

## IPM-BASED ANIMATION FOR FALL ARMYWORM: A MULTI-INSTITUTIONAL AND VIRTUAL INTERNATIONAL COLLABORATION USING THE SCIENTIFIC ANIMATIONS WITHOUT BORDERS (SAWBO) PLATFORM

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### Abstract

Rapid dissemination of critical and accurate information to low-resource and poorly literate people in crisis situations has long been a challenge. Historically, print media as well as radio and television have served as major delivery channels. With the advent of cellphones, SMS (texting), and the Internet, these digital technologies now afford enhanced opportunities for reaching this poorly literate, low-resource client group quickly and efficiently. Here, we describe a two-step, rapid response approach to the Fall Armyworm (*Spodoptera frugiperda*), an invasive noctuid pest newly causing havoc on maize production in Africa and Asia. First, we developed a science-based, animated video – now being localized further into various languages across Africa and Asia – intended to aid semi-literate, smallholder farmers in identifying and scouting for fall armyworm effectively. Second, we made the animation easily available for (re)distribution in affected areas via the Internet and copying/sharing with Bluetooth®, thereby exponentially increasing the animation's reach across a wide spectrum of diverse languages and literacy levels. In this way, this form of asymmetrical communication hybridizes and combines the educational qualities of print dissemination with the range of radio/television delivery.

### Introduction

With globalization and the interconnectedness of air travel, the incidence of invasive pests is now increasing at a staggering pace. This poses a particularly acute problem for low-resource, smallholder farmers in the less developed countries who need effective, reliable (science-based) information to address rapidly emerging threats from transnational pests and pathogens. Moreover, this challenge is never merely local, as uncontrolled outbreaks can afford a foothold for pests or pathogens to spread further. Fortunately, the advent of powerful information and communication technologies (ICTs) provides

tools for producing and disseminating critical, effective, and reliable information rapidly in a scalable manner.

The Fall Armyworm (*Spodoptera frugiperda*; FAW) is a serious pest of maize (corn) in the Americas, where it was identified in the U.S. as early as the late 1700s. In the Americas, the pest is controlled with an integrated pest management (IPM) framework, based mainly on genetically modified (GM) maize and more advanced safe-to-use pesticides. First identified in Africa in 2016 (Goergen *et al.*, 2016), FAW has since been confirmed in nearly every sub-Saharan African country on the continent (Nagoshi *et al.*, 2018) and more recently in the Karnataka state in southern India (Sharanabasappa *et al.*, 2018). Estimates of potential crop losses across all of Africa run as high as \$2 to 6 billion a year in perpetuity (Day *et al.*, 2017).

Providing technical information effectively to low-literate farmers in a developing world context is never simply a straightforward matter of delivery (Prasanna, Huesing, Eddy, & Peschke, 2018). To control FAW in Africa, the scope involves transferring technical, science-based knowledge to at least 40 countries and hundreds of diverse linguistic, geographic, cultural, and political regions with widely divergent (often poor) levels of physical and social support network infrastructures. Upscaling of such efforts necessarily increases costs as well. Any solution directed towards smallholders across this range of variation needs not only to be easy to understand and subject to translation into a wide range of languages, while maintaining a consistent, clear, and technically accurate message, but must also be consistently deliverable by (and to) people of widely divergent educational backgrounds.

Scientific Animations Without Borders (SAWBO) is currently a Michigan State University-based program (previously located at University of Illinois at Urbana-Champaign) focused on developing pathways to take global expert knowledge on given topics and place it in a format useful for low-literate learners within developing nation contexts. SAWBO originated, in part, out of the development and deployment of IPM strategies for pests of cowpea in West Africa (Agunbiade *et al.*, 2018). The platform, has since expanded, both in terms of global research and topic areas (Bello-Bravo *et al.*, 2011). To date, SAWBO's principle work product has

