, Dept of Agriculture, Regional Agric Dept, Assistant RELC Coordinators, Research, Universities	MoFA	Q2 2017
	Develop standardized reporting format for district level frontline staff (Report should capture geographical area, area/extent of infestation, target crop, estimated yield loss, etc)	MoFA-PPRSD, DAES, Dept of Agriculture, Regional Agric Dept, Assistant RELC Coordinators, Research, Universities	CABI, MoFA	Q2 2017
	Identify canidate natural enemies and initiate classical biological control programme	PPRSD/MOFA, CABI, FAO		Oct-17
	Conduct laboratory efficacy test for recommended pesticides and Provide emergency or temporal registration of recommended pesticides. Registrant should provide supporting data from sources with fall history such as the America	PPRSD-MOFA, EPA, Input Dealers		
	Regularly review recommendations for fall armyworm control and publish the	PPRSD-MOFA, EPA, Input Dealers, CABI-Plantwise CSIR-CRI		

Theme	Activities	Who is involved	Who already has plans	Time Line
	changes promptly and widely			
MEDIUM-TERM ACTIVITIES				
Awareness Creation	Establish a user-friendly feedback system (communication mechanisms). Toll free lines. SMS alert /voice notes for mobile phone users, IVR system	MoFA-PPRSD, CSIR, Universities	Extension officers, NGOs (Farm Radio)	2018 onwards
Surveillance	Set up a national monitoring and Early Warning System	MoFA-PPRSD, DAES, Dept of Agriculture, Regional Agric Dept, CSIR, Universities	MoFA-PPRSD, CABI, ADVANCE (USAID), CSIR, Universities	Q2 and onwards
	Establish and maintain a regional or national network of both pheromone traps and field scouting efforts.	Farmers/Public and Private Extension/Community Lead Farmers/Departments of Agric/PPRSD/	CABI/Plantwise System	PPRSD/CABI/Plantwise (ongoing)
Control, management and research	**Insecticide Research**			
	Comprehensive assessment of effective and available insecticides on the Ghanaian market for the fall armyworm management in Ghana (spray trials at different ecological zones on efficacy, application timing, number of applications, crop stage, etc)	PPRSD/EPA, CABI, Research/Universities (CSIR-CRI, CSIR-SARI, BNARI/GAEC, UG, UDS,UCC) Input dealers, Farmer, NGOs	PPRSD/EPA, CSIR-CRI	End 2017
	Cost Control	Research/Universities (CSIR-CRI, CSIR-SARI,		2018

Theme	Activities	Who is involved	Who already has plans	Time Line
		BNARI/GAEC, UG, UDS,UCC)		
	Assess armyworm insecticides in terms affordability, accessibility, and availability. Agricultural economist to study of the most cost effective methods of armyworm control.			
	Establish pesticide subsidies for the control of the fall armyworm	MOFA		
	Process and analyse information (link to other data sets); The data from pheromone traps and field scouting needs to be collected at a central point, analysed, and reported.	MoFA-PPRSD, CSIR, Universities	MoFA-PPRSD, CSIR, Universities, CABI	2018
LONG TERM				
	Insecticide Research			
	Low Tech Insecticide Strategies	Research/Universities (CSIR-CRI, CSIR-SARI, BNARI/GAEC, UG, UDS,UCC)		2018
	Develop effective, low toxicity, low technology strategies for insecticide applications by small farmers. (Example: mixing Bt or Spinosad with corn meal and dropping it, by hand, into the whorl.)			
	Armyworm Biology	Research/Universities (CSIR-CRI, CSIR-SARI,		2018

Theme	Activities	Who is involved	Who already has plans	Time Line
	Research-into Fall Armyworm biology, ecology and population dynamics, susceptibility to pesticides, subtle differences in life patterns that may affect insecticide strategy (for improved recommendations that may affect pesticide use	BNARI/GAEC, UG, UDS,UCC)		
	Cultural Controls	Research/Universities (CSIR-CRI, CSIR-SARI, BNARI/GAEC, UG, UDS,UCC		2018
	Research-based recommendations on how planting date affects risk of crop damage in the various maize production regions of Ghana.			
	Development of novel control strategies	Research/Universities (CSIR-CRI, CSIR-SARI, BNARI/GAEC, UG, UDS,UCC)		2018
	Research into new ways of controlling the Fall Armyworm. Strategies such as the sterile insect technique, GM crops, resistant varieties etc			
	Conservation Bio-Control	PPRSD/MoFA		2018
	Research on the diseases and natural enemies of Fall Armyworm, especially indigenous diseases and natural enemies that may cross over from African to the Fall Armyworm	Parliamentary Select Committee on Agricultural/Development Partners/FAO		

Theme	Activities	Who is involved	Who already has plans	Time Line
	Evaluation/assessment of impact of the awareness and sensitization programs carried out in the country	PPBD, CABI		Year ongoing
	Insecticide Resistance Management	PPRSD/EPA/CABI/Research/Universities (CSIR-CRI, CSIR-SARI, BNARI/GAEC, UG, UDS,UCC)		
	Research-based recommendation on how to slow armyworm insecticide resistance that involved pesticide dealers, agencies, farmer groups, and others.	NGOs/FBOs/Input dealers		End 2017
	Monitor resistance in Fall armyworm populations			

Annex 3. Synoptic Proposed Fall Armyworm (FAW) Emergency Action Plan for Affected Countries (generic)(source: CABI Plantwise. Feb. 2017).

