SO1.B1 – Scalable and Sustainable Biological Solutions for Pest Management of Insect Pests of Cowpea in West Africa

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Collaborating Programs

- S01.A5 – Dr. Phil Roberts and team
- S04.1 – Mywish Maredia and Byron Reyes

Cowpea

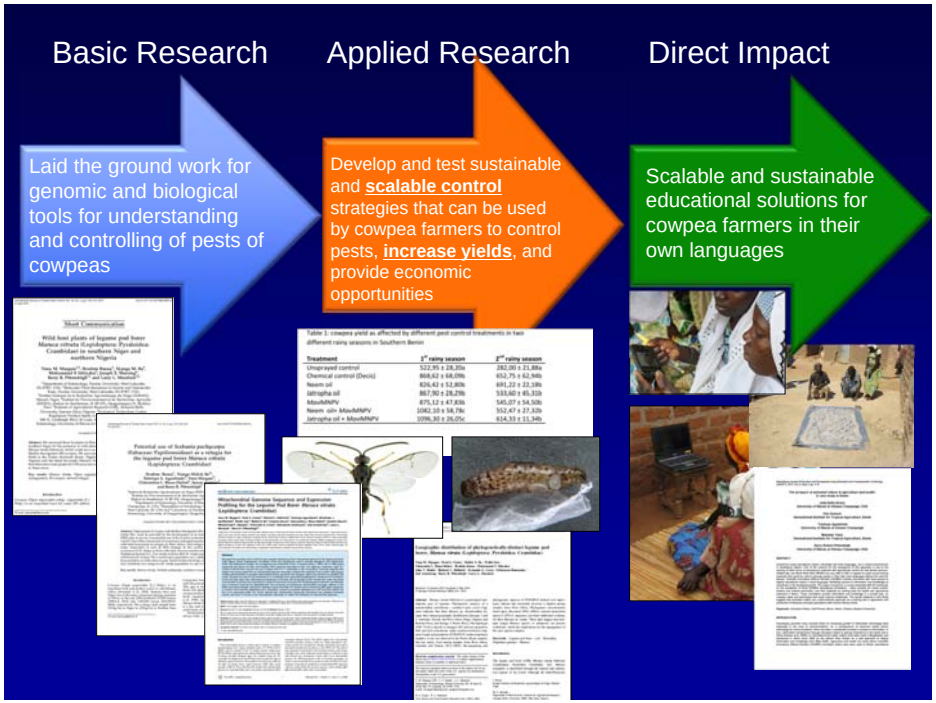
1. **Important protein source for approximately 200 million Africans**
2. **Major crop in West Africa**
3. **Insect pests are major drag on yield**

Research/Extension Efforts

- Six major insect pest species that attack this crop in the field and in storage
- The damage caused by these pests can devastate farmer's livelihoods
- Development and deployment of ***Integrated Pest Management*** control strategies
  - Understand the pests to develop best practices for given environments
- Technology-based community building efforts for extension deployment strategies

Four Objectives

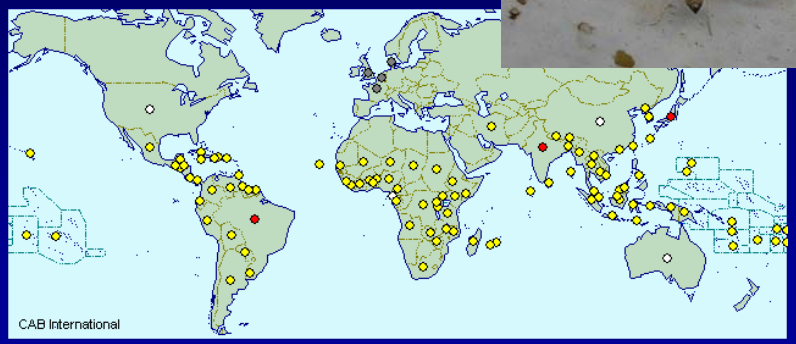
- Define the pest problems on cowpea in Ghana, Burkina Faso, Niger and Benin
- Discover, document and set the stage for scaling of appropriate IPM solutions
- Scaling of Solutions (and testing of the scaling)
- Capacity Building



Understanding Pest Systems

- Understanding the pest problems has given us insights into solutions
- Study of pest problems
  - Using organism level and ecological studies
  - Coupled with molecular tools

