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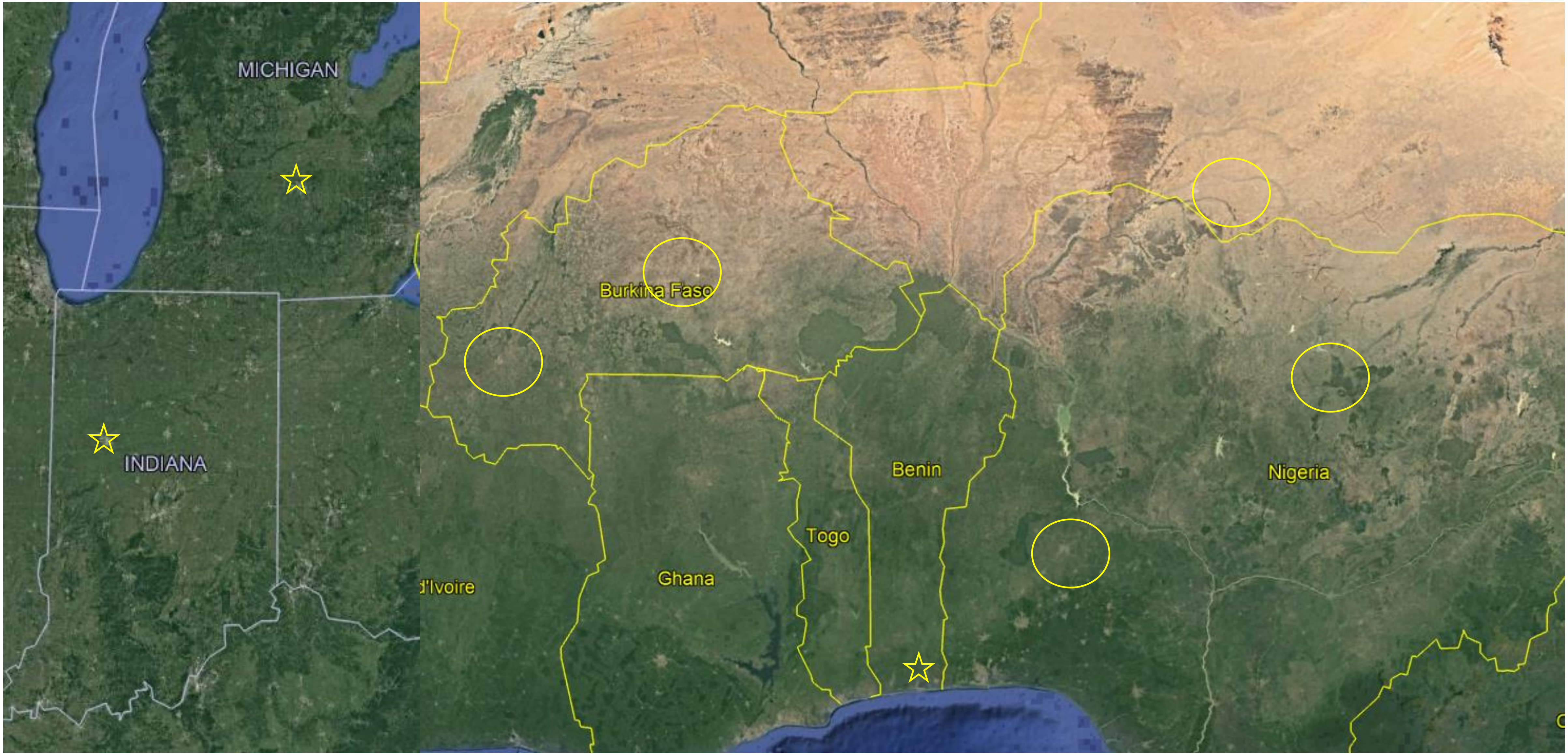
24–26 October 2022

Science-driven, nature-based plant health management for African smallholder farmers

Manuele Tamò
Principal Scientist, Entomologist
IITA-Benin Country Representative
On behalf of many national and international collaborators