CABI's proposed Fall Armyworm (FAW) emergency action plan for affected countries

Category	Concurrent partnership actions, starting February 2017	Stakeholders
Intervention planning (at first sign of alert)	• Assessment of and linking to relevant existing internal/external programmes at national and regional level, and issue precautionary notice, e.g. to NPPO/Plantwise partners/MOFA • If not already done, support diagnostic confirmation (morphological and molecular) • National emergency response committee formed to design emergency plan and assign actions • Connect to the IPPC and IAPSC • Audit possible chemical/biopesticide/resistant variety options (locally / globally available) • Support emergency plant protection product registration • Draft protocols for effective ground-based interventions and identify counter-productive activities	Min of Agriculture NPPO / IPPC Plant doctors and non-Plantwise trained extension staff Quarantine officers / inspectors FAO Agrochemical Industry Food/Supply chain
Awareness	• Audit potential pathways (into and out of country) • Develop tools/messages for the awareness campaign, including information dossier • Implement awareness campaign – mass extension (multimedia, citizen science)	Plantwise partners; Media; Farmer Organisations
Early detection and suppression	• Develop protocol for detection e.g. Plantwise clinic national alert & reporting mechanism • Update Plantwise-PMDGs, image-based diagnostics, farmer factsheets • Farmer-friendly symptom identification tool, solutions & mitigation advice • Dissemination plan of existing technologies available to locations across country • Plant protection product advice sent to agro-dealers and plant doctors • Develop prevention protocols for use by authorities with trade partners within the country & beyond	Plantwise partners & plant doctors NPPO / IPPC Quarantine officers etc Agro-dealer networks Farmers Private sector (traders)
Control	• Develop protocol for control and dissemination of existing technologies available to locations across the country • Identify potential new short term control strategies (including natural enemies) • Establish plan to develop a biological-based, integrated pest management strategy for a sustainable, medium-long term management approach	Plantwise partners & plant doctors NPPO / FAO Quarantine officers etc Food / Supply chain
Information collection	• Review historical control measures' efficacy to inform control strategy • Map host plant range; Spread and damage in country • Assess baseline, collect available data and, if required, conduct surveys to baseline current situation • Develop monitoring plan to see how well control strategies are working	MinAgr & other Govt Depts Plantwise countries (beyond Ghana) FAO / NPPO
Research	• Review possible pathways of introduction & spreading mechanisms, to inform unaffected countries in the region, Mediterranean and Asia • Investigate existing and potential new control measures • Consult with research scientists involved in S. frugiperda research	Research institutions Plantwise partners incl. Govt FAO / NPPO IOBC global maize IWGO

Annex 4. Biological Control Agents: parasitoid wasps of Fall armyworm eggs.

Annex 4. Table 1: List of *Telenomus* spp. found in Africa

Telenomus spp.	Host	Distribution
T. procas	*Antigastra catalaunalis*	Senegal, Sudan
T. nemesis	*Chilo orichalcociliellus*	Ghana, Kenya, Mozambique, Senegal
T. busseolae	*Busseola fusca, Sesamia spp., Coneista ignefusalis*	Cameroon, Egypt, Ghana, Kenya, Nigeria, Reunion, Senegal, South Africa, Sudan, Uganda
T. creusa	*Chilo diffusilineus*	Malawi
T. bini	*Maliarpha separratella, Chilo spp., Scirpophaga spp.*	Ghana, Ivory Coast, Madagascar, Malawi, Senegal, Tanzania.
T. thestor	*Chilo orichalcociliellus*	Ivory Coast, Kenya, Senegal, Uganda, Zaire
T.soudanensis,	*Chilo zacconius*	Niger
T.nephele	*Scirpophaga melanoclista, S. occidentella, S. subumbrosa*	Cameroon, Ghana, Ivory Coast, Malawi, Mali, Senegal.
T. etielliphaga	*Etiella zinckenella,*	Senegal
T. applanatus	*Eldana saccharina*	Gabon, Ghana, Ivory coast
T.versicolor	*Scirpophaga melanoclista*	Ghana, Ivory Coast, Malawi, Senegal

Annex 4. Table 2. Trichogrammatidae egg parasitoids recorded in Africa

Trichogrammatidae	Host	Distribution
Trichogramma bourarachae	*Helicoverpa armigera*	Morocco
Trichogramma bournieri	*Chilo partellus*	Comoros, Kenya,
Trichogramma cacoeciae	-	Morocco

Trichogramma chilonis	*Eldana saccharina, Busseola fusca*, *Chilo partellus*	South Africa
Trichogramma ethiopicum	-	Cameroon
Trichogramma evanescens	*Chilo Agamemnon,* *Helicoverpa armigera,* *Pectinophora gossypiella,* *Spodoptera littoralis*	Egypt, Madagascar
Trichogramma japonicum	*Chilo partellus*	Malawi
Trichogramma kalkae	*Diopsis macrophthalma*	Malawi
Trichogramma sp. nr *kalkae*	-	Zimbabwe
Trichogramma kayo	-	Sudan
Trichogramma mandelai	*Diparopsis watersi*	Chad
Trichogramma sp. nr *mwanzai*	*Chilo diffusilineus, Chilo partellus, Busseola fusca, Eldana saccharina, Sitotroga cerealella*	Malawi, Kenya
Trichogramma ostriniae	*Busseola fusca*, *Chilo partellus*	South Africa
Trichogramma papilionidis		Angola
T. Pretiosum	*Apple leaf roller*	South Africa
Trichogramma pinneyi	*Diopsis macrophthalma*	Malawi
Trichogramma sp. nr *exiguum*	*Chilo partellus*	Kenya

