Progress towards establishing biocontrol agents against the pod borer *Maruca vitrata*

Manuele Tamò
IITA focal point
CoA 3.2 co-leader

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RESEARCH PROGRAM ON
Grain Legumes and Dryland Cereals

Cowpea in Africa

Food security & income crop for smallholder farmers in West Africa: 10M ha & 5.4M MT produced

- Genetic gains but insect pests remain the single greatest source of yield loss (50-80%)
- Currently, farmers use inappropriate and often highly toxic synthetic pesticides to fight the pests

- **There are options to pest control!**

Integrated Pest Management (IPM):
no silver bullet approach

Preventive interventions

Improved plant resistance to pests

- Improved varieties (conventional breeding)
- Transgenics (Bt-cowpea)

Improved ecosystems services

- Biological control
- Ecological engineering

Curative interventions

Application of pest-control products

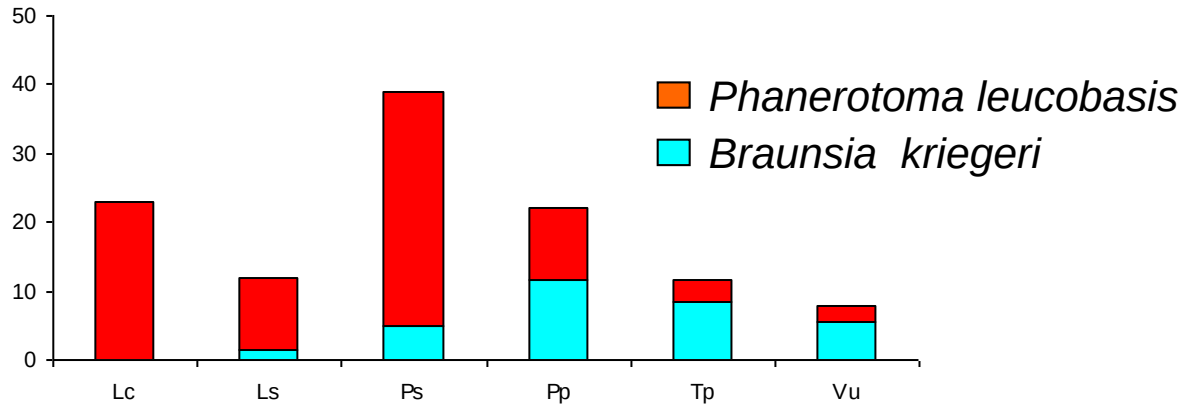
- Bio-pesticides
- Semio-chemicals (attractants, repellants)
- Synthetic insecticides (last resort, targeted)

One of the most devastating insect pests of cowpea in Africa: the legume pod borer, *Maruca vitrata*

Attacks flowers and pods of various legumes, up to 80% yield loss, farmers resort to inappropriate pesticide applications

Why biological control and what science is needed??

Biodiversity studies: locally available natural enemies of *Maruca vitrata* in West Africa



