Biological control, a pillar of sustainable agriculture in Africa

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IITA: International Institute of Tropical Agriculture

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IITA in Benin has been a home for large biological control projects in Africa

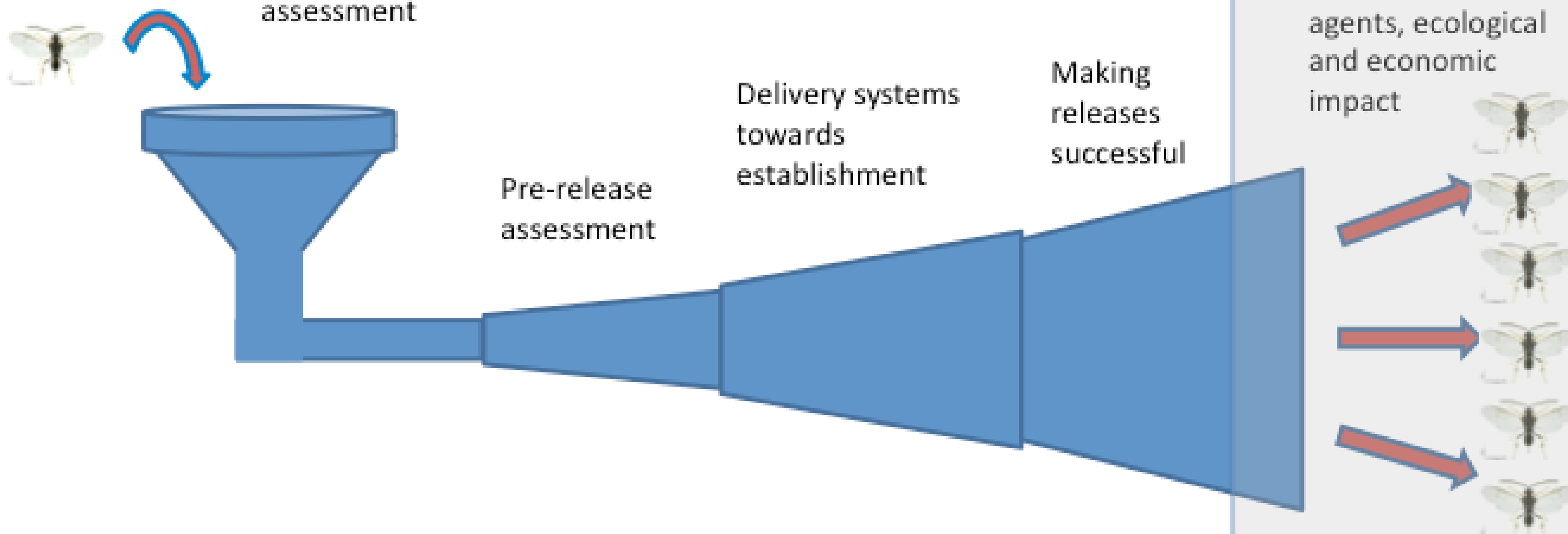
What is biological control?

The use of natural enemies to combat arthropod pests, diseases, and noxious weeds:

-‘classical’ biological control, mainly through inoculative releases of hymenopteran parasitoids

- inundative biological control, through periodic releases of all sorts of natural enemies (parasitoids, predators, pathogenic organisms)

The biocontrol pipeline



Steps in the pipeline towards delivery	Discovery of biocontrol candidates	Technical assessment	Pre-release assessment	Delivery systems towards establishment	Making releases successful	Scaling of release of biocontrol agents, ecological and economic impact
Science involved	Biodiversity, ecology, biology, population genetics	Eco-climatic suitability, colony establishment, rearing methods, ex-ante socio-economic assessment	Host range, host finding behaviour, biosecurity, impact on biodiversity, interactions with other IPM methods	Suitability of gender-equitable mass production by private enterprises, innovative delivery/nursery systems	Capacity development, novel ICT methods for technology dissemination, targeting of release sites	Changes in pest population abundance and dynamics, yield data, savings from pesticide use, environmental, social and human health benefits

What is the approach?