Basel, October 25, 2022


MICHIGAN
INDIANA
Burkina Faso
Benin
Nigeria
Togo
Ghana
d'Ivoire


MICHIGAN
Burkina Faso
d'Ivoire
Ghana

Characterization of farm households and adoption of agro-ecological practices

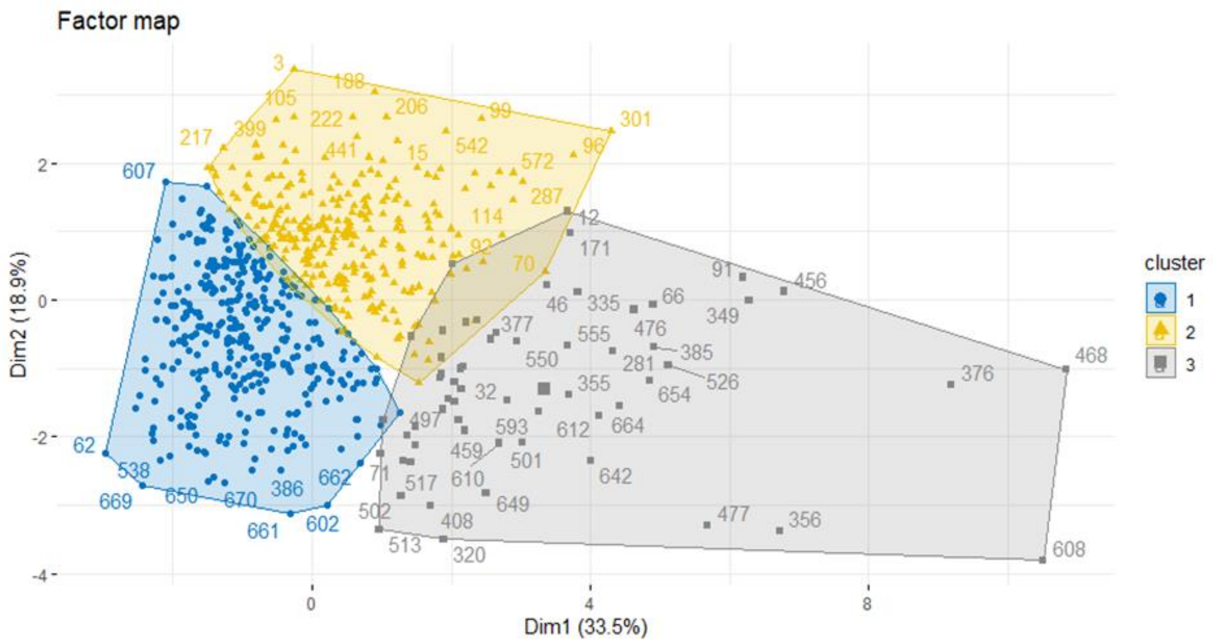
Table 1. Pest management characteristics in Benin

Characteristics	%
Apply chemical pesticides to cowpeas	88
Believe pesticides are harmful to people	93
Knows color label for highly toxic pesticides	11
Use face/nose mask to apply pesticides	24
Skin problems after spraying	73
Eye irritation after spraying	57
Awareness of beneficial insects	9

Agyekum et al, 2016

Socio-economic survey

- 675 farm households surveyed in Maradi, Tahoua and Zinder
- 19.5% women-managed farms
- average age of respondents 47.91 ± 12.85 y
- average hh size10.64 ± 5.31 individuals
- 50.1% of farmers are literate and have 3.60 ± 2.61 fields with an average area of 4.44 ± 4.18 ha per farm.
- Land acquisition most often by inheritance (91.6%) and by purchase (33.9%)
- predominant system millet + cowpea (93.9%) and millet + cowpea + sorghum (73%).
- Average cowpea area 1.42 ± 1.62 ha with an average yield of 223.61 ± 171.86 kg / ha.



Factor	Cluster 1	Cluster 2	Cluster 3
Average cowpea yield	190.93±148.67	243.54±172.12	320.44±233.05
Cowpea surface	1.16±0.92	1.36±0.87	4.29±3.04
years of experience cowpea	19.80±8.80	33.63±10.31	20.32±7.54
Average age	43.01±11. 64	55.67±10.11	42.35±11.61
HH numbers	7.82±3.47	13.18±2.66	13.74±5.61
HH in agriculture	2.64±1.59	5.18±2.66	6.42±3.14

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ScienceDirect

Current Opinion in Insect Science

How does IPM 3.0 look like (and why do we need it in Africa)?

Manuele Tamò[1], Isabelle Glitho[2], Ghislain Tepa-Yotto[1] and Rangaswamy Muniappan[3]

The concept of Integrated Pest Management (IPM) was introduced sixty years ago to curb the overuse of agricultural pesticides, whereby its simplest version (IPM 1.0) was aiming at reducing the frequency of applications. Gradually, agro-ecological principles, such as biological control and habitat management, were included in IPM 2.0. However, throughout this time, smallholder farmers did not improve their decision-making skills and continue to use hazardous pesticides as their

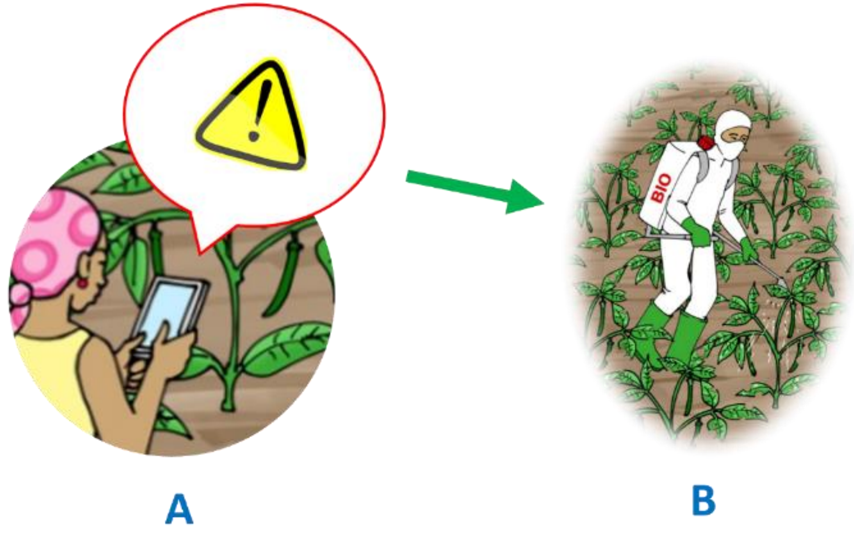
concept should be labeled 'IPM 3.0'. The past sixty years of Integrated Pest Management (IPM) have been well-described and characterized in detail [1••] with the following simplified historical perspective of IPM. Accordingly, the label IPM 1.0 is attributed to the initial efforts in the 1960s and 1970s for drastically reducing the indiscriminate use of pesticides by introducing the notion of threshold-based intervention derived from scouting. For