Lc: *Lonchocarpus cyanescens*

Ls: *Lonchocarpus sericeus*

Ps: *Pterocarpus santalinoides*

Pp: *Pueraria phaseoloides*

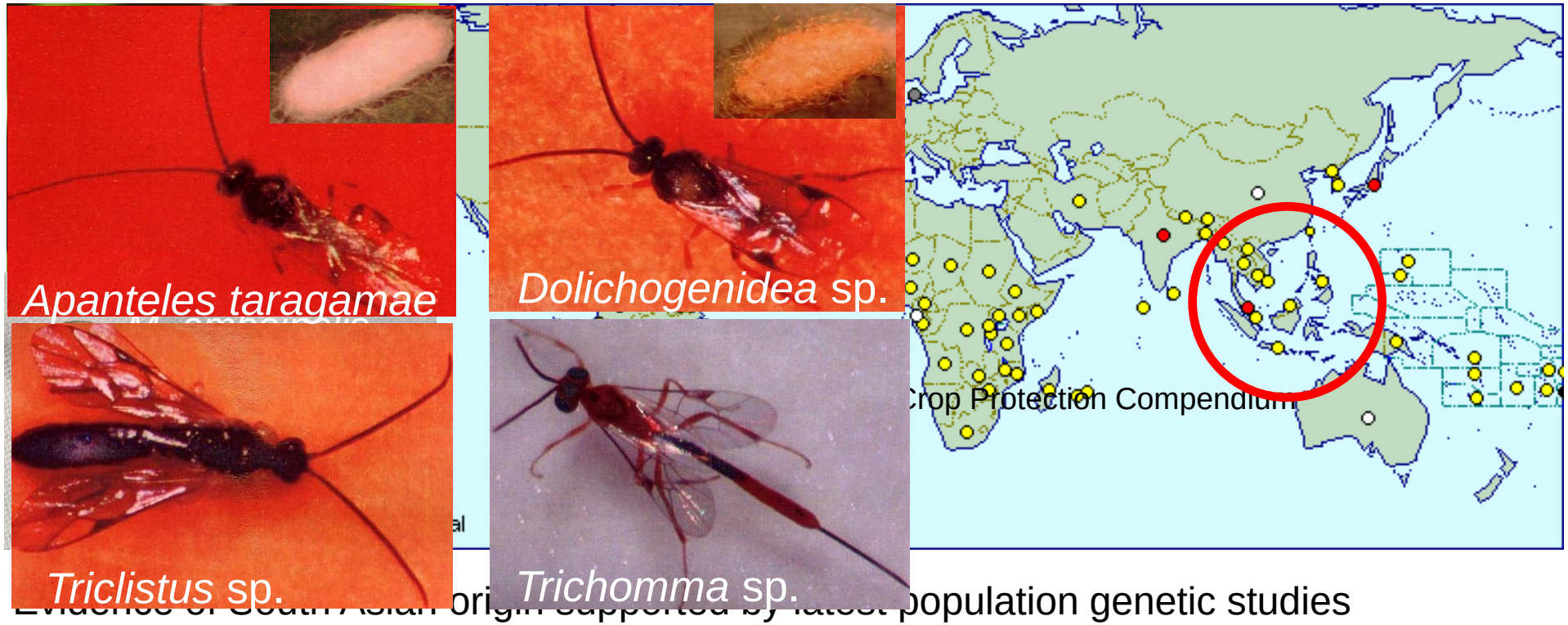
Tp: *Tephrosia plathycarpa*

Vu: *Vigna unguiculata* (cowpea)