been “mobile ESD” (mobile education for sustainable development): a knowledge-delivery medium grounded in scientifically accurate educational animations that can be over-dubbed into local languages and played back or shared on information and communication (ICT) devices (e.g., projectors, tablets, laptops, and, most importantly, Android and basic video- and Bluetooth®-capable cellphones). Developed iteratively through a four-step (internally peer-reviewed and member-checked) process with global and local knowledge experts, and anchored in key insights from effective multimedia and adult learning theory (Clark & Mayer, 2016; Taylor & Marienau, 2016), SAWBO’s “mobile ESD” enables a wide distribution of best-practices visualizations addressing issues regarding IPM, agriculture, health, and women’s empowerment to the widest possible demographic.

For FAW specifically, SAWBO coordinated and worked closely with FAW research and development teams at the United States Agency for International Development (USAID), the International Maize and Wheat Improvement Center (CIMMYT), the International Institute for Tropical Agriculture (IITA), and other partners, to develop a mobile ESD video animation for combatting fall armyworm. The four iterative steps of this process were:

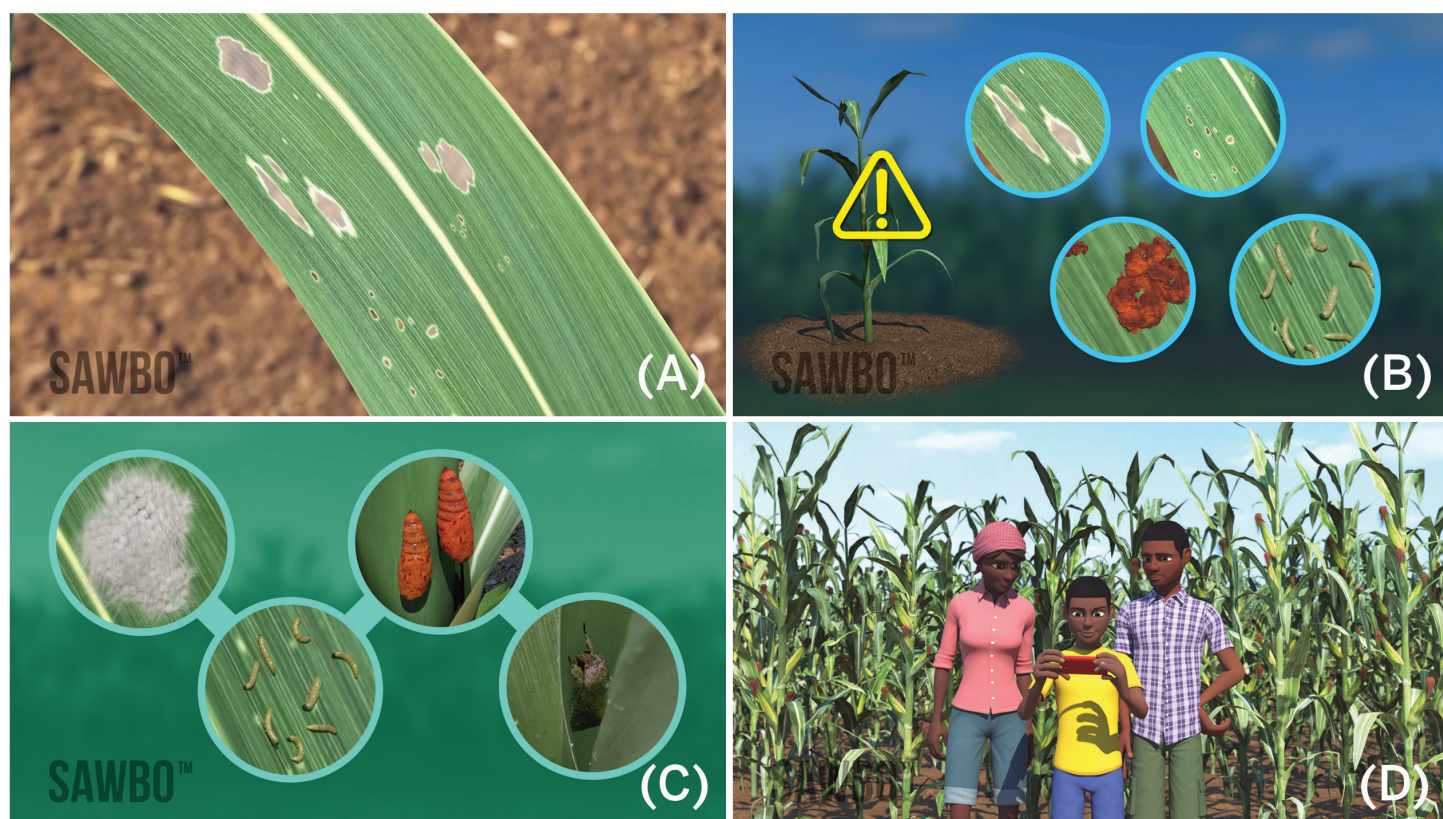
*Defining the specific idea or concept for the initial animation.* Many African farmers have very little to no knowledge of the accidentally introduced pest, including how to identify or scout for it, subsequent to making effective decisions on pest management (such as when and how often to spray). The concept for the first SAWBO animation on FAW emerged out of three Regional Training and Awareness Creation Workshops on FAW Management organized jointly by USAID,