Maruca vitrata



Life-history and regional movement patterns

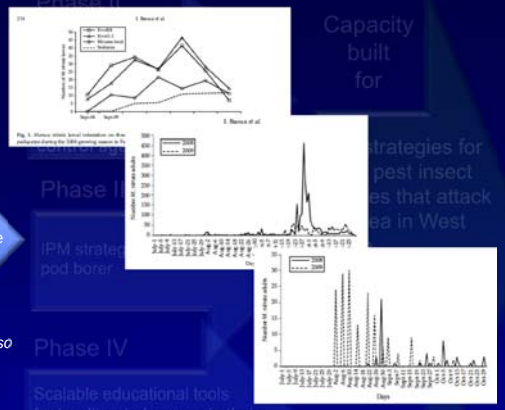
- South to North migration hypothesis
- Endemic and migratory zones
- The zones make a difference in the control strategy

Laid the ground work genomic and biological tools for understanding and controlling of legume pod borer (*Maruca vitrata)* (LPB)

Outcomes (LPB)

✔*LIfe history better defined*

✔*In Niger, Nigeria, Benin, and Burkina Faso*



Ba et al., 2009; Baoua et al., 2011

September 2008 — September 2010 — September 2012

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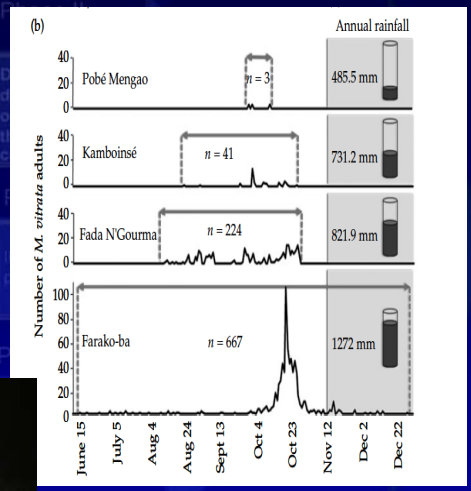
✔*Migratory patterns better defined*



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✔*LIfe history better defined*
✔*Migratory patterns better defined*
✔*Alternative hosts*


Short Communication

Wild host plants of legume pod borer *Maruca vitrata* (Lepidoptera: Pyraloidea: Crambidae) in southern Niger and northern Nigeria

Potential use of *Sesbania pachycarpa* (Fabaceae: Papilionoideae) as a refugia for the legume pod borer *Maruca vitrata* (Lepidoptera: Crambidae)

September 2008

Ba et al., 2009; Baoua et al., 2011

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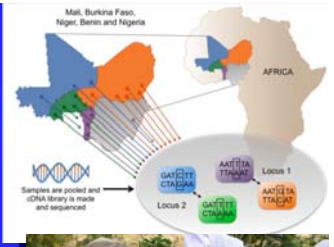
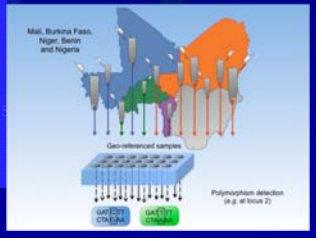
✔*Migratory patterns better defined*
✔*Alternative hosts*
✔*Genomic tools developed*

Approaches

1)Insects from large geographical regions were collected
2)Some were pooled and sequenced to discover polymorphisms
3)Others were tested individually to test for polymorphisms and test hypotheses





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✔*LIfe history better defined*
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✔*Genomic tools applied to understand pest populations*

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✔*Host plant resistant varieties tested*
✔*Improved varieties in the hands of farmers*
✔*Training programs for farmers*
✔*Implications for Bt cowpea*

Recommendations based on IRM models from our field data (Bt cowpea)

1)Bt cowpea can be grown in the north with minimal concerns for resistance
2)If grown in the south two Bt pyramided genes would be required
3)Wild alternative hosts can serve as a refuge for Bt cowpea

Phase II

Laid the ground work genomic and biological tools for understanding and controlling of legume pod borer (*Maruca vitrata)* (LPB)

Outcomes (LPB)

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- ✔*Migratory patterns better defined*
- ✔*Alternative hosts*
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- ✔*Genomic tools applied to understand pest populations*
- ✔*Host plant resistant varieties tested*
- ✔*Improved varieties in the hands of farmers*
- ✔*Training programs for farmers*
- ✔*Implications for Bt cowpea*
- ✔*Implications for biocontrol*

Recommendations for Biocontrol

1)Endemic zone extends into southern Burkina Faso

2)Biocontrol agents can be released into these areas this far north

3)Development of a neem plus virus (MaviNPV) spray can be used

- **safe alterative for pesticide sprays**
- **just as effective as pesticides and in some cases better**

Table 1: cowpea yield as affected by different pest control treatments in two different rainy seasons in Southern Benin*

