# IPM-omics: Scalable and Sustainable Biological Solutions for Pest Management of Insect Pests of Cowpea in Africa (S01.B1)

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**Abstract**
Cowpea is an important protein source for tens of millions of West Africans living on less than $2 a day. The major biotic constraint on cowpea crops in West Africa is an insect pest complex. Pesticides and/or transgenics will not provide the long-term solutions needed to bring these pest populations below the economic thresholds needed by cowpea farmers. The only remaining logical strategy: Integrated Pest Management (IPM) involving a pipeline of diverse pest control solutions. Our program is focused on the development and deployment of scalable pest control solutions involving a combination of traditional pest control and deployment strategies and cutting-edge technologies, including genomics and GIS to help direct the most effective deployment of these approaches. Testing and deploying cutting-edge information communication and technology (ICT) tools is also a part of the scaling of these solutions.

Our program, *IPM-omics*, involves defining the pest problems, bringing forward appropriate solutions through a biocontrol/biopesticide pipeline, and scaling these solutions through multipronged strategies that will include farmer field flora, ICT approaches, women's cooperatives, and partnerships with small-scale industries. We have and will continue to develop online interfaces that make our outcomes easily available to other groups that can benefit from the materials; we will continue to develop approaches so that we can share solutions with outsides groups that can help in the scaling and sustainability of these solutions. We will develop, deploy, and test training/technology packages/programs that will be passed-off to groups (e.g., NGOs, national/international agencies), and we will determine the potential for impact of this approach.

**Problem Statement and Justification**
Insect pests of cowpeas dramatically reduce yields for cowpea farmers in West Africa, many of whom live on less than $2 per day. Arguably, the greatest biotic constraints on cowpea (*Vigna uguiculata* [L.] Walp.) production are insect pests. The major pests of cowpea in the field in northern Nigeria, Niger, and Burkina Faso include the legume pod borer (*Maruca vitrata* Fabricius); the coreid pod-bugs (*Clavigralla tomentosicollis* Stal and *Anoplocnemis curvipes* [F.]); the groundnut aphid (*Aphis craccivora* Koch); and thrips (*Megalurothrips sjostedti* Trybom). Foundational work has been initiated to understand these insect pests in the areas where we propose to work to develop and deploy solutions. This foundational work has positioned us well to have a better understanding of pest biology and population structure (due to molecular tools), which will help direct current and future pest control strategies.

Although biocontrol agents, transgenic plants, and traditional plant breeding for insect-resistant varieties are all potentially effective methods for controlling pests of cowpeas, a continued refinement of our understanding of pest populations is needed to integrate these—and other—pest control options into an overall integrative pest management plan to maximize cowpea production in the field. IPM refers to a pest control strategy in which a variety of complementary approaches are used to minimize the negative effects of pests on a given crop or cropping system. As we develop, refine, and deploy IPM strategies, we must understand the important life-history parameters of these pest insects in relationship to their environment.

Scalable IPM solutions are going to be highly necessary to increase yields, which are dramatically affected by pest populations. From the last cycle of the CRSP program, we observed that a logical set of combined IPM strategies could increase yield of cowpeas by more than 100 percent (e.g., neem plus *M. vitrata*-specific virus spray controls). We also have developed and released biocontrol agents that can be released across more areas of West African and establish themselves in the field to suppress insect populations over the long-term; this approach is highly cost-effective, sustainable, farm-sized, and gender neutral. Over the next four years, we will research, develop, implement, and determine the impacts of an IPM-omics program for cowpea in West Africa. We will continue to research and develop scalable solutions, with the potential for larger-scale impact with donor community buy-in.

**Objectives**

1. Define the pest problems on cowpea in Ghana, Burkina Faso, Niger, and Benin
2. Discover, document, and set the stage for scaling of appropriate IPM solutions
3. Scaling of solutions
4. Capacity Building Research Approach and Methods

**Research Approach and Methods**

Objective 1. We have and will continue to use a mixture of field studies and molecular tools to define the pest population on cowpea across multiple ecological zones in Ghana, Burkina Faso, Niger, and Benin.

Objective 2. We have and will continue to bring forward ecologically sound and highly cost-effective pest control strategies for the pests of cowpea. This will involve the continued development of appropriate solutions through host plant resistance traits, a biocontrol/biopesticide pipeline, and other IPM solutions that involve local educational programs.

Objective 3. We will research and deploy tangible outputs for the scaling of our IPM solutions. This includes, but is not limited to, releasing of biocontrol agents that can establish in the environment (and control the pest populations), testing the potential for cottage industries for biopesticide production, and, finally, creating scalable educational tools for IPM.

Objective 4. We will continue to capacity build through diverse educational programs that range from graduate student and technician training to ICT technologies that help local institutions increase their impact.

**Anticipated Achievements and Outputs**

1. In the past phase of this program our approach of combining field and molecular data gave us important insights into the movement patterns of *M. vitrata;* the results from this work are now driving recommendations for pest management strategies for this species. In the next phase of this

project, we expect to develop similar insights and recommendations for other pest species that attack cowpea in the field.

2. Our program has both developed novel pest control strategies for the control of the pests of cowpeas (e.g., neem plus a virus that kills *M. vitrata* larvae) and emerging new biocontrol agents that will be highly useful in minimizing pest populations on cowpeas.
3. We expect to develop, based on our research outputs, the most cost-effective strategies for biocontrol agent release. Additionally, we also expect to determine the potential for local biopesticide production through women's cooperatives, from both a technical and market prospective.
4. We will train new MS and PhD students with a focus on IPM for cowpeas and the population genomics of the pests of cowpeas, cross-train technicians and scientists in our network, and develop scalable ICT solutions for the educational component of our IPM program.

**Projected Developmental Outcomes**

We expect to have a greater understanding of the pest problems of cowpeas to facilitate the cost-effective development and deployment of IPM solutions for cowpea farmers in Ghana, Burkina Faso, Niger, and Benin. It is expected that many of these strategies will have the potential to double the yield of cowpea crops in the field.

**Contributions to Institutional Capacity Building**

Our program will continue to train the next generation of scientists in Ghana, Burkina Faso, Niger, and Benin who will focus on issues associated with pest problems in cowpea through the training of undergraduate, master's, and PhD students. We will also promote the cross-training of scientists and technicians across the four host-country programs and with U.S. scientists to build a network capable of understanding pest problems on cowpea in West Africa and to develop the sharing of solutions. We will continue to develop, to test, and to deploy novel ICT programs in local languages, alongside and in conjunction with farmer field flora, in order to take our pest control innovations into the hands of cowpea farmers. Finally, our ICT infrastructure will allow us the capacity to share these pest control approaches directly with other government and nongovernment organizations as well as international organizations involved in the dissemination of pest control solutions.