IPM 3.0 – three main pillars

Pillar #1 Empowering farmers

Pillar #3 Integration of innovations

Pillar #2 Science-driven, nature-based solutions

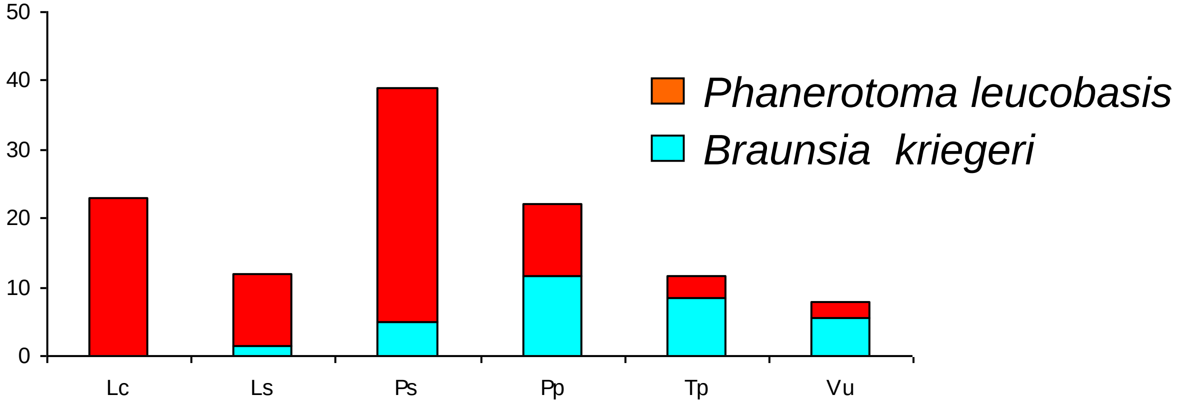


One of the most devastating insect pests of cowpea in Africa: the legume pod borer, *Maruca vitrata*

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

So, 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*

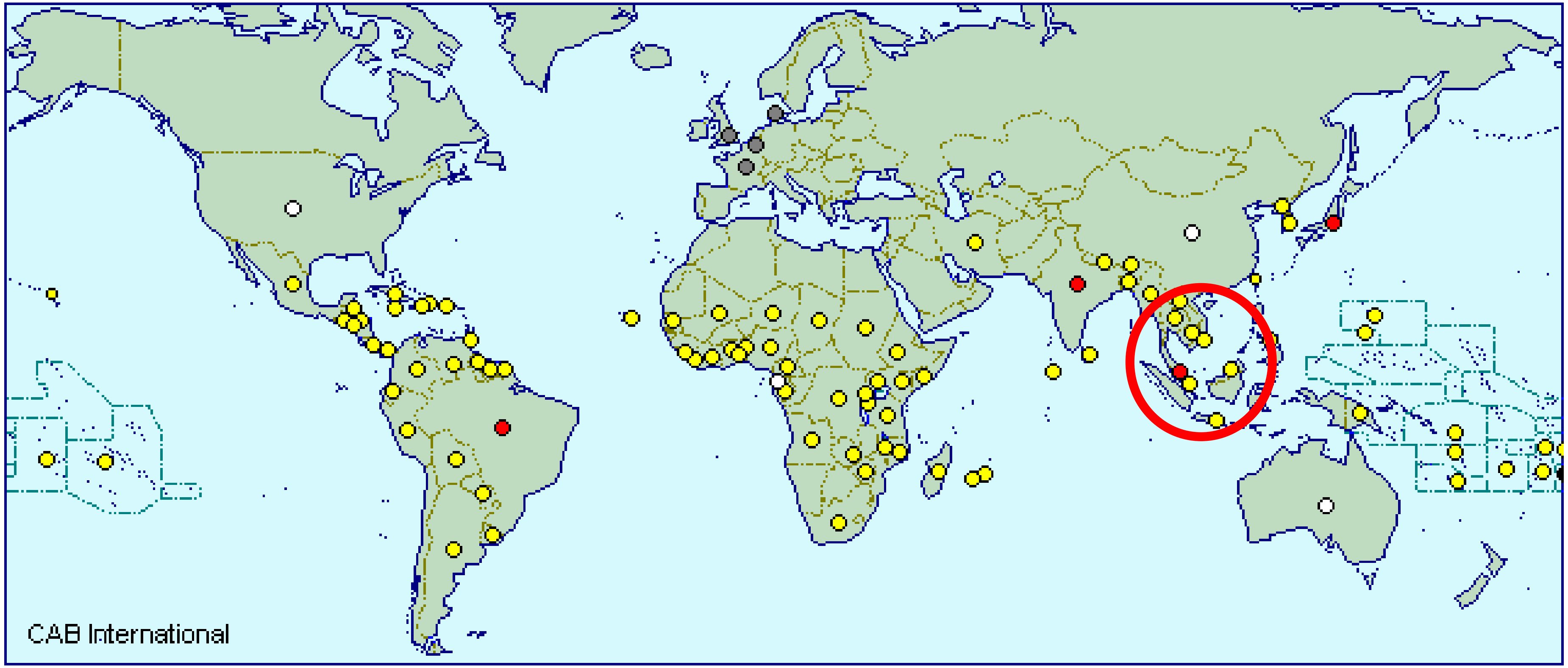
Vu: *Vigna unguiculata* (cowpea)

Non-host specific parasitoids, low and insufficient parasitism rates

Arodokoun *et al*, 2006

So, what science is needed??