Non-host specific parasitoids, low and insufficient parasitism rates

Arodokoun *et al,* 2006

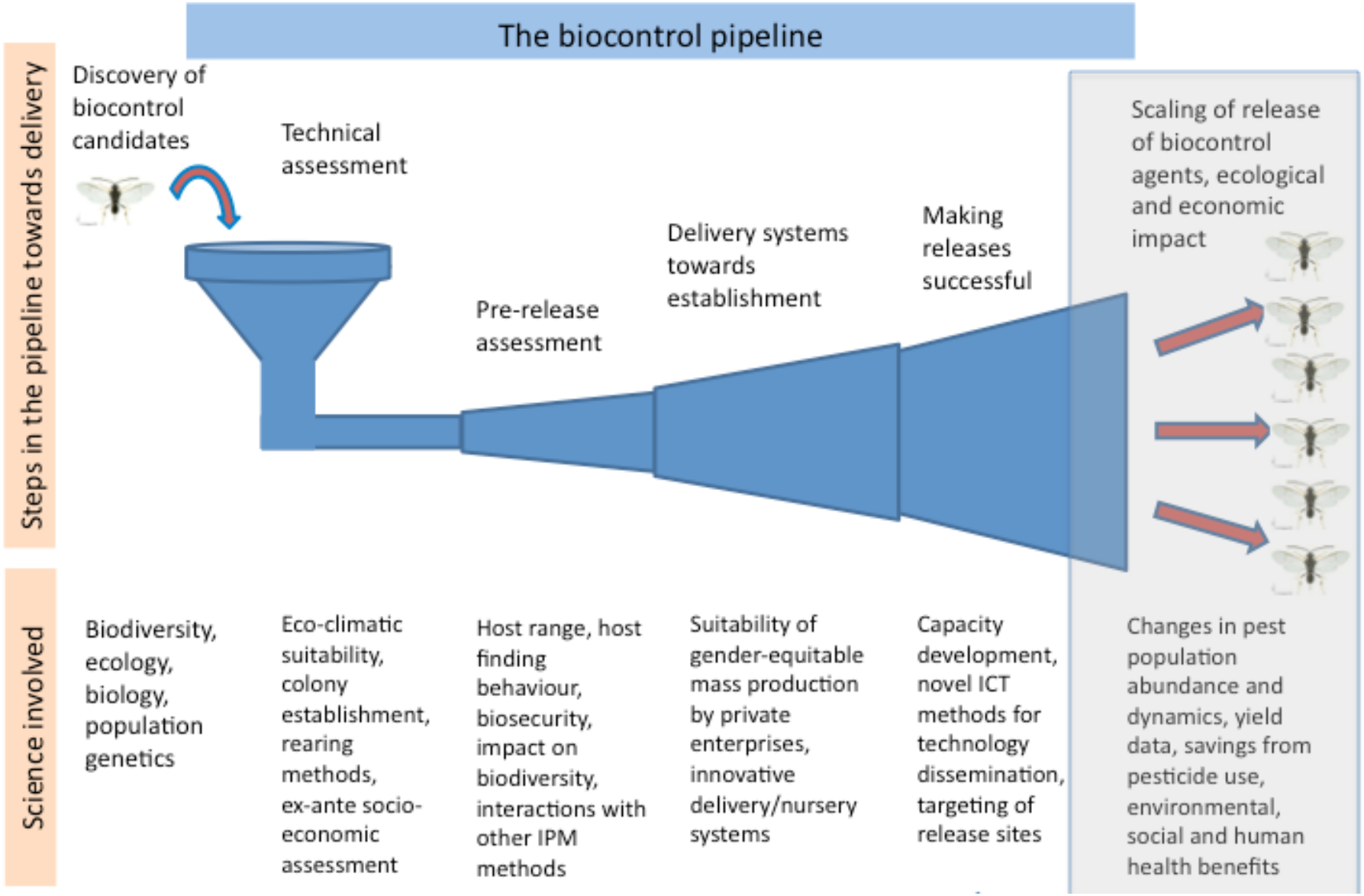
What's about the origin of *M. vitrata*?



Evidence of South Asian origin supported by latest population genetic studies (Periasamy et al, 2015)

Much larger diversity of co-evolved natural enemies that need to be assessed for their performance using a 'biocontrol pipeline' approach

The biocontrol pipeline

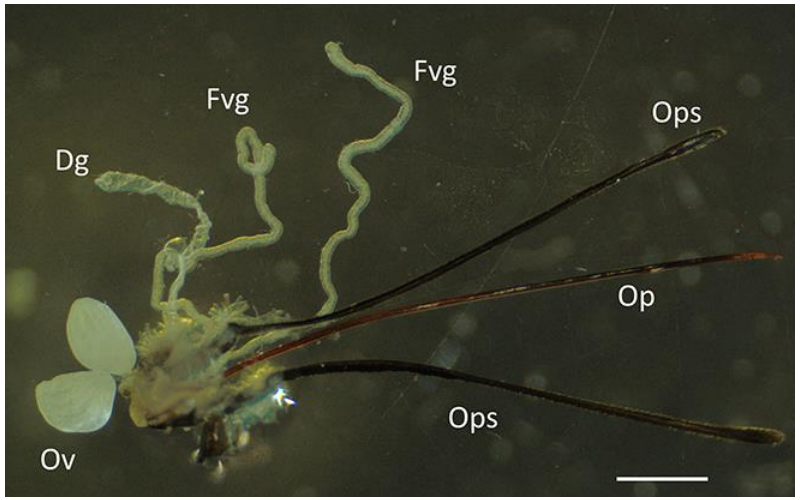


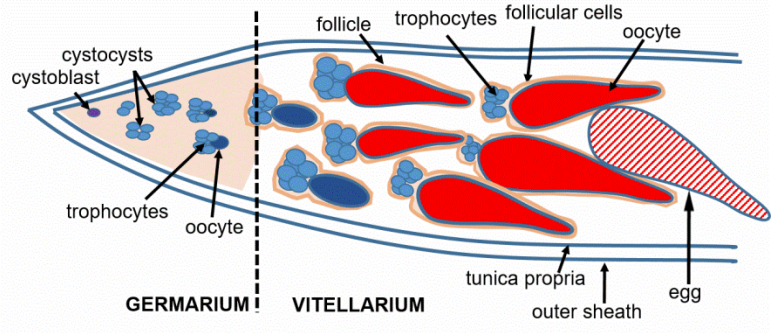
How to feed the pipeline: novel biocontrol agents from the area of origin in Asia