CIMMYT, and IITA during 2017–2018 in Harare, Zimbabwe (October 30–November 1, 2017), Addis Ababa, Ethiopia (November 13–15, 2017), and Cotonou, Benin (February 13–15, 2018). During these workshops, the SAWBO team virtually presented its mobile ESD approach. These meetings provided an opportunity for identifying a first topic area for a SAWBO animation on FAW.

*Developing a script.* Over a six-month period during 2017–2018, USAID and CIMMYT worked intensively with global experts to develop the publication *Fall Armyworm in Africa: A Guide for Integrated Pest Management* (Prasanna *et al.*, 2018). Based on details provided in this manual, SAWBO developed an animation script for identification of FAW (including the life stages of the pest, and damage symptoms on the maize plants), as well as scouting strategies at different developmental stages of the maize plant and threshold levels for FAW damage that might warrant appropriate intervention measures.

*Storyboarding and assets for the animation.* Interactively, SAWBO generated the visual narrative of the animation with FAW experts at USAID, CIMMYT, and IITA, along with inputs from other knowledge experts on this pest. Animation assets that were developed as necessary for the narrative included: characters useful within the African context, structurally accurate maize plants at all of the respective developmental stages, and developmental stages of the FAW pest. Critical concepts were outlined and refined at this stage, along with the narrative (animated) sequencing needed for their presentation in the video.

*Producing the animation.* SAWBO first produced a short, scientifically based, best-practices mobile ESD animation for



**Figure 1.** Screen shot from the FAW SAWBO animation showing (A) FAW damage on a maize leaf, (B) signs of FAW damage, (C) the developmental stages of the FAW, and (D) characters used in the animation.



identifying the signs of FAW damage and scouting in English, and has since continued to develop, record, and voice-over accurately the audio portion of the animation in various target languages spoken in Africa and Asia. A key criterion throughout this step is that the SAWBO animation be playable on any video-enabled ICT device (especially cellphones) and downloadable in various file sizes and corresponding image quality at any location where Internet access is available for downloading and offline watching (Figure 1).

Previously, under USAID-funded research through the Feed the Future Lab for Collaborative Research on Grain Legumes, SAWBO worked with farmers across multiple language and cultural groups in southern and western Africa to develop animations for hermetic bean storage and row planting of beans. Major outcomes from this previous work demonstrated a need for (1) highly accurate ESD/information models, (2) non-specific (i.e., generic) character images and dress, (3) “clean” messaging with unambiguously matching audio and visuals, and (4) participant reported visually high quality and aesthetically appealing 3D imagery (Bello-Bravo & Baoua, 2012; Bello-Bravo, Dannon, Agunbiade, Tamò, & Pittendrigh, 2013; Bello-Bravo, Olana, Enyadine, & Pittendrigh, 2013; Bello-Bravo, Seufferheld, *et al.*, 2013). We applied the empirical findings from this previous work to the mobile ESD animation for FAW titled “How to Identify and Scout for Fall Armyworm.”