Biodiversity studies: re-visiting the origin of *Maruca vitrata*

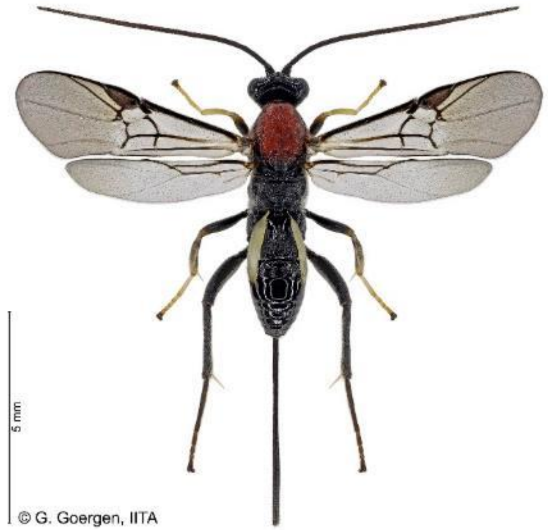


Evidence of South Asian origin supported by latest population genetic studies (Periasamy et al, 2015)

So, what science is needed??

Biodiversity studies: much larger diversity of specific and efficient hymenopteran parasitoids

Apanteles taragamae



Liragathis javana

Phanerotoma syleptae

So, what science is needed??

Hindawi
Psyche
Volume 2017, Article ID 3156534, 8 pages
https://doi.org/10.1155/2017/3156534

Research Article

An Insight in the Reproductive Biology of *Therophilus javanus* (Hymenoptera, Braconi Agathidinae), a Potential Biological Control A the Legume Pod Borer (Lepidoptera, Crambic

Djibril Aboubakar Souna,[1,2,3] Aimé Bokonon-Ganta,[3] Marc Ravallec,[1] Antonino Cusumano,[4] Barry Robert Pittendri Anne-Nathalie Volkoff,[1] and Manuele Tamò[2]

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[2]*International Institute of Tropical Agriculture, Benin Research Station (IITA-Benin), 08 B*
[3]*Faculté des Sciences Agronomiques (FSA), Université d'Abomey Calavi, 01 BP 526 Cotono*
[4]*Department of Plant Sciences, Wageningen University & Research, Wageningen, Netherla*
[5]*Department of Entomology, Michigan State University (MSU), East Lansing, MI, USA*

Correspondence should be addressed to Anne-Nathalie Volkoff; anne-nathalie.volkoff@ and Manuele Tamò; m.tamo@cgiar.org

Received 23 June 2017; Accepted 17 August 2017; Published 28 September 2017

Academic Editor: Jacques Hubert Charles Delabie

Therophilus javanus is a koinobiont, solitary larval endoparasitoid currently being consi the pod borer *Maruca vitrata*, a devastating cowpea pest causing 20–80% crop loss morphology and anatomy, oogenesis, potential fecundity, and egg load in *T. javanus*, of the female and parasitoid/host size at oviposition on egg load. The number of ovariole influenced by the age/size of the *M. vitrata* caterpillar when parasitized. Egg load also of *M. vitrata* caterpillar at the moment of parasitism and wasp age. The practical implica rearing of the parasitoid toward successful biological control of *M. vitrata* are discussed

Biological Control 130 (2019) 104–109

Contents lists available at ScienceD

ELSEVIER

Biological Control

journal homepage: www.elsevier.com/

Volatiles from *Maruca vitrata* (Lepidoptera, Crambida olfactory responses of the parasitoid *Therophilus java* Braconidae, Agathidinae)

Djibril Aboubakar Souna[a,b,c], Aimé Hippolyte Bokonon-Ganta[c], Elie Nazyhatou Imorou[b], Benjamin Agui[b], Antonino Cusumano[a], Ramas Barry Robert Pittendrigh[d], Anne-Nathalie Volkoff[a], Manuele Tamò[b]

[a] *UMR DGIMI 1333 INRA, UM, Case Courrier 101, Place Eugène Bataillon, 34 095 Montpellier, France*
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[c] *Department of Crop Production, Faculty of Agronomic Sciences (FSA), University of Abomey-Calavi (UAC), 03 BP*
[d] *Michigan State University (MSU), Department of Entomology, East Lansing, USA*
[e] *World Vegetable Center (AVRDC), Tainan, Taiwan*

ARTICLE INFO

Keywords:
Biological control
Natural enemy
Olfaction
Attraction
Cowpea
Host plants

ABSTRACT

Plants damaged by herbivores are known to rel information how leguminous plants damaged b *Therophilus javanus*, which was imported into B Asia for assessing its potential as a biological co to investigate *T. javanus* response towards odor *unguiculata*, the most important cultivated ho *Sesbania rostrata* and *Tephrosia platycarpa*. Olfa plant damaged by the pod borer. Moreover, o and pods) were discriminated over non-infeste are discussed in the context of the possible im subsequent establishment in natural environm