After 2 years of confined testing: first experimental releases of the parasitic wasps (parasitoids) *Therophilus javanus* and *Phanerotoma syleptae*

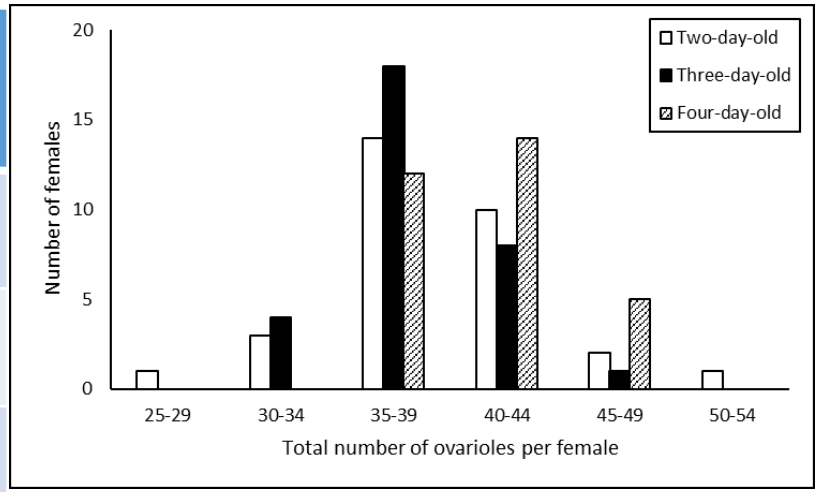
What science is needed?

Reproductive physiology and biology of the parasitoid *Therophilus javanus*





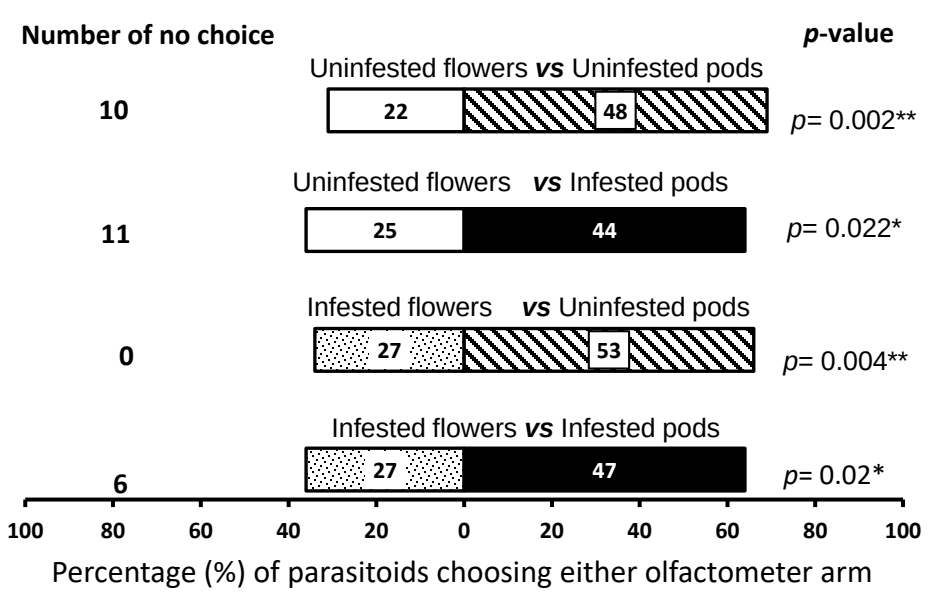
Species	Intrinsic rate of increase (r_m)	Finite rate of increase (λ)
Therophilus javanus	**0,24**	**1,27**
Phanerotoma syleptae	**0,14**	**1,15**
Maruca vitrata	**0,19**	**1,20**



