

Precision Integrated Pest Management (IPM) for Smallholder Cowpea Farmers in West Africa

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Introduction

Cowpeas are a fundamental food security crops for smallholder farmers in West Africa; however, insect pests present an ongoing threat to production, and the chemical pesticides used to combat them pose serious health and environmental risks to both farmers and consumers due to misuse. Given the severity of these risks, it is vital to identify alternative pest control strategies. This project is developing a prototype precision integrated pest management (IPM) platform based on bringing cowpea researchers, extension workers, and farmers together to collect pest data and then identify and communicate sustainable pest management solutions. Researchers from Michigan State University and the International Institute of Tropical Agriculture (IITA), in collaboration with the Institut de Recherches Agricoles du Benin (INRAB), have developed this innovative program. Based on crop and pest modeling, a



A cowpea field in southern Benin

prototype expert system was established to provide the scientific basis for deriving and identifying pest control solutions in real time. Solutions involve testing new biological controls along with biopesticides and other pest management options. Cellphone technology and simple visuals within an application provide the data gathering

and learning tools. Using surveys and choice experiments, the project team is assessing the potential impacts of using such an integrated system. While the proof of concept is based in Benin and focuses on pod borers in cowpea production, the precision IPM technology has the potential to be scaled up to all the cowpea producing regions in West Africa and adapted to manage other pests. Initial funding for this IPM project spans three years, from July 2014 through June 2017.



West Africa farmer with harvest

Project Description

There are more than 10 million smallholder cowpea farmers in five West African countries (Benin, Burkina Faso, Ghana, Niger, and Nigeria). This project establishes the foundation for a sustainable plan to address insect pest infestations that currently reduce cowpea grain yields by more than 50 percent, severely affecting both the food security and household income of smallholder farmers, many of whom survive on no more than \$2.00 per day.

The long-term vision of this project is to develop a highly scalable, precision Integrated Pest Management (IPM) platform that would leverage digital systems and incorporate traditional and novel approaches, including biological control agents (i.e., using natural enemies or parasitoids against insect pest), local biopesticides, new improved

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cowpea varieties, and other good farming management practices to address farmers' needs for safe, sustainable, and cost-effective management of cowpea pests.



Maruca vitrata adult moth, larva, and damage on cowpea flower and pods
Source: IITA, Benin, 2015

Project Pillars

1. Development of a prototype expert system for modeling pest attacks combined with a Farmer Interface Application (FIA) that has the potential for both receiving data and delivering pest control recommendations
2. Experimental releases of biological control agents and assessment of their effectiveness
3. Completion of ex ante economic analyses to estimate the potential impact of biologicals with complementary financial analysis of community biopesticide production

Activities under the three pillars focus on control of the cowpea pod borer *Maruca vitrata* in Benin. *Maruca vitrata* is one of the major insect pests that reduces cowpea productivity in West Africa. Benin is an ideal location for developing Insect Pest Management technology because it is representative of the major cowpea agroecologies and smallholder demographics of West Africa. Additionally, the Biocontrol Unit of the International Institute of Tropical Agriculture is located in Benin, increasing the cost-effectiveness of the project.

The Three Project Pillars

For Pillar 1, a prototype expert system is being assembled from new and existing models, datasets, and digital platforms on pest and natural enemies, farmer economics, ecology and dynamics, population genetics, and long-term climate data relevant to the cowpea pod borer in West Africa. Much of the existing data is derived from multiyear collaborative projects led by the University of Illinois at Urbana-Champaign and IITA. Based



Delivering IPM recommendations on a cellphone

on available data, the expert system enables us to identify pest problems and propose local solutions. The Farmer APP is a simple cell phone technology that allows farmers and other stakeholders (e.g., extension agents) to input data into the expert system and instantly receive pest control recommendations in local languages.

The Farmer App is designed with both data collection and solution delivery capabilities. First, the necessary components of the data collection and the minimum dataset required for diagnosis were identified. Second, an internet-based interface for use by farmers and others in the field for collecting data on pest occurrences was developed. The data methodology is being validated by comparing data collected by farmers to those collected by extension agents and field researchers. Following validation, the pest data from Benin are being integrated into the prototype expert system to generate preliminary sets of recommendations for evaluation by researchers and extension agents.



Pesticide used on cowpeas in Benin targeting *Maruca vitrata*, are being conducted in Benin. These evaluations provide critical information for the expert system and for developing an implementation strategy for safe and effective large-scale releases of parasitoids. These releases follow confined lab and greenhouse testing consistent with the Food and Agriculture Organization code of conduct for importation and release of biocontrol agents

(<http://www.fao.org/docrep/x5585e/x5585e0i.htm>). Data collection using the Farmer App could potentially provide a mechanism for tracking the impact of the released parasitoids, resulting in appropriate release recommendations for farmers. To date, close to 50,000 parasitoids have been released at six main locations in Benin. Preliminary observations



A parasitoid

indicate establishment of the parasitoids. Prior to the releases, a biocontrol sensitization campaign targeting women and men cowpea farmers had been carried out at all release sites.



Farmer education campaign

For Pillar 3, economic analyses are being conducted to provide insight into the potential economic and financial sustainability of precision IPM technology. A major factor in this analysis is an ex ante assessment of the financial and economic impacts of biological controls on smallholder farmers and farming systems in Benin.

Using new data systems with tablets and the ODK (Open Data Kit) digital data collection method adapted for use in Benin, household surveys captured information on demographics, current farmer crop and pest management practices, production costs and yield, and other crop-related data. With the addition of biological controls to the management options, decision experiments were conducted with farmers

to understand how they might modify their use of chemical pesticides and other pest control measures. A complementary analysis is currently looking at the financial feasibility of producing the pod borer-specific biopesticide virus through a cottage industry made up of women's groups in Benin.

Establishing the direct and spillover effects of biologicals as well as the financial viability of biopesticides contributes to IPM strategy development.

Vision

The project vision for cowpea pest control is the deployment of locally tailored interventions built on an underlying infrastructure that can monitor ongoing pest pressure and respond in real-time. Beyond the scope of this 36-month project, the expert system will use farmer-, extension-, and researcher-collected data from the Farmer App coupled with the linked datasets to produce tailored, precision IPM solutions that will feed information to the Farmer App to create local recommendations for individual farmers.



Parasitoid release



Farmers harvesting mature cowpea pods

Additional funding is critical to developing this precision IPM technology into a fully functional platform for West African and other regions affected by insect pests. For the future delivery of farm-level recommendations, the potential for linking with or adapting existing knowledge exchange platforms, such as appropriate training materials in Scientific Animations Without Borders (SAWBO; <http://sawbo-illinois.org/main.htm>), will be explored. Finally, the platform will be scaled up to cover other cowpea-producing countries in West Africa as well as address other economically harmful insect pests.

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