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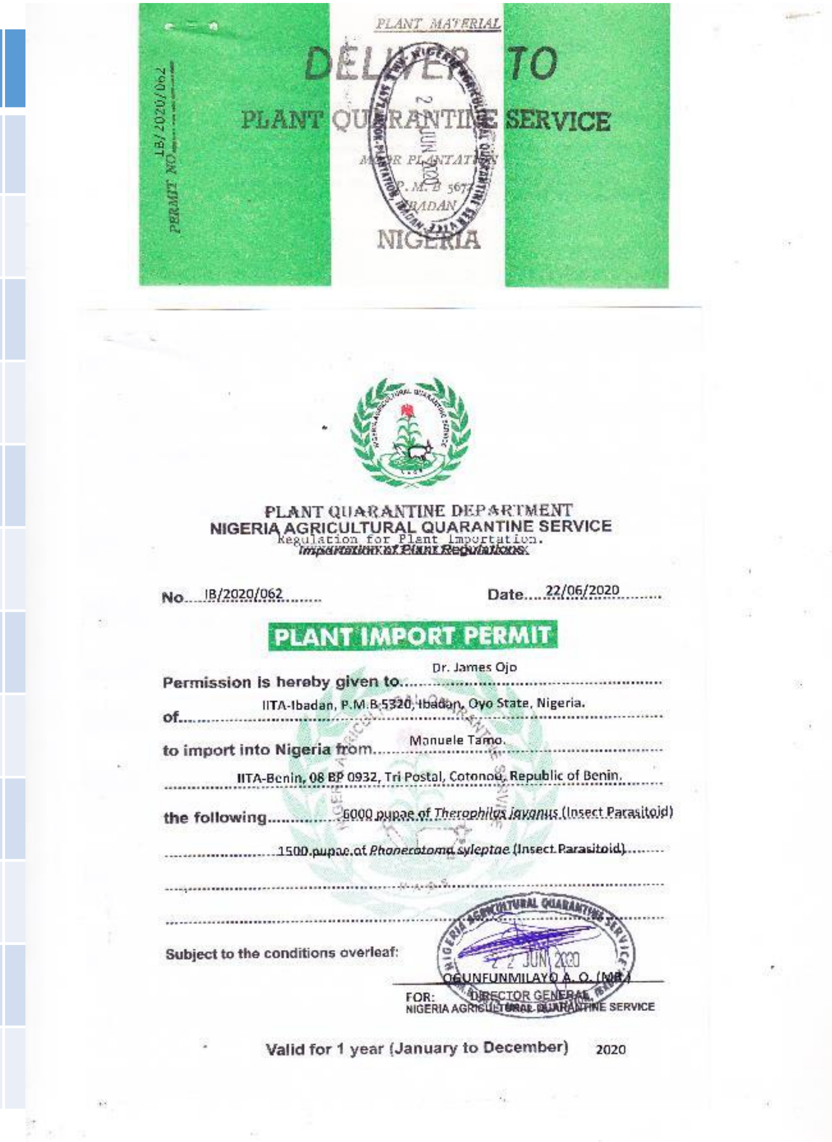
Progeny fitness determines the performance of the parasitoid *Therophilus javanus*, a prospective biocontrol agent against the legume pod borer

Djibril Aboubakar Souna[1], Aimé Hippolyte Bokonon-Ganta[2], Marc Ravallec[3], Mesmin Alizannon[1], Ramasamy Srinivasan[4], Barry Robert Pittendrigh[5], Anne-Nathalie Volkoff[3] & Manuele Tamò[1]

Therophilus javanus (Bhat & Gupta) is an exotic larval endoparasitoid newly imported from Asia into Africa as a classical biological control agent against the pod borer *Maruca vitrata* (Fabricius). The parasitoid preference for the five larval instars of *M. vitrata* and their influence on progeny sex ratio were assessed together with the impact of larval host age at the time of oviposition on development time, mother longevity and offspring production. In a choice situation, female parasitoids preferred to oviposit in the first three larval instars. The development of immature stages of the parasitoid was observed inside three-day-old hosts, whereby the first two larval instars of *T. javanus* completed their development as endoparasites and the third larval instar as ectoparasite. The development time was faster when first larval instars (two- and three-day-old) of the host caterpillars were parasitized compared to second larval instar (four-day-old). The highest proportion of daughters (0.51) was observed when females were provided with four-day-old hosts. The lowest intrinsic rate of increase (r) (0.21 ± 0.01), the lowest rate of increase (λ) (1.23 ± 0.01), and the lowest net reproductive rate (Ro) (35.93 ± 6.51) were recorded on four-day-old hosts. These results are discussed in the light of optimizing mass rearing and release strategies.

Experimental releases

Country	Parasitoid
Benin	*Liragathis javana*
Benin	*Phanerotoma syleptae*
Burkina Faso	*Liragathis javana*
Burkina Faso	*Phanerotoma syleptae*
Niger	*Liragathis javana*
Niger	*Phanerotoma syleptae*
Ghana	*Liragathis javana*
Ghana	*Phanerotoma syleptae*
Nigeria	*Liragathis javana*
Nigeria	*Phanerotoma syleptae*
Mali	*Liragathis javana*
Total	


PLANT MATERIAL
DELIVER TO
PLANT QUARANTINE SERVICE
NIGERIA
PERMIT NO. IB/2020/062

PLANT QUARANTINE DEPARTMENT
NIGERIA AGRICULTURAL QUARANTINE SERVICE
Regulation for Plant Importation.
Importation of Plant Regulations.