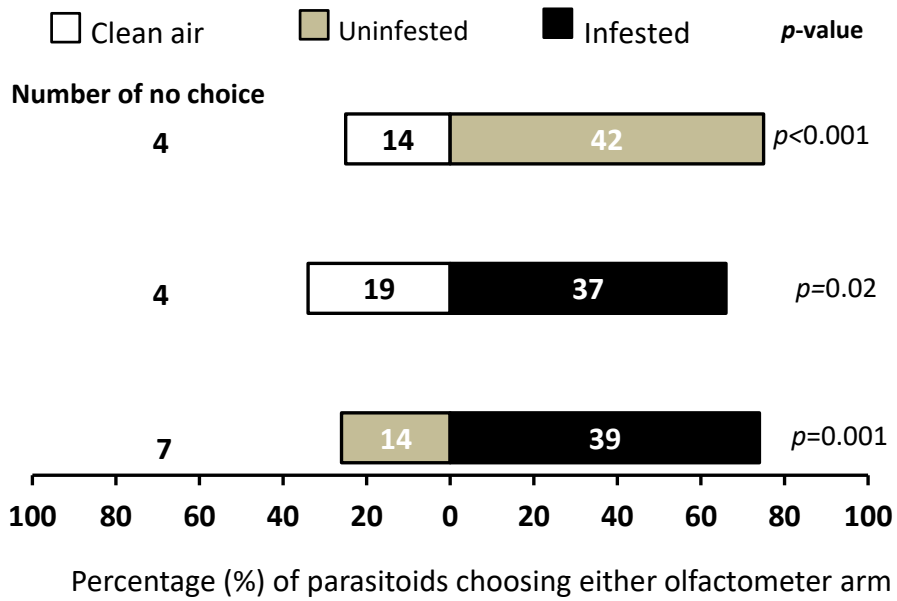
Aboubakar Souna et al., 2017

What science is needed?

Chemical ecology of the parasitoid *Therophilus javanus*



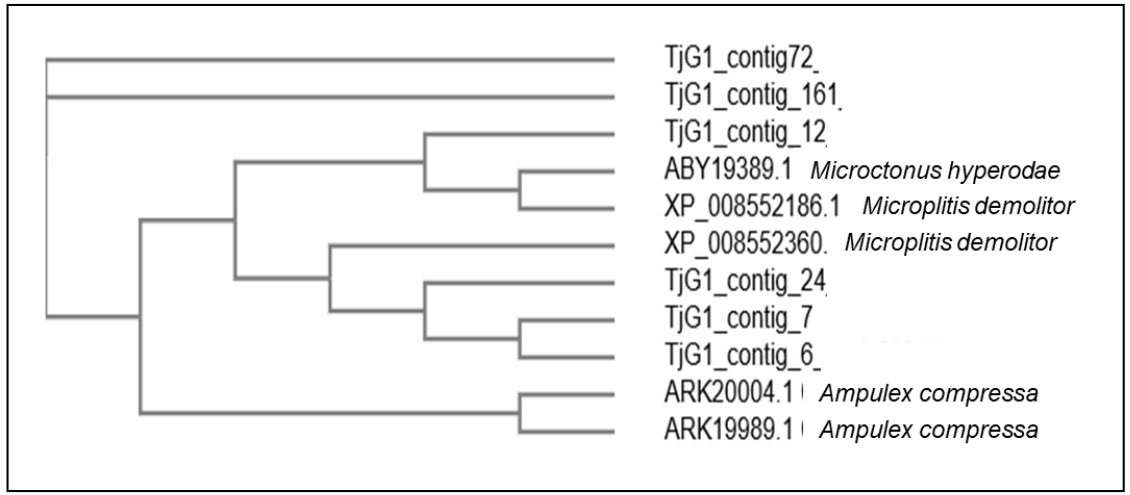
Response of female *T. javanus* when offered choices between cowpea flower and cowpea pod volatiles sources in a Y-tube olfactometer.



Response of female *T. javanus* when offered volatiles sources from the wild host plant *Tephrosia platycarpa* flower in a Y-tube olfactometer.