Treatment	1st rainy season	2nd rainy season
Unsprayed control	522,95 ± 28,20a	282,00 ± 21,88a
Chemical control (Decis)	868,62 ± 68,09b	652,75 ± 62,94b
Neem oil	826,42 ± 52,80b	691,22 ± 22,18b
Jatropha oil	867,90 ± 28,29b	533,60 ± 45,31b
*Mavi*MNPV	875,12 ± 47,83b	545,07 ± 54,50b
Neem oil+ *Mavi*MNPV	1082,10 ± 58,78c	552,47 ± 27,32b
Jatropha oil + *Mavi*MNPV	1096,30 ± 26,05c	614,33 ± 11,34b

*Kg/ha

High humidity
High *Maruca* density

Dry conditions after flowering
Lower *Maruca* density in pods

1) Doubling of yields under both conditions
2) As good as conventional pesticides

Biological control: exploiting the large diversity of *M. vitrata* natural enemies in Asia

- Our first case study: the exotic parasitoid *Apanteles taragamae,* an interesting biological control candidate
- up to 60 % parasitism on *M. vitrata* feeding on *Sesbania*

Surprize N1: *Apanteles taragamae* and *Mavi*MNPV flying together !

Exotic parasitoid from Asia: *Apanteles taragamae*

\+

Entomopathogenic Baculovirus *Mavi*MNPv

= implications for biological control

Treatments	Exposure time	
	2 h	24 h
Control	0 b	0 b
Ovipositor	0,91 a	0,96 a
Whole body	0,94 a	0,97 a
Diet	0,90 a	0,98 a
P>F	<0,0001***	<0,0001***

Biological control pipeline: more to come

On-going collaborative project with AVRDC and *icipe*:

Photo courtesy C. van Achterberg

***Therophilus marucae* (Hymenoptera, Braconidae)**

***Nemorilla maculosa* (Diptera, Tachinidae)**

Moving forward

- We now have molecular markers for all the pests of cowpea
- These will be used in this phase, along with organism and ecological level studies, to understand these pest systems
- Outcomes will be used to develop and drive pest management strategies
- Biocontrol agents for release and in development
  - In field testing of scaled release programs
- Neem + virus spray for larger scaling testing and deployment

Scaling

Cheap and simple rearing methods together with the combination of bio-pesticides open up new opportunities:

Scaling

Developed in India – IITA in process of reproducing this approach in West Africa

Scaling

80 t of neem seeds collected by a community of 600 women (in Benin)

Neem oil extraction, 500 l / week

Scaling

4500 liters ready for commercialization

Production of essential oils

Scaling

Bio-fertilizers: useful and income-generating by-products

Mixing neem oil with essential oils

Scaling

The final product: a commercially viable bio-pesticide

The next step:

same women groups mass-produce *Maruca vitrata*, infest larvae with the virus and sell the dead larvae to the enterprise for extraction, purification and conditioning

Scientific Animations Without Borders

- Exploration of how we can make information available to target groups with diverse language and literacy levels
- Exploration of how we can cost-effectively bring together expertise to create that content
- Exploration of how to engage partners for scaling

Educational Strategies for Pest Control




Future efforts

1) Field testing
2) Adding new languages through virtual network of collaborators
3) Freely accessible to the rest of the world

Deployment Approaches

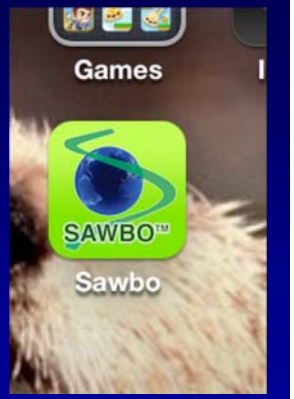


- Local groups
  - NGOs, NARs, etc
- Online
- Library systems
- Cell phones
- Video viewing clubs
- SAWBO-App
- Etc…



SAWBO App

- A system to easily access educational videos
- Rapidly (in seconds) sort through dozens or hundreds or thousands of videos to find the one you want
  - By topic
  - By language
  - By country
- Videos can be downloaded onto the phone
- Share with other phones using Bluetooth®
- Alpha version has been created and tested
- Beta version to be released