Problem identification:
indigenous vs. exotic pest

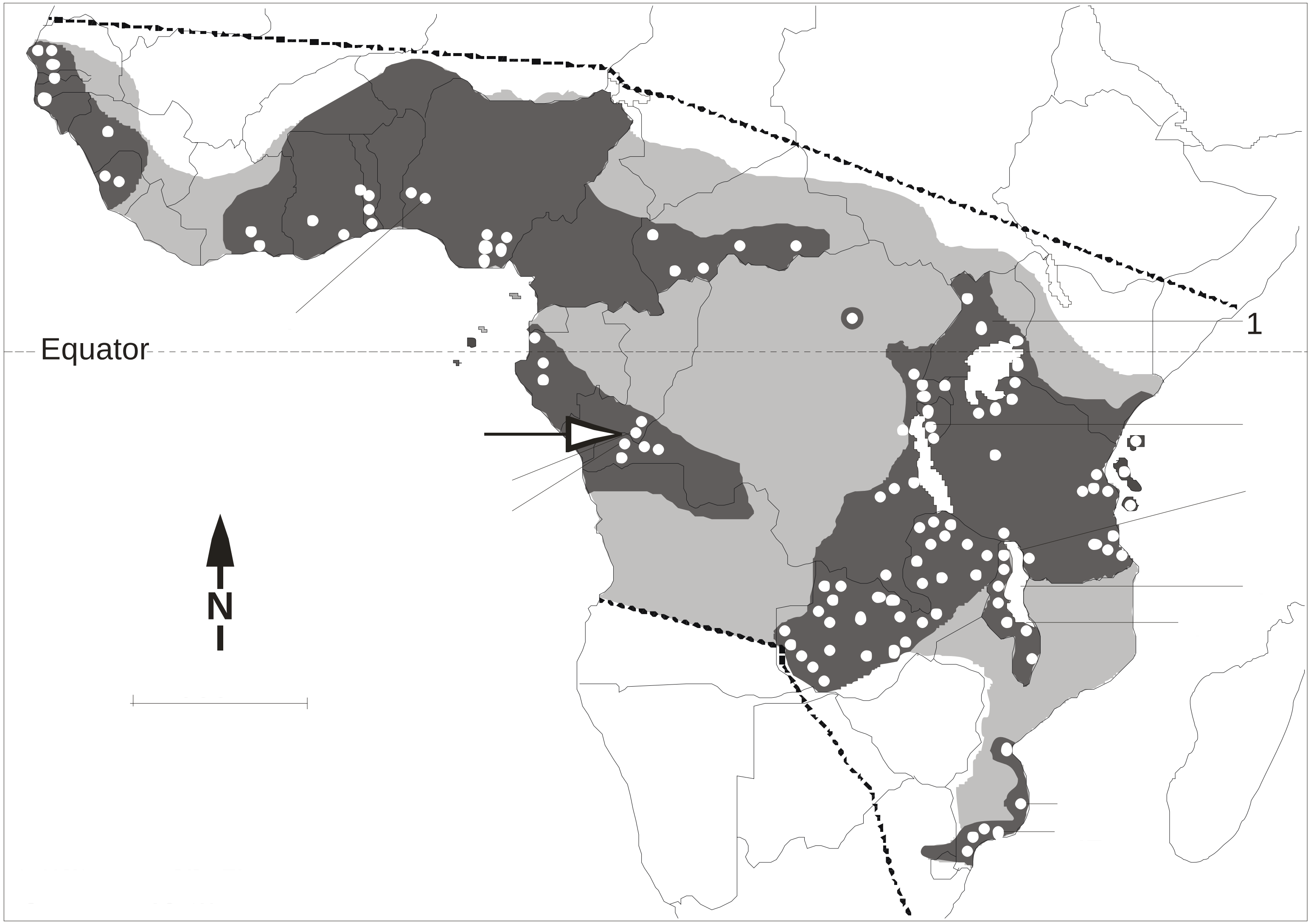
Cassava mealybug

Phenacoccus manihoti

The discovery: *Anagyrus lopezi*

Screening phase: what is the best available natural enemy?

Biological and ecological assessment phase: host range, specificity, climatic suitability



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Impact of biological control: $$$$

Pest species	Estimated loss	Redress (reduction in loss, %)	Savings in US$ million	Cost/benefit ratio
Cassava mealybug	40%	90-95%	7971 to 20226	1:150 to 1:600
Cassava green mite	35%	80-95%	2157	1:101 to 1:125
Mango mealybug	90%	90%	531	up to 1:145
Water hyacinth	US$83m	72%	260	up to 1:124

very high return value, even including a 10% depreciation rate per annum

Biological control: a less obvious option for managing insect pests in cowpea (*Vigna unguiculata* Walp.)