No. IB/2020/062 Date 22/06/2020

PLANT IMPORT PERMIT

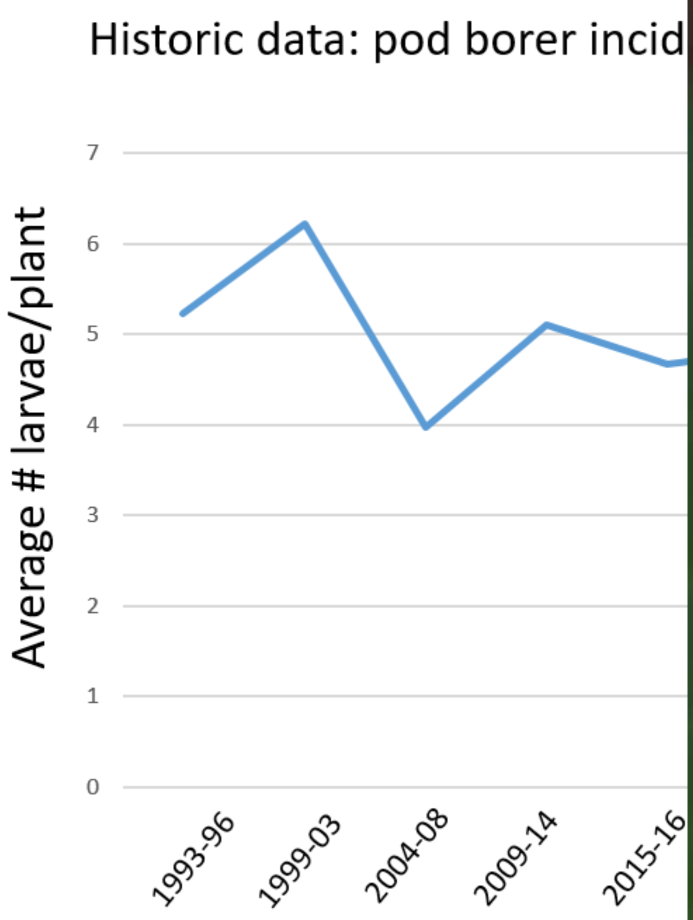
Permission is hereby given to Dr. James Ojo
of IITA-Ibadan, P.M.B 5320, Ibadan, Oyo State, Nigeria.
to import into Nigeria from Manuele Tamo.
IITA-Benin, 08 BP 0932, Tri Postal, Cotonou, Republic of Benin.
the following 6000 pupae of *Therophilus javanus* (Insect Parasitoid)
1500 pupae of *Phanerotoma syleptae* (Insect Parasitoid)

Subject to the conditions overleaf:

22 JUN 2020
OGUNFUNMILAYO A. O. (MRS)
FOR: DIRECTOR GENERAL
NIGERIA AGRICULTURAL QUARANTINE SERVICE

Valid for 1 year (January to December) 2020

… preliminary impact data from pilot sites !



Up to 86% pod borer population reduction at pilot release sites

BUT there is **no 'silver bullet' approach in IPM**, all compatible technologies have to work together and **in synergy**

Scaling of neem tea bag in Niger

- Game changer: use of easily transportable motorized mills (acquired during the initial activity phase) to grind the neem grains
- Saving time and reduce women drudgery

Scaling of neem tea bag in Niger

- Game changer: use of easily transportable motorized mills (acquired during the initial activity phase) to grind the neem grains
- Saving time and reduce women drudgery
- Currently three community-based production units have produced 2774 neem tea bags, of which over 2300 already sold
- Strong cap dev activities

Neem tea bag: SAWBO animation

Review

Received: 17 January 2019 Revised: 27 April 2019 Accepted article published: 10 May 2019 Published online in Wiley Online Library:

(wileyonlinelibrary.com) DOI 10.1002/ps.5480

Biopesticide based sustainable pest management for safer production of vegetable legumes and brassicas in Asia and Africa

Ramasamy Srinivasan,[a*] Subramanian Sevgan,[b] Sunday Ekesi[b] and Manuele Tamò[c]

Abstract

Vegetables are one of the important crops which could alleviate poverty and malnutrition among the smallholder farmers in tropical Asia and Africa. However, a plethora of pests limit the productivity of these crops, leading to economic losses. Vegetable producers overwhelmingly rely on chemical pesticides in order to reduce pest-caused economic losses. However, over-reliance on chemical pesticides poses serious threats to human and environmental health. Hence, biopesticides offer a viable alternative to chemical pesticides in sustainable pest management programs. Baculoviruses such as nucleopolyhedrovirus (NPV) and granulovirus (GV) have been exploited as successful biological pesticides in agriculture, horticulture and forestry. *Maruca vitrata* multiple nucleocapsid NPV (MaviMNPV) was found to be a unique baculovirus specifically infecting pod borer on food legumes, and it has been successfully developed as a biopesticide in Asia and Africa. Entomopathogenic fungi also offer sustainable pest management options. Several strains of *Metarhizium anisopliae* and *Beauveria bassiana* have been tested and developed as biopesticides in Asia and Africa. This review specifically focuses on the discovery and development of entomopathogenic virus and fungi-based biopesticides against major pests of vegetable legumes and brassicas in Asia and Africa.