The English version of the FAW video was released on August 15, 2018, with the Portuguese and French versions released on September 10, 2018. At the time of the writing of this article, our team is currently working on other language variants including, but not limited to, Swahili, Gikũyũ, and Twi. Still other languages may be added, even dozens or hundreds more, and limited only by resources and language variant translators to do so. All variants of the animation are, and will be, both freely available for educational purposes to any group and accessible through multiple online and offline means. Table 1 summarizes SAWBO’s currently available FAW animation resources.

The animations can also be accessed, downloaded, and shared (offline) through the SAWBO Deployer App. The App is available for download on Google Play ([goo.gl/kpymYQ](http://goo.gl/kpymYQ)) (Figure 2A) and allows users, when connected to the Inter-

net, to choose the FAW animation (Figure 2B) and then filter through the languages available (Figure 2C). As new language variants are uploaded to the SAWBO library, they become immediately available for SAWBO App users to download (Figure 2D). Those accessing the videos can then either play them on their phones for themselves or to others (Figure 2E) or share videos by Bluetooth® to other phones. (, Bluetooth® functionality is virtually universal on video-enabled cellphones). In this way, mobile ESD videos can be used and shared offline even in the remotest or difficult to access locations. And because the videos are dialectically localized, viewers in those otherwise inaccessible locations thus can access mission-critical, scientifically grounded information about issues like FAW.

In addition to the findings from previous USAID-funded research noted above, further research has measured not only equal or greater levels of learning gains compared to other methods of delivery among African farmers but also considerably higher expressed preferences for mobile ESD as a method of delivery (Bello-Bravo, Lutomia, & Pittendrigh, 2019; Bello-Bravo, Tamò, Dannon, & Pittendrigh, 2018; Bello-Bravo, Zakari, Baoua, & Pittendrigh, 2018). However, the combination of first viewing a mobile ESD video, followed by a discussion facilitated by an extension agent, showed the highest overall knowledge transfer. While this suggests that mobile ESD is effective stand-alone, when resources exist to support extension agents as well, this may represent the most effective knowledge transfer approach.

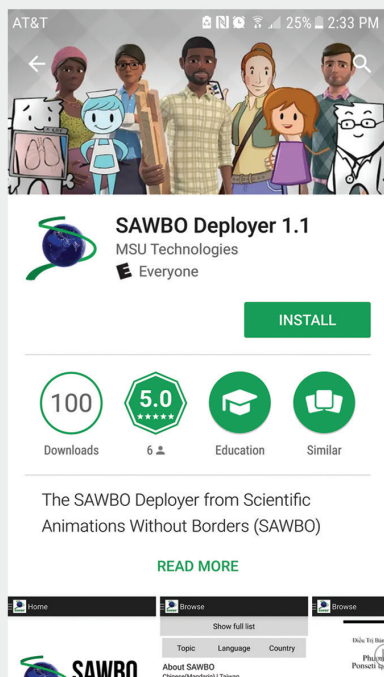
While increased access to the widest demographic possible and high levels of scientifically grounded knowledge transfer are needed to optimize rapid dissemination of critical and accurate information to low-resource and poorly literate people in crisis situations, solution adoption is also a critical need for successful intervention. From one recent follow-up study in Mozambique (Bello-Bravo, Abbott, Mocumbe, Maria, Mazur, & Pittendrigh, in Preparation), we measured a 97.9% knowledge retention and 89% solution adoption rate two years after an initial mobile ESD training. Moreover, when rapid response is called for in crisis situation, the length of time to generate a mobile ESD fully from scratch is typically less than six months; in cases where mobile ESD content already exists, it becomes simply a matter of locating, trans-

**Table 1.** Language Variants, Websites Where Available and Links, and Format Options to View or Download Specific File Types.