Trichogramma voegel	-	Morocco
Trichogrammatoidea armigera	*H. armigera*	Kenya
Trichogrammatoidea bactrae	*P. gossypiella*	Egypt
Trichogrammatoidea citri	-	Madagascar
Trichogrammatoidea combreti	-	Senegal
Trichogrammatoidea cryptophlebia	*Cryptophlebia batrochopa, C. leucotreta*	Malawi, South Africa
Trichogrammatoidea eldanae	*E. saccharina, Sesamia calamistis*	South Africa, Nigeria, Kenya
Trichogrammatoidea lutea	*C. partellus, B. fusca, H. armigera, H. armigera*	South Africa, Kenya, Ivory Coast, Ethiopia, Mali, Mozambique, Senegal
Trichogrammatoidea simmondsi	*Diopsis macrophthalma, C. partellus,* False codling moth, *H. armigera, Atherigona soccata*	Malawi, South Africa, Kenya, Burkina Faso

Annex 5. Pesticide Data Sheets for FAW Programmatic PERSUAP (May 2017).

Summary Overview of Pesticide Data Sheet (PDS) Elements

Reg 216 Factor	Corresponding box on PDS	Requirements
US EPA registration status & Host country	Top box, 3rd line, left: *"USEPA registration status & date"*	Must be registered in the US and in the host country
Basis for selection	Box 1: "*Basis for Selection"*	The selected pesticide must have been tested and demonstrated in the field that it works against the target pest (same or similar pest species), in this case *Spodoptera frugiperda*. These data may come from other countries.
Extent to which IPM is used	Box 6: *"Role in IPM"*	The selected pesticide should be used in an IPM approach, so only when needed based on some level of understanding of economic thresholds, and combination with other control tactics should be promoted so as to lower the need for pesticides.
Application methods and safety equipment	Box 10: "*Application Methods"* Box 11" "Personal Protective Equipment"	Methods for application (e.g. backpack sprayer) and PPE should be available in the market place
Toxicology and mitigation measures	Box 7: *"Human Toxicological Hazards"* Box 8: *"Environmental Hazards"*	Very low and Low Toxicity categories (EPA) are preferred, especially for small-scale farmers; Moderately and High Toxicity only under strictly controlled conditions, by certified and trained staff, with all required PPE and other safety measures applied
Efficacy	Box 4: "Effectiveness"	The pesticide must effectively control the pest for which it has been selected.
Target vs. non-target species	Box 8: *"Environmental Hazards"*	Mortality of non-target species, especially beneficial insects such as parasitoids, predators and pollinators, should be minimized. Therefore, broad-spectrum pesticides are less preferred. Target-specific pesticides such as *Bacillus thuringiensis* are ideal.
Environmental conditions at the location of proposed use	Box 9: "*Location Environmental Conditions"*	Where in the country and under which conditions will the pesticide be applied and will that influence its efficacy? For instance, high temperature and humidity may influence efficacy of a pesticide, e.g. in greenhouse conditions. Presence of wetlands or rivers nearby may limit the choice of certain pesticides that are highly toxic to aquatic organisms.
Availability of alternatives	Box 5: "Alternatives"	The use of less-toxic or non-toxic pesticide alternatives should be promoted wherever possible. Other alternatives that must be promoted include bio pesticides and biological control with parasitoids and predators.
Country's ability to control and regulate pesticides	Top box, 3rd line, right: *"Location registration status & date"* Box 13: *"Location Regulatory Issues"*	The pesticide must be registered in the country it will be. Where regulatory capacity is weak e.g. regarding enforcing safety standards and product quality, highly and moderately toxic products should be avoided
User training	Box 14: *"Training Program Elements"*	Training must be provided, particularly for safer use but also for IPM. Where opportunity for safety training is lacking or inadequate, highly and moderately toxic products should be avoided
Monitoring provisions	Box 15: *"Monitoring Plan"*	Farmers should be able to identify the pest (in this case *Spodoptera frugiperda*) and be able to monitor infestation levels in the field, either with pheromone traps or by inspecting plants.

USAID Pesticide Data Sheet 2017

Date: 3/21/2017 Project: Spodoptera Frugiperda Location: Africa USAID Tracking Code: n/a

Active Ingredient (AI): BEAUVERIA BASSIANA		Pesticide Use Type: insecticide	
Formulation: Wettable powder	% AI: 22	Location Common Names:	
USEPA registration status, code, & date: Active, 82074-1, 3/10/1997		Location registration status & date:add information for specific use location	
US Common Name: Mycotrol wpo		USEPA Tox Signal word: Caution	USEPA RUP flag: Not Restricted / WHO Tox Class: U
Chemical Abstract Service (CAS) Registry Number: 63428-82-0		USEPA PC Code: 128924	Location Registration Code: specific to location

1. Basis for Selection:	2. Crop / Target:	3. Pest / Disease:	4. Effectiveness:
Beauveria bassiana is a naturally occurring fungal insecticide that is commonly found in soils worldwide and is used as a pesticide for controlling many kinds of insects.	Maize/ Corn Also registered for use on potatoes, peppers, and eggplants.	Fall army worm Spodoptera frugiperda	Registered for use in US for similar pests.