Keywords: vegetable legumes; brassicas; MaviMNPV; *Metarhizium anisopliae*; *Beauveria bassiana*

Biological Contro

Contents lists ava

Biologic

journal homepage: www

Improving the efficiency of *Beauveria bassi* management of *Plutella xylostella* (Lepidop

Lakpo K. Agboyi[a,c], Guillaume K. Ketoh[a], Orou K. Dou
Isabelle A. Glitho[a], Manuele Tamò[b,*,1]

[a] Université de Lomé, Laboratoire d'Entomologie Appliquée, Unité de Recherche en Ecotoxicolo
[b] International Institute of Tropical Agriculture (IITA), Benin Station, 08 B.P. 0932 Cotonou,
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ARTICLE INFO

Keywords:
Cabbage
Plutella xylostella
Entomopathogenic fungi
Beauveria bassiana

ABSTRACT

The effectiveness of the ento
Bb116 and Bb362 against th
was investigated in the labo
and 10^9 conidia/ml of eac
inoculated with 2 µl of ea
oculated with sterilized Tw
against DBM with LD_{50} valu
The effectiveness of Bb11 a
and Togo, at a low doses of
unsprayed control and delta
4 days was able to reduce
cabbage yield obtained on fa
a 199% and 452% increase i
the better performance of I
dosage and frequency of Bb

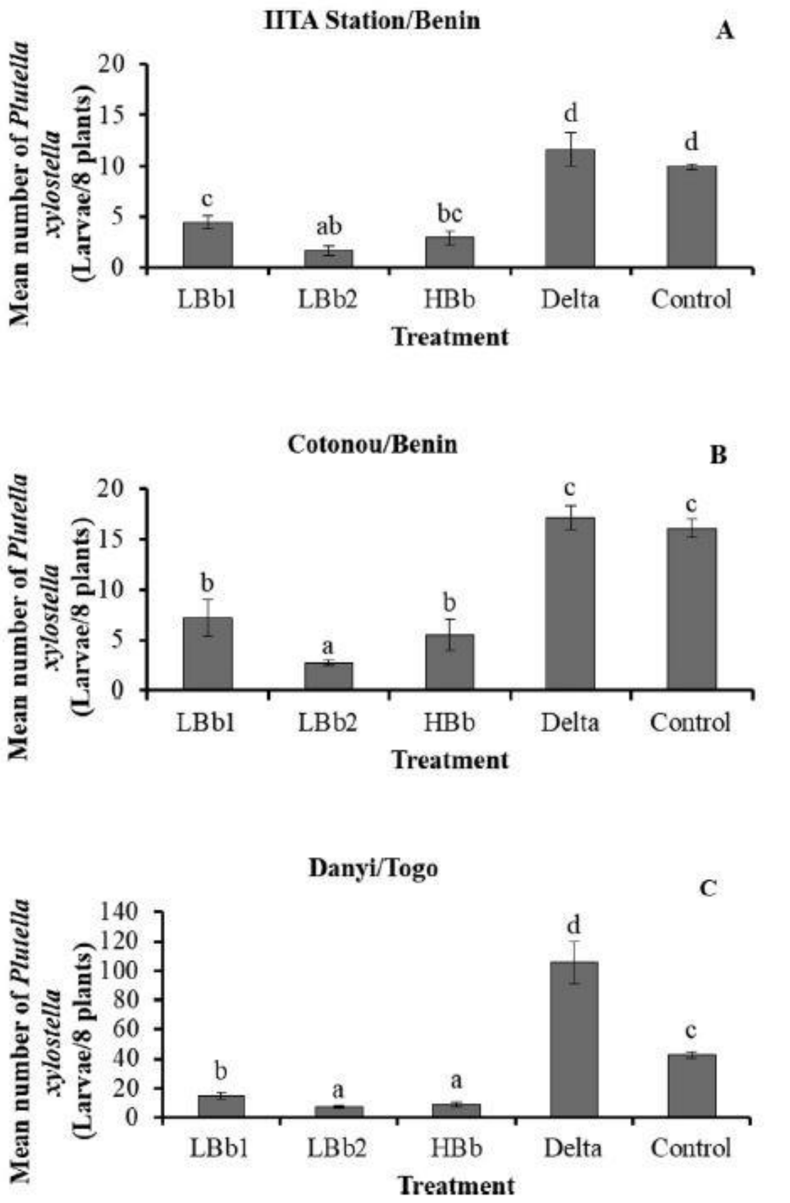


Fig. 4. Density of diamondback moth (DBM) populations under the influence of the different treatments on station (A) and on farm (B and C). Mean (± SE) with the same letter are not significantly different (ANOVA; SNK test; $P < 5\%$); LBb1: low dose of *B. bassiana* (53 g/ha) applied once a week; LBb2: low dose of