Most important grain legume in West Africa,

estimated average production loss of 3.8 million tons due to insect pests,

ca. 3 billion USD losses every year

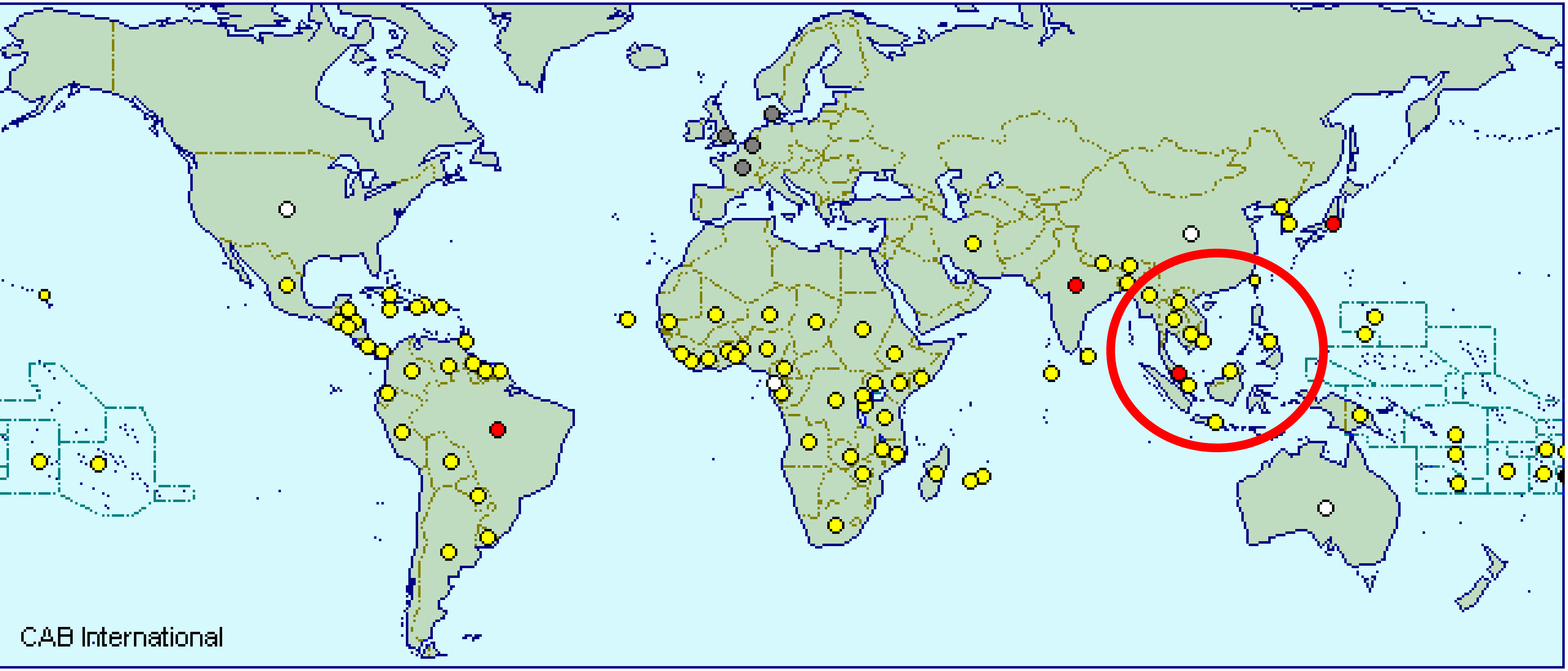
Pesticide issues

Need for more sustainable plant protection approach

An old enemy: the legume pod borer, *Maruca vitrata*

Attacks flowers and pods of various legumes, up to 80% yield loss

Distribution of *M. vitrata*



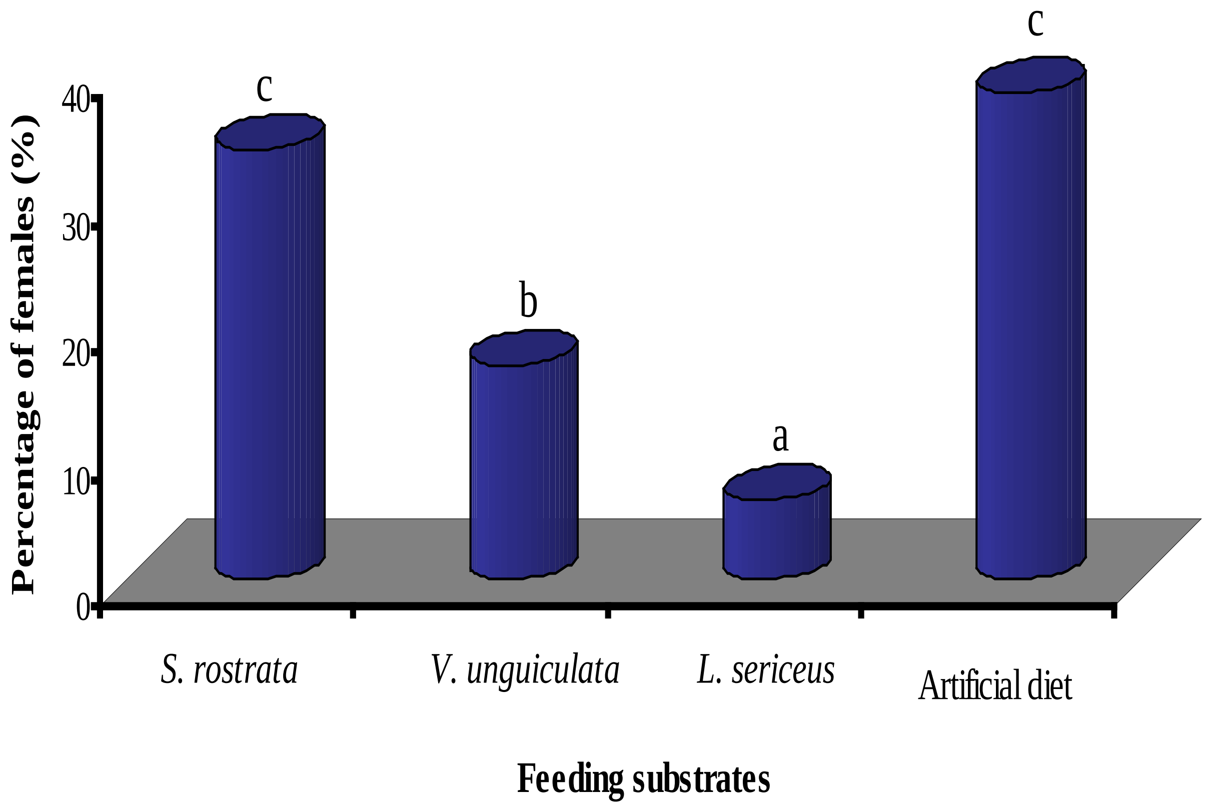
Source: CABI Crop Protection Compendium

Evidence of South Asian origin supported by latest population genetic studies (Periasamy et al, in press)

Biological control: exploiting the larger 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 cannabina* in Taiwan (Huang et al, 2006)
- Lack of information on its bioecology

Host plant/substrate influence on *Apanteles taragamae* biological control performance



Percentage of female wasps (%) emerging from *M. vitrata* larvae feeding on different substrates (Dannon et al, 2012)

All this is encouraging,

„BUT“

A. taragamae not well adapted to major host plant for *M. vitrata* in West Africa

Poor host finding capacity: *A. taragamae* uses cues mediated by both *S. cannabina* kayromones and vibration stimuli from *M. vitrata* larvae feeding as leaf rollers, not attracted by local African Sesbania species

This is also a good way to use the BC pipeline as a tool in decision making

Biological control pipeline: more to come

Photo courtesy C. van Achterberg

Therophilus marucae
(Hymenoptera, Braconidae)

Nemorilla maculosa
(Diptera, Tachinidae)

GIZ-project with AVRDC

Therophilus javanus seems the best ever parasitoid against *M. vitrata*, replacing *A. taragamae* in Taiwan

Diversity of *Therophilus* spp. in Vietnam and Cambodia

Up to 40% field parasitism on yard-long beans

Phanerotoma philippinensis best candidate in Thailand

Need for extended biodiversity studies, coupled with population genetics and GIS

Therophilus javanus: the next biocontrol hero?

Therophilus javanus: first experimental releases

Are there 'good' viruses ??

Maruca vitrata Multiple Nucleopolyhedrovirus *Mavi*MNPV

Insect-smart cowpea systems

Novel BC agents

MR-cowpea

Biopesticides as tools in IRM

Alternative host plants (BC and IRM)

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Legume Innovation Lab

Biological Foundations for Management of Field Insect Pests of Cowpea in Africa (UIUC, Benin, Burkina Faso, Niger)

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Thanks for your attention !