5. Alternatives:	6. Role in IPM:	7. Human Toxicological Hazards	8. Environmental Hazards
Selected biopesticides	Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will also be rotated with pesticides from other classes	Long-Term: No expected long-term risks. Acute: Causes moderate eye irritation. Harmful if absorbed through the skin, inhaled or swallowed. May produce an allergic reaction.	General: May be toxic to bees, fish and aquatic organisms Non-Target Organisms: Potentially pathogenic to honey bees Non-Target Ecosystems: Aquatic areas, streams, run-off areas

9. Location Environmental Conditions:	10. Application Methods:	12. Storage Provisions and Disposal Issues:	14. Training Program Elements:
Add information for specific use location	Follow label per formulation	Empty containers: rinse 3 times, empty into spray tank, puncture, bury Containers should NEVER be reused	- follow label per formulation - application - handling - disposal - PPE - entry intervals - pre-harvest intervals
	11. Personal Protective Equipment: Follow label per formulation long-sleeved shirts and pants, gloves, shoes and socks	13. Location Regulatory Issues Add information for specific use location	

15. Monitoring Plan:
use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 3/21/2017 Project: Spodoptera frugiperda Location: Africa USAID Tracking Code: n/a

Active Ingredient (AI): BIFENTHRIN		Pesticide Use Type: insecticide	
Formulation: Emulsifiable Concentrate	% AI: 25.1	Location Common Names: Africa	
USEPA registration status, code, & date: Active, 279-3313		Location registration status & date:add information for specific use location	
US Common Name: Brigade, Disciplie, Fanfare		USEPA Tox Signal word: Warning	USEPA RUP flag: Restricted / WHO Tox Class: II
Chemical Abstract Service (CAS) Registry Number: 82657-04-3		USEPA PC Code: 128825	Location Registration Code: specific to location

1. Basis for Selection:

Bifenthrin is a member of the pyrethroid class with contact and stomach action. It acts on the nervous system of insects, disturbs the function of neuron by interaction with sodium channels.

2. Crop / Target:

Maize/ Corn
also registered for use on cotton, citrus, ornamentals and vegetables.

3. Pest / Disease:

Fall army worm
Spodoptera frugiperda

4. Effectiveness:

Has been registered and used against Spodoptera frugiperda in US.

5. Alternatives:

selected biopesticides

6. Role in IPM:

Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It will also be rotated with pesticides from other classes.

7. Human Toxicological Hazards

Long-Term:

May be a possible carcinogen.

Acute:

Fatal if swallowed. Harmful if inhaled or absorbed through skin. Causes moderate eye irritation.

8. Environmental Hazards

General:

extremely toxic to fish and aquatic invertebrates

Non-Target Organisms:

highly toxic to bees, direct exposure

Non-Target Ecosystems:

aquatic areas, streams, ponds,

9. Location Environmental Conditions:

add information for specific use location

10. Application Methods:

Follow label per formulation

11. Personal Protective Equipment:

long-sleeved shirts and pants, chemical resistant gloves, protective eye wear, shoes, & socks

12. Storage Provisions and Disposal Issues:

Empty containers: rinse 3 times, empty into spray tank, puncture, bury
Containers should NEVER be reused

13. Location Regulatory Issues

add information for specific use location

14. Training Program Elements:

- follow label per formulation
- application
- handling
- disposal
- PPE
- entry intervals
- pre-harvest intervals

15. Monitoring Plan:

use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 3/21/2017 Project: Spodoptera frugiperda Location: Africa USAID Tracking Code: n/a

Active Ingredient (AI): CARBARYL		Pesticide Use Type: insecticide	
Formulation: Liquid Suspension	% AI: 44.1	Location Common Names: Africa	
USEPA registration status, code, & date: Active, 264-333		Location registration status & date:add information for specific use location	
US Common Name: Sevin XLR Plus		USEPA Tox Signal word: Caution	USEPA RUP flag: Not restricted / WHO Tox Class: II
Chemical Abstract Service (CAS) Registry Number: 63-25-2		USEPA PC Code: 056801	Location Registration Code: specific to location

1. Basis for Selection:	2. Crop / Target:	3. Pest / Disease:	4. Effectiveness:
It is a member of the carbamate class with contact and stomach action and slight systemic properties.	Maize/ Corn also registered for use on cotton, citrus, ornamentals and vegetables.	Fall army worm Spodoptera frugiperda	Has been registered and used against Spodoptera frugiperda in US.

5. Alternatives:	6. Role in IPM:	7. Human Toxicological Hazards	8. Environmental Hazards
selected biopesticides	Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It will also be rotated with pesticides from other classes.	Long-Term: likely to be carcinogenic in humans. Acute: Harmful if swalloed, inhaled or absorbed through skin. Overexposure can result in convulsions, coma, and death.	General: extremely toxic to aquatic invertebrates Non-Target Organisms: highly toxic to bees, direct exposure Non-Target Ecosystems: aquatic areas, streams, ponds,

9. Location Environmental Conditions:	10. Application Methods:	12. Storage Provisions and Disposal Issues:	14. Training Program Elements:
add information for specific use location	Follow label per formulation	Empty containers: rinse 3 times, empty into spray tank, puncture, bury Containers should NEVER be reused	- follow label per formulation - application - handling - disposal - PPE - entry intervals - pre-harvest intervals
	11. Personal Protective Equipment: long-sleeved shirts and pants, chemical resistant gloves, protective eye wear, chemical resistant shoes, & socks	13. Location Regulatory Issues add information for specific use location	

15. Monitoring Plan:
use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 3/21/2017 Project: Spodoptera frugiperda Location: Africa USAID Tracking Code: n/a

Active Ingredient (AI): CHLORANTANILIPROLE		Pesticide Use Type: insecticide	
Formulation: Suspension Concentrate	% AI: 5	Location Common Names: Africa	
USEPA registration status, code, & date: Active, 352-884		Location registration status & date:add information for specific use location	
US Common Name: Prevathon		USEPA Tox Signal word: None	USEPA RUP flag: WHO Tox Class: III
Chemical Abstract Service (CAS) Registry Number: 500008-45-7		USEPA PC Code: 090100	Location Registration Code: specific to location

1. Basis for Selection:	2. Crop / Target:	3. Pest / Disease:	4. Effectiveness:
It acts primarily through ingestion and also through contact. Affected insects rapidly stop feeding, general lethargy, paralysis and ultimate death.	Maize/ Corn also registered for use on cotton, citrus, ornamentals and vegetables.	Fall army worm Spodoptera frugiperda	Has been registered and used against Spodoptera frugiperda in US.