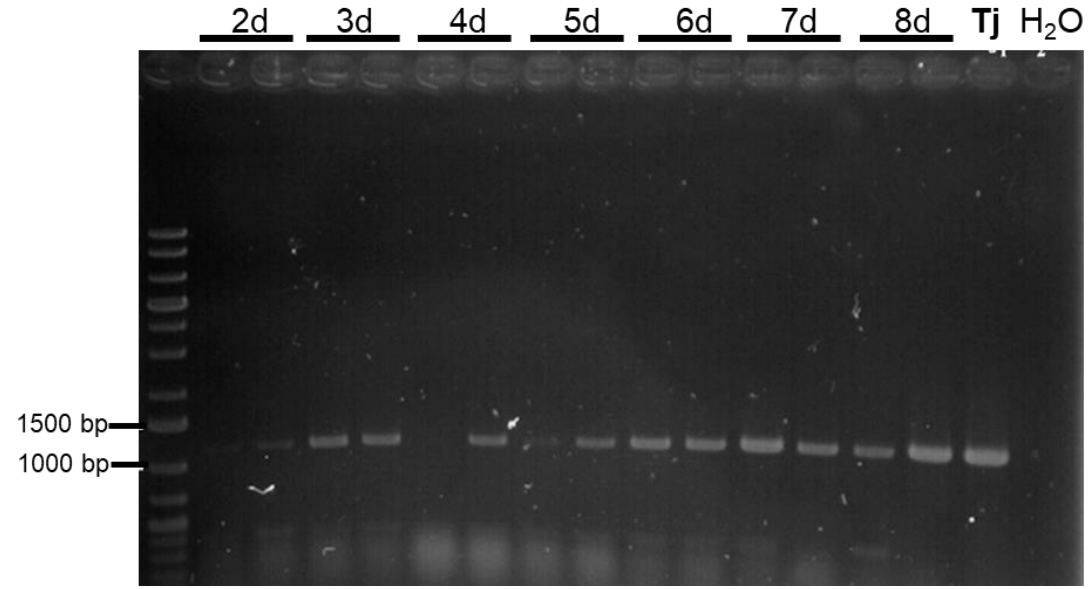
Aboubakar Souna et al., submitted

Discovery of *T. javanus* venom proteins and their application



Phylogenetic tree showing the relationships between the 6 *T. javanus* predicted venom proteins and other parasitoid proteins

