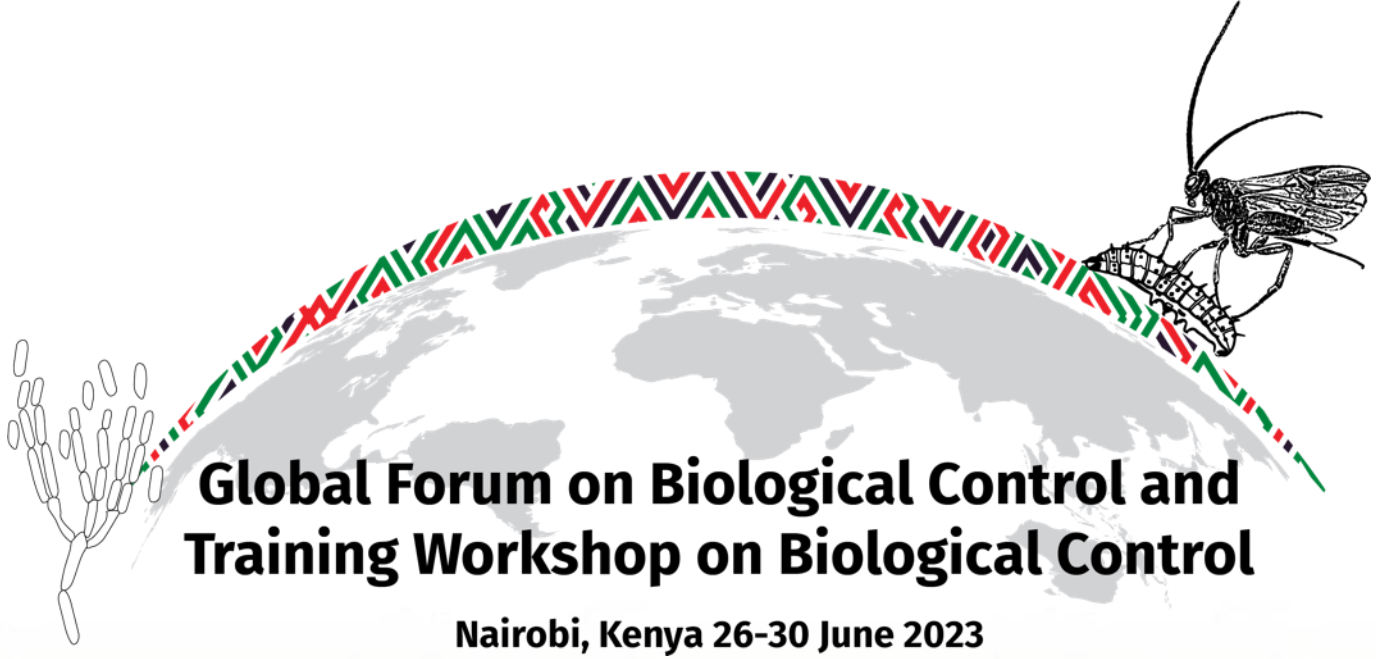

Global Forum on Biological Control and
Training Workshop on Biological Control

Nairobi, Kenya 26-30 June 2023

Microbial Biological Control against Fall Armyworm in the Philippines

Barbara L. Caoili, Marcela M. Navasero, Melissa P. Montecalvo, Samantha Izabelle R. Alforja, Emerald Flor A. Felicitas and Romnick A. Latina

National Crop Protection Center and Institute of Weed Science, Entomology & Plant Pathology
College of Agriculture & Food Science, University of the Philippines Los Baños

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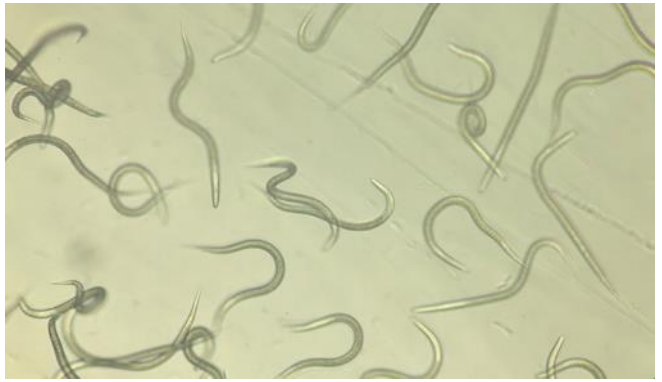
Presentation Outline

1. Background on FAW infestation
2. FAW management initiatives
3. Microbial biological control research
4. Entomopathogenic fungi
5. Nucleopolyhedrovirus
6. Entomopathogenic nematodes & associated bacterium
7. Small field validation of biocon-based Package of Technology



1 Background on FAW infestation in the Philippines

- First report in 2019 infesting corn
- 70 out of 79 provinces in the Philippines are reported to have been infested with FAW (Cuaterno, 2020)

Philipp Ent 33 (2): 171-184 ISSN 0048-3753 July-December 2019

DETECTION OF THE FALL ARMYWORM, *Spodoptera frugiperda* (J.E. Smith) (LEPIDOPTERA