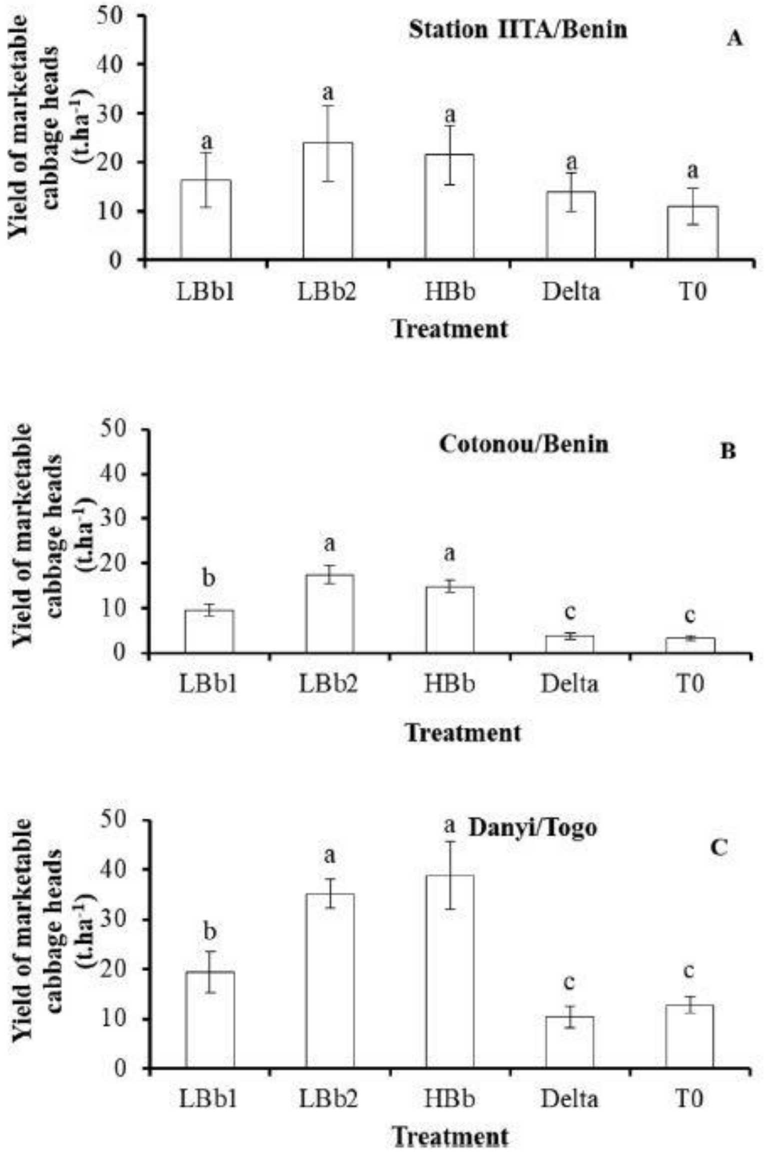


Fig. 5. Marketable cabbage heads yield on station (A) and on farm (B and C) per season. Mean (± SE) with the same letter are not significantly different (ANOVA; SNK test; $P < 5\%$). LBb1: low dose of *B. bassiana* (53 g/ha) applied once a week; LBb2: low dose of *B. bassiana* (53 g/ha) applied twice a week; HBb: High dose of *B. bassiana* (315 g/ha) applied once a week; Control: cabbage

Empowering farmers: Farmer Interface App FIA

Wha

- Smart ... pea fields to mo

What is FIA-niébé and how does it work?

- Smartphone App on Android guiding farmers to scout their cowpea fields to monitor and detect the attack by the brown pod bug
- Integrates a scouting algorithm guiding the farmer with voice commands (French for the moment, Hausa early next year) how to move randomly in the field and to check a number of crop plants, inspect them for pests (or damage symptoms), and press the right symbol to record presence/absence of the pest.

What is FIA-niébé and hov

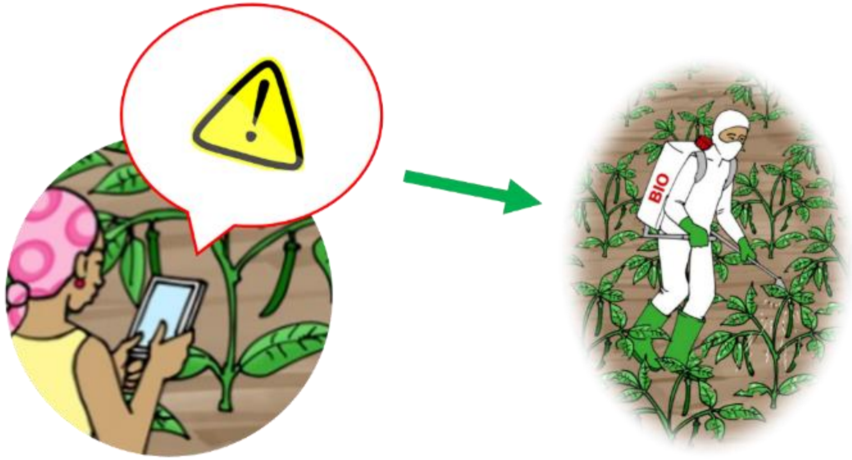
- Smartphone App on Android guiding
  to monitor and detect the attack by th
- Integrates a scouting algorithm guidi
  (French for the moment, Hausa early
  in the field and to check a number of
  (or damage symptoms), and press th
  presence/absence of the pest.
- This will allow FIA, independently fro
  to calculate an intervention threshold
  informed decision about protective m

IPM 3.0 – three main pillars

Pillar #1 Empowering farmers

Pillar #3 Integration of innovations

Pillar #2 Science-driven, nature-based solutions



A

B

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Innovation Lab for Legume Systems Research

Acknowledgements

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