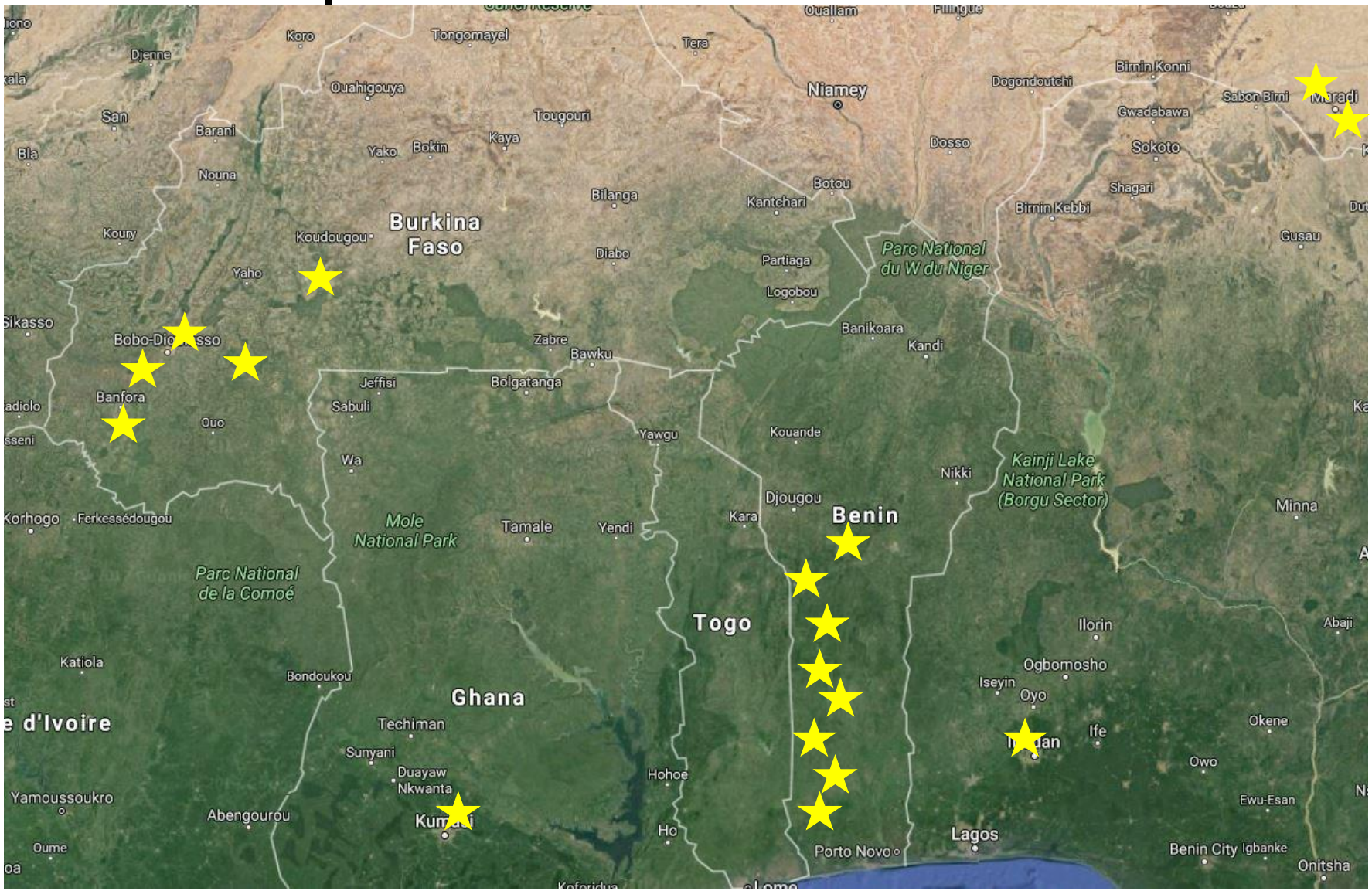
PCR amplification using primers specific to *Tj*VP1 gene using gDNA extracted from parasitized *M. vitrata* caterpillars at increasing number of days following parasitism (2 days till 8 days; 2 different caterpillars for each time point)



Aboubakar-Souna et al., in preparation

Pre-release sensitization campaign at each of the release sites

Experimental release sites



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Experimental releases

…and backyard science

Country	Parasitoid
Benin	*Therophilus javanus*
Benin	*Phanerotoma syleptae*
Burkina Faso	*Therophilus javanus*
Burkina Faso	*Phanerotoma syleptae*

...and first data on establishment !

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Date	Sites	Host plant
23/02/2017	476	Milletia
23/02/2017	477	Milletia
23/02/2017	478	Milletia
09/03/2017	503	Lonchocarpus
13/03/2017	507	Milletia
13/03/2017	508	Pterocarpus
13/03/2017	509	Pueraria
13/03/2017	512	Pterocarpus
13/03/2017	513	Pterocarpus
13/03/2017	514	Pterocarpus
14/03/2017	516	Pterocarpus
14/03/2017	517	Pterocarpus
14/03/2017	524	Milletia
15/03/2017	525	Milletia
16/03/2017	527	Pterocarpus
16/06/2017	633	Lonchocarpus
24/04/2018	668	Lonchocarpus
25/06/2018	701	Cyanescens
26/06/2018	701	Cyanescens
26/06/2018	703	Cyanescens

Ultra-highthrouput cutteromics and scissoromics

Choice of releases and recovery sites: Google earth !


establishment
Release
new1
new1
new1
Image © 2017 CNES / Airbus
Image © 2017 DigitalGlobe
Google earth

Next steps and expected impact:

- Scaling out biocontrol approach to all major cowpea producing countries in West Africa, community-based production?

- Released parasitoids get established and control the pod borer on both natural vegetation and legume crops

- Overall *M. vitrata* population reduction of 40-60% depending on agro-ecological region

thank you !


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Thank you