5. Alternatives:	6. Role in IPM:	7. Human Toxicological Hazards	8. Environmental Hazards
selected biopesticides	Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It will also be rotated with pesticides from other classes.	Long-Term: Not a possible carcinogen. Acute:	General: toxic to aquatic invertebrates Non-Target Organisms: highly toxic to bees, direct exposure Non-Target Ecosystems: aquatic areas, streams, ponds,

9. Location Environmental Conditions:	10. Application Methods:	12. Storage Provisions and Disposal Issues:	14. Training Program Elements:
add information for specific use location	Follow label per formulation	Empty containers: rinse 3 times, empty into spray tank, puncture, bury Containers should NEVER be reused	- follow label per formulation - application - handling - disposal - PPE - entry intervals - pre-harvest intervals
	11. Personal Protective Equipment: long-sleeved shirts and pants, chemical resistant gloves, protective eye wear, shoes, & socks	13. Location Regulatory Issues add information for specific use location	

15. Monitoring Plan:
use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 3/21/2017 Project: Spodoptera frugiperda Location: Africa USAID Tracking Code: n/a

Active Ingredient (AI): CHLORANTANILIPROLE, lambda CYHALOTHRIN		Pesticide Use Type: insecticide		
Formulation: Zeon Concentrate	% AI: 9.26+4.63	Location Common Names: Africa		
USEPA registration status, code, & date: Active, 100-1402		Location registration status & date:add information for specific use location		
US Common Name: Besiege		USEPA Tox Signal word: Warning	USEPA RUP flag: Restricted	WHO Tox Class:
Chemical Abstract Service (CAS) Registry Number: 500008-45-7, 91465-08-6		USEPA PC Code:	Location Registration Code: specific to location	

1. Basis for Selection:	2. Crop / Target:	3. Pest / Disease:	4. Effectiveness:
Broad-spectrum insecticide providing both rapid knockdown and long lasting residual control of lepidopteran, sucking and chewing insect pests. It has dual modes of action and provides control by contact, ingestion and ovicidal action.	Maize/ Corn also registered for use on canola, vegetables. cereal crops	Fall army worm Spodoptera frugiperda	Has been registered and used against Spodoptera frugiperda in US.

5. Alternatives:	6. Role in IPM:	7. Human Toxicological Hazards	8. Environmental Hazards
selected biopesticides	Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It will also be rotated with pesticides from other classes.	Long-Term: Not a possible carcinogen. Acute: Fatal if swallowed.Harmful if absorbed through skin. Causes moderate eye irritation,may cause allergic skin reactions.	General: Extremely toxic to fish, aquatic invertebrates and wildlife. Non-Target Organisms: highly toxic to bees, direct exposure Non-Target Ecosystems: aquatic areas, streams, ponds,

9. Location Environmental Conditions:	10. Application Methods:	12. Storage Provisions and Disposal Issues:	14. Training Program Elements:
add information for specific use location	Follow label per formulation	Empty containers: rinse 3 times, empty into spray tank, puncture, bury Containers should NEVER be reused	- follow label per formulation - application - handling - disposal - PPE - entry intervals - pre-harvest intervals
	11. Personal Protective Equipment: long-sleeved shirts and pants, chemical resistant gloves, protective eye wear, shoes, & socks	13. Location Regulatory Issues add information for specific use location	

15. Monitoring Plan:
use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 3/21/2017 Project: Spodoptera frugiperda Location: Africa USAID Tracking Code: n/a

Active Ingredient (AI): beta-CYFLUTHRIN		Pesticide Use Type: insecticide	
Formulation: Emulsifiable Concentrate	% AI: 12.7	Location Common Names: Africa	
USEPA registration status, code, & date: Active, 264-840		Location registration status & date:add information for specific use location	
US Common Name: Baythroid XL		USEPA Tox Signal word: Warning	USEPA RUP flag: Restricted / WHO Tox Class: II
Chemical Abstract Service (CAS) Registry Number: 68359-37-5		USEPA PC Code: 128831	Location Registration Code: specific to location

1. Basis for Selection:

It is a non systemic insecticide with contact and stomach action. it causes rapid knock down and has long residual activity. It acts on the nervous system of insects, disturbs the function of neuron by interaction with sodium channels.

2. Crop / Target:

Maize/ Corn
also registered for use on cotton, citrus, ornamentals and vegetables.

3. Pest / Disease:

Fall army worm
Spodoptera frugiperda

4. Effectiveness:

Has been registered and used against Spodoptera frugiperda in US.

5. Alternatives:

selected biopesticides

6. Role in IPM:

Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It will also be rotated with pesticides from other classes.

7. Human Toxicological Hazards

Long-Term:
May be a possible carcinogen.

Acute:
Harmful if swallowed, inhaled or absorbed through skin. Causes substantial but temporary eye injury.

8. Environmental Hazards

General:
extremely toxic to fish and aquatic invertebrates

Non-Target Organisms:
highly toxic to bees, direct exposure

Non-Target Ecosystems:
aquatic areas, streams, ponds,

9. Location Environmental Conditions:

add information for specific use location

10. Application Methods:

Follow label per formulation

11. Personal Protective Equipment:

long-sleeved shirts and pants, chemical resistant gloves, protective eye wear, shoes, & socks

12. Storage Provisions and Disposal Issues:

Empty containers: rinse 3 times, empty into spray tank, puncture, bury
Containers should NEVER be reused

13. Location Regulatory Issues

add information for specific use location

14. Training Program Elements:

- follow label per formulation
- application
- handling
- disposal
- PPE
- entry intervals
- pre-harvest intervals

15. Monitoring Plan:

use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 3/21/2017 Project: Spodoptera frugiperda Location: Africa USAID Tracking Code: n/a

Active Ingredient (AI): y-CYHALOTHRIN		Pesticide Use Type: insecticide	
Formulation: Aqueous based formulation	% AI: 14.4	Location Common Names: Africa	
USEPA registration status, code, & date: Active, 67760-96		Location registration status & date:add information for specific use location	
US Common Name: Declare		USEPA Tox Signal word: Caution	USEPA RUP flag: Restricted / WHO Tox Class: III
Chemical Abstract Service (CAS) Registry Number: 76703-62-3		USEPA PC Code: 128807	Location Registration Code: specific to location

1. Basis for Selection:

It is a non systemic insecticide with contact and stomach mode of action. It acts on the nervous system of insects, disturbs the function of neuron by interaction with sodium channels.

2. Crop / Target:

Maize/ Corn
also registered for use on some row crops and vegetables.

3. Pest / Disease:

Fall army worm
Spodoptera frugiperda

4. Effectiveness:

Has been registered and used against Spodoptera frugiperda in US.

5. Alternatives:

selected biopesticides

6. Role in IPM:

Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It will also be rotated with pesticides from other classes.

7. Human Toxicological Hazards

Long-Term:
May be a possible carcinogen.

Acute:
Harmful if swallowed, inhaled or absorbed through skin. Causes moderate eye irritation.

8. Environmental Hazards

General:
extremely toxic to fish and aquatic invertebrates and wildlife

Non-Target Organisms:
highly toxic to bees, direct exposure

Non-Target Ecosystems:
aquatic areas, streams, ponds,

9. Location Environmental Conditions:

add information for specific use location

10. Application Methods:

Follow label per formulation

11. Personal Protective Equipment:

long-sleeved shirts and pants, chemical resistant gloves, protective eye wear, shoes, & socks

12. Storage Provisions and Disposal Issues:

Empty containers: rinse 3 times, empty into spray tank, puncture, bury
Containers should NEVER be reused

13. Location Regulatory Issues

add information for specific use location

14. Training Program Elements:

- follow label per formulation
- application
- handling
- disposal
- PPE
- entry intervals
- pre-harvest intervals

15. Monitoring Plan:

use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 3/21/2017 Project: Spodoptera frugiperda Location: Africa USAID Tracking Code: n/a

Active Ingredient (AI): lambda-CYHALOTHRIN		Pesticide Use Type: insecticide		
Formulation: Aqueous based formulation	% AI: 22.8	Location Common Names: Africa		
USEPA registration status, code, & date: Active, 100-1097, 100-1295		Location registration status & date:add information for specific use location		
US Common Name: Karate, Warrior		USEPA Tox Signal word: Caution	USEPA RUP flag: Restricted	WHO Tox Class: II
Chemical Abstract Service (CAS) Registry Number: 91465-08-6		USEPA PC Code: 128897	Location Registration Code: specific to location	

1. Basis for Selection:	2. Crop / Target:	3. Pest / Disease:	4. Effectiveness:
It is a non systemic insecticide with contact and stomach mode of action and repellent properties. It acts on the nervous system of insects, disturbs the function of neuron by interaction with sodium channels. it gives rapid knock down and has long residual activity.	Maize/ Corn also registered for use cotton, ornamentals and vegetables.	Fall army worm Spodoptera frugiperda	Has been registered and used against Spodoptera frugiperda in US.

5. Alternatives:	6. Role in IPM:	7. Human Toxicological Hazards	8. Environmental Hazards
selected biopesticides	Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It will also be rotated with pesticides from other classes.	Long-Term: May be a possible carcinogen. Acute: Fatal if swallowed. Harmful if absorbed through skin. Causes moderate eye irritation.	General: extremely toxic to fish and aquatic invertebrates and wildlife Non-Target Organisms: highly toxic to bees, direct exposure Non-Target Ecosystems: aquatic areas, streams, ponds,

9. Location Environmental Conditions:	10. Application Methods:	12. Storage Provisions and Disposal Issues:	14. Training Program Elements:
add information for specific use location	Follow label per formulation	Empty containers: rinse 3 times, empty into spray tank, puncture, bury Containers should NEVER be reused	- follow label per formulation - application - handling - disposal - PPE - entry intervals - pre-harvest intervals
	11. Personal Protective Equipment:	13. Location Regulatory Issues	
	long-sleeved shirts and pants, chemical resistant gloves, protective eye wear, shoes, & socks	add information for specific use location	

15. Monitoring Plan:
use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 3/21/2017 Project: Spodoptera frugiperda Location: Africa USAID Tracking Code: n/a

Active Ingredient (AI): Z-CYPERMETHRIN		Pesticide Use Type: insecticide	
Formulation: Emulsifiable Concentrate	% AI: 9.6	Location Common Names: Africa	
USEPA registration status, code, & date: Active, 279-3327		Location registration status & date:add information for specific use location	
US Common Name: Mustang-Max		USEPA Tox Signal word: Caution	USEPA RUP flag: Restricted / WHO Tox Class: I b
Chemical Abstract Service (CAS) Registry Number: 52315-07-8		USEPA PC Code: 109702	Location Registration Code: specific to location

1. Basis for Selection:	2. Crop / Target:	3. Pest / Disease:	4. Effectiveness:
It is a member of the pyrethroid class with contact and stomach action. It acts on the nervous system of insects, disturbs the function of neuron by interaction with sodium channels.	Maize/ Corn also registered for use on cotton, citrus, ornamentals and vegetables.	Fall army worm Spodoptera frugiperda	Has been registered and used against Spodoptera frugiperda in US.