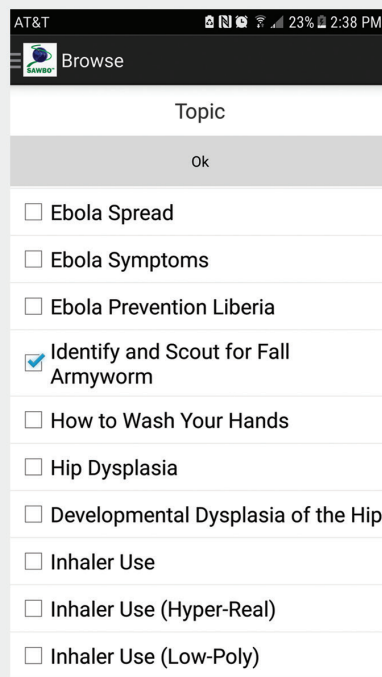
Language (Accent)	Website	Link	Format Options*
English (USA)	YouTube SAWBO Video Library	<a href="https://bit.ly/2x58bBL">https://bit.ly/2x58bBL</a> <a href="https://bit.ly/2xhkGKA">https://bit.ly/2xhkGKA</a>	Online Online, downloadable, 3gp, MP4, and MOV formats
French (Benin)	YouTube SAWBO Video Library	<a href="https://bit.ly/2OpBJl5">https://bit.ly/2OpBJl5</a> <a href="https://bit.ly/2QDNbeq">https://bit.ly/2QDNbeq</a>	Online Online, downloadable, 3gp, MP4, and MOV formats
Portuguese (Mozambique)	YouTube SAWBO Video Library	<a href="https://bit.ly/2Opnj4t">https://bit.ly/2Opnj4t</a> <a href="https://bit.ly/2xk6twm">https://bit.ly/2xk6twm</a>	Online Online, downloadable, 3gp, MP4, and MOV formats

\* “Online” indicates accessibility through Internet portals. 3gp files are a format specific to cellphones. MP4 and MOV files are more readily viewable on devices with higher pixel count screens (e.g., computers, projector systems, TVs, tablets).

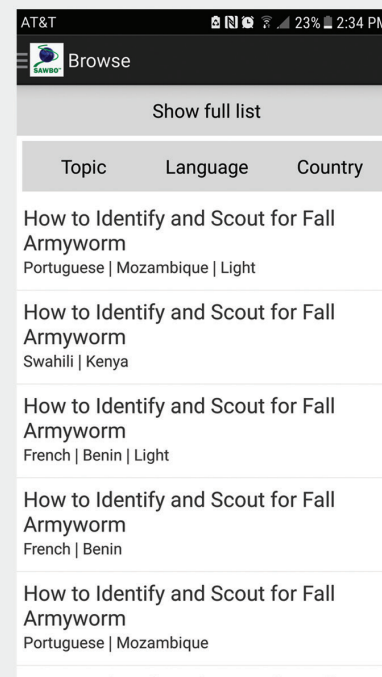
(A)



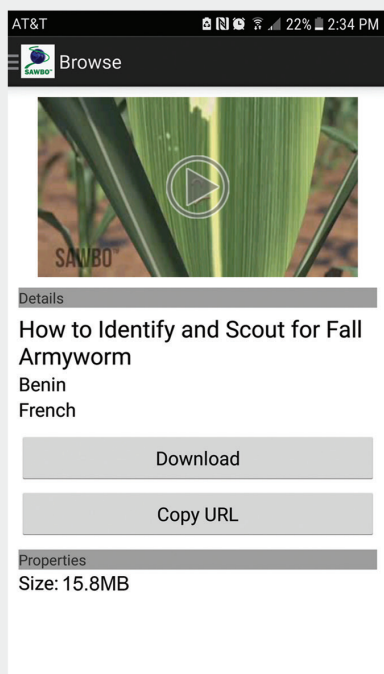
(B)