Understanding Scaling

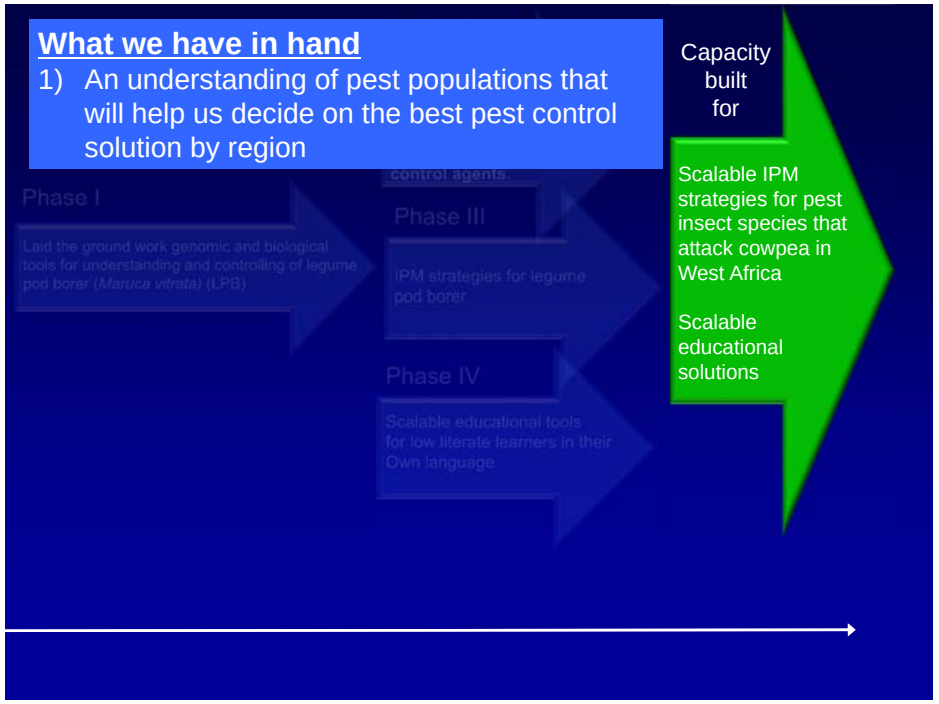

Questions regarding how to have impact

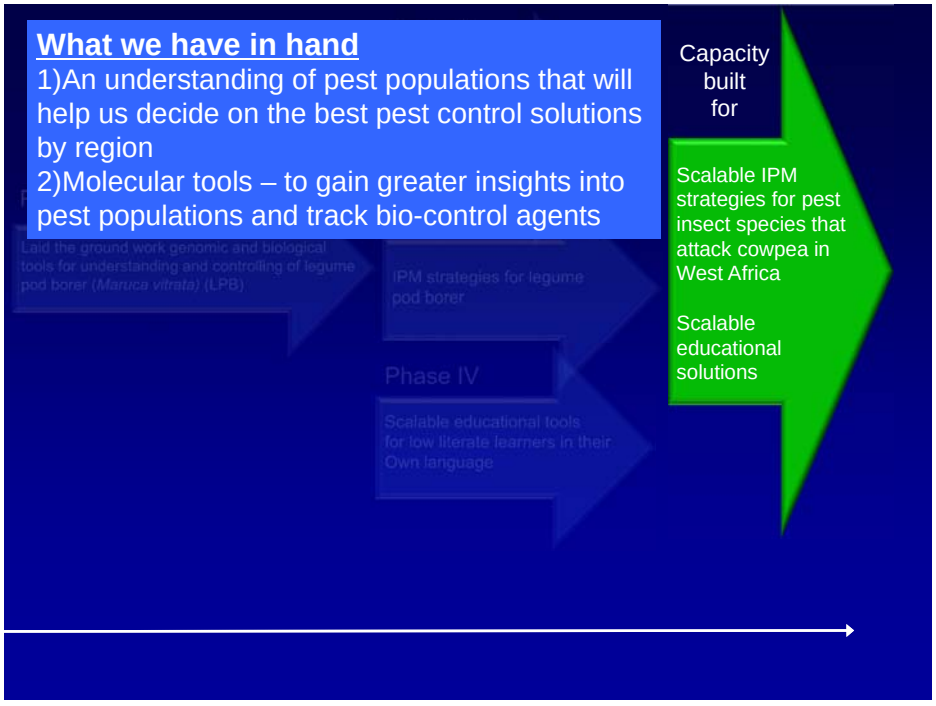
- What do people learn?
- How do people use this knowledge?
- Localized versus specialized
- Who are the potential partners?
- What in field technologies are the best?
- How can these be used with existing programs?
- Pathways for deployment – online/offline
- How can these fit into existing educational programs (FFF)?
- Etc…



Capacity Building

-Graduate and undergraduate training
-Technician cross-training
-Farmer field schools
-Creation of education content and sharing with outside groups





What we have in hand

1)An understanding of pest populations that will help us decide on the best pest control solution by region
2)Molecular tools – to gain greater insights into pest populations and track bio-control agents
3)Bio-control agents that can be used to manage pest populations
4)A neem plus viral spray that is as or more effective than traditional pesticide sprays

Capacity built for

Scalable IPM strategies for pest insect species that attack cowpea in West Africa

Scalable educational solutions

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5)Potentially scalable educational solutions for educators of cowpea farmers
- Growing library of educational materials
- In the language the farmers speak with no need to be literate
- Tools and a program to create more educational content (SAWBO)

Capacity built for

Scalable IPM strategies for pest insect species that attack cowpea in West Africa

Scalable educational solutions

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