5. Alternatives:	6. Role in IPM:	7. Human Toxicological Hazards	8. Environmental Hazards
selected biopesticides	Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It will also be rotated with pesticides from other classes.	Long-Term: May be a possible carcinogen. Acute: Harmful if swallowed, inhaled or absorbed through skin. Causes moderate eye irritation.	General: extremely toxic to fish and aquatic invertebrates Non-Target Organisms: highly toxic to bees, direct exposure Non-Target Ecosystems: aquatic areas, streams, ponds,

9. Location Environmental Conditions:	10. Application Methods:	12. Storage Provisions and Disposal Issues:	14. Training Program Elements:
add information for specific use location	Follow label per formulation	Empty containers: rinse 3 times, empty into spray tank, puncture, bury Containers should NEVER be reused	- follow label per formulation - application - handling - disposal - PPE - entry intervals - pre-harvest intervals
	11. Personal Protective Equipment: long-sleeved shirts and pants, chemical resistant gloves, protective eye wear, shoes, & socks	13. Location Regulatory Issues add information for specific use location	

15. Monitoring Plan:
use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 3/21/2017 Project: Spodoptera frugiperda Location: Africa USAID Tracking Code: n/a

Active Ingredient (AI): Metarhizium anisopliae strain F52		Pesticide Use Type: Insecticide	
Formulation: Wettable Powder	% AI: 97.6	Location Common Names:	
USEPA registration status, code, & date: Active, 70127-7		Location registration status & date:add information for specific use location	
US Common Name: TAE-001 technical Bioinsecticide		USEPA Tox Signal word: Caution	USEPA RUP flag: Not Restricted / WHO Tox Class: U
Chemical Abstract Service (CAS) Registry Number: 67892-13-1		USEPA PC Code: 029056	Location Registration Code: specific to location

1. Basis for Selection:

Metarrhizium anisopliae is a natural biopesticide based on the naturally occurring fungus. It is effective against a variety of pests.Metarhizium anisopliae should be applied when the temperature is between 18-28°C/65-82°F and the relative humidity is approximately 80% for several days after application.

2. Crop / Target:

Maize/ Corn.
Also registered for use on potatoes, peppers, and eggplants.

3. Pest / Disease:

Fall army worm
Spodoptera frugiperda

4. Effectiveness:

Registered for use in US for similar pests.

5. Alternatives:

Selected biopesticides

6. Role in IPM:

Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will also be rotated with pesticides from other classes

7. Human Toxicological Hazards

Long-Term:

No expected long-term risks.

Acute:

Harmful if swallowed, inhaled or absorbed through skin. Causes moderate eye irritation.

8. Environmental Hazards

General:

No major threats to non-target ecosystems

Non-Target Organisms:

Non-Target Ecosystems:

9. Location Environmental Conditions:

Add information for specific use location

10. Application Methods:

Follow label per formulation

11. Personal Protective Equipment:

Follow label per formulation
long-sleeved shirts and pants, gloves, shoes and socks

12. Storage Provisions and Disposal Issues:

Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited. Do not reuse empty container.

13. Location Regulatory Issues

Add information for specific use location

14. Training Program Elements:

- follow label per formulation
- application
- handling
- disposal
- PPE
- entry intervals
- pre-harvest intervals

15. Monitoring Plan:

use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 3/21/2017 Project: Spodoptera frugiperda Location: Africa USAID Tracking Code: n/a

Active Ingredient (AI): METHOXYFENOZIDE		Pesticide Use Type: insecticide	
Formulation: Flowable concentrate	% AI: 22.6	Location Common Names: Africa	
USEPA registration status, code, & date: Active, 62719-442		Location registration status & date:add information for specific use location	
US Common Name: Intrepid 2F		USEPA Tox Signal word: Caution	USEPA RUP flag: Restricted / WHO Tox Class: U
Chemical Abstract Service (CAS) Registry Number: 161050-58-4		USEPA PC Code: 121027	Location Registration Code: specific to location

1. Basis for Selection:

It belongs to the diacylhydrazine class and mimics the action of molting hormone of lepidopteran insects. It is an ecdysone agonist, caused cessation of feeding and lethal premature molt. complete mortality of insect may take several days but the affected larvae becomes lethargic. It does not have any systemic properties.

2. Crop / Target:

Maize/ Corn

3. Pest / Disease:

Fall army worm
Spodoptera frugiperda

4. Effectiveness:

Has been registered and used against Spodoptera frugiperda in US.

5. Alternatives:

selected biopesticides

6. Role in IPM:

Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It will also be rotated with pesticides from other classes. It is virtually safe to other insects or beneficials except lepidoptera.

7. Human Toxicological Hazards

Long-Term:

Not likely a carcinogen.

Acute:

Harmful if absorbed through skin. Avoid contact with eyes and skin.

8. Environmental Hazards

General:

May be hazardous to aquatic invertebrates.

Non-Target Organisms:

highly toxic to bees, direct exposure

Non-Target Ecosystems:

aquatic areas, streams, ponds,

9. Location Environmental Conditions:

add information for specific use location

10. Application Methods:

Follow label per formulation

11. Personal Protective Equipment:

long-sleeved shirts and pants, chemical resistant gloves, protective eye wear, shoes, & socks

12. Storage Provisions and Disposal Issues:

Empty containers: rinse 3 times, empty into spray tank, puncture, bury
Containers should NEVER be reused

13. Location Regulatory Issues

add information for specific use location

14. Training Program Elements:

- follow label per formulation
- application
- handling
- disposal
- PPE
- entry intervals
- pre-harvest intervals

15. Monitoring Plan:

use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 3/21/2017 Project: Spodoptera frugiperda Location: Africa USAID Tracking Code: n/a

Active Ingredient (AI): PERMETHRIN		Pesticide Use Type: insecticide		
Formulation: Emulsifiable Concentrate	% AI: 38.4	Location Common Names: Africa		
USEPA registration status, code, & date: Active, 279-3014		Location registration status & date:add information for specific use location		
US Common Name: Pounce 3.2 EC		USEPA Tox Signal word: Warning	USEPA RUP flag: Restricted	WHO Tox Class: II
Chemical Abstract Service (CAS) Registry Number: 52645-53-1		USEPA PC Code: 109701	Location Registration Code: specific to location	

1. Basis for Selection:

It is a non systemic insecticide with contact and stomach action and some repellent properties. It acts on the nervous system of insects, disturbs the function of neuron by interaction with sodium channels.

2. Crop / Target:

Maize/ Corn
also registered for use on cotton, citrus, ornamentals and vegetables.

3. Pest / Disease:

Fall army worm
Spodoptera frugiperda

4. Effectiveness:

Has been registered and used against Spodoptera frugiperda in US.

5. Alternatives:

selected biopesticides

6. Role in IPM:

Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It will also be rotated with pesticides from other classes.

7. Human Toxicological Hazards

Long-Term:

May be a possible carcinogen.

Acute:

Harmful if swallowed, inhaled or absorbed through skin. Causes skin irritation.

8. Environmental Hazards

General:

extremely toxic to fish and aquatic invertebrates

Non-Target Organisms:

highly toxic to bees, direct exposure

Non-Target Ecosystems:

aquatic areas, streams, ponds,

9. Location Environmental Conditions:

add information for specific use location

10. Application Methods:

Follow label per formulation

11. Personal Protective Equipment:

long-sleeved shirts and pants, chemical resistant gloves, protective eye wear, shoes, & socks

12. Storage Provisions and Disposal Issues:

Empty containers: rinse 3 times, empty into spray tank, puncture, bury
Containers should NEVER be reused

13. Location Regulatory Issues

add information for specific use location

14. Training Program Elements:

- follow label per formulation
- application
- handling
- disposal
- PPE
- entry intervals
- pre-harvest intervals

15. Monitoring Plan:

use, storage, transport, dispersal, disposal

USAID Pesticide Data Sheet 2017

Date: 3/21/2017 Project: Spodoptera frugiperda Location: Africa USAID Tracking Code: n/a

Active Ingredient (AI): SPINETORUM		Pesticide Use Type: insecticide		
Formulation: Suspension Concentrate	% AI: 11.7	Location Common Names: Africa		
USEPA registration status, code, & date: Active, 62719-545		Location registration status & date:add information for specific use location		
US Common Name: Radiant SC		USEPA Tox Signal word: Caution	USEPA RUP flag:	WHO Tox Class: II
Chemical Abstract Service (CAS) Registry Number: 187166-40-1		USEPA PC Code: 110009	Location Registration Code: specific to location	

1. Basis for Selection:	2. Crop / Target:	3. Pest / Disease:	4. Effectiveness:
Fermentation product of Saccharopolyspora spinosa, and an analogue of spinosad. It acts as contact and stomach poison and causes paralysis.	Maize/ Corn also registered for use on cotton, citrus, ornamentals and vegetables.	Fall army worm Spodoptera frugiperda	Has been registered and used against Spodoptera frugiperda in US.

5. Alternatives:	6. Role in IPM:	7. Human Toxicological Hazards	8. Environmental Hazards
selected biopesticides.	Monitor insect populations to determine whether or not there is a need for application based on locally determined economic thresholds. It will be used until an effective less toxic biopesticide is identified, which is also compatible with parasitoids and predators and appropriate to IPM objectives. It does not have a significant impact on certain parasitic insects and natural predators and reduces the likelihood of secondary pest outbreaks.	Long-Term: May be a possible carcinogen. Acute: Causes moderate eye irritation.	General: Non-Target Organisms: toxic to bees duri 3 hours after treatment Non-Target Ecosystems: aquatic areas, streams, ponds,

9. Location Environmental Conditions:	10. Application Methods:	12. Storage Provisions and Disposal Issues:	14. Training Program Elements:
add information for specific use location	Follow label per formulation	Empty containers: rinse 3 times, empty into spray tank, puncture, bury Containers should NEVER be reused	- follow label per formulation - application - handling - disposal - PPE - entry intervals - pre-harvest intervals
	11. Personal Protective Equipment: long-sleeved shirts and pants, chemical resistant gloves, protective eye wear, shoes, & socks	13. Location Regulatory Issues add information for specific use location	

15. Monitoring Plan:
use, storage, transport, dispersal, disposal