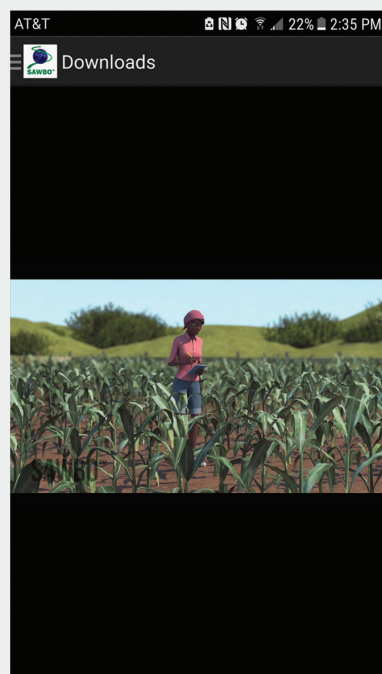
(C)



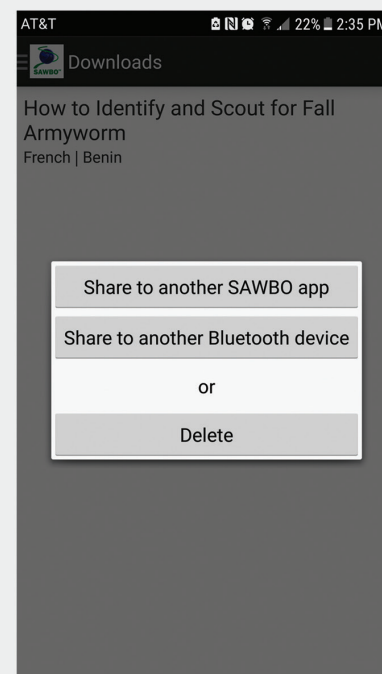
(D)



(E)



(F)



**Figure 2.** The SAWBO Deployer App can be (A) downloaded from Google Play, whereby (B) App allows users, when connected to the Internet, can choose the FAW animation, then filter through the languages available (C). The user can download, onto the phone/App, the language variant(s) of interest to them (D). (E) The animation(s) can be played for the user or others on the phone or (F) shared by Bluetooth® to other phones – all of which can be used and shared offline in settings such as villages.

lating, recording, and voice-overing a new target language, if needed. This will be crucially the case with FAW, as its rapid spread to different areas of the world continues.

## Conclusion

An urgent need now exists to place the existing mobile ESD FAW animation into as many local languages as needed/possible to improve management of this pest. Such language variants will also increase the usefulness of the FAW animation for governments, intergovernmental institutions, non-government organizations, and civil society groups intent of working with farmers in Africa (and Asia) as it pertains to FAW IPM. The USAID, CIMMYT, IITA, and SAWBO teams will continue to foster awareness around mobile ESD as a FAW resource through each of their respective networks, but we also encourage other research and development organizations to do the same. More broadly, there is also the need to develop and disseminate further SAWBO mobile ESD animations on other aspects of FAW management to assist farmers in their attempts to control this pest.

Making sure that target audiences have access to this animation, and any future animations, is undoubtedly a considerable challenge. It will be critical to inform inter-governmental, governmental, and non-governmental organizations, working directly or indirectly with farmers, that this resource exists, such that they can be the direct conduit to its deployment in the field. Thus, this (and any future FAW) animation(s) represent(s) a supporting tool for other organizations to use. It will also require that they develop localized pathways for deployment. However, it is important to note that training local educational deployment agents (e.g., extension agents) in the use of the SAWBO Deployer App allows for a highly effective approach to make SAWBO animations available for deployment with farmers in real time as new animations and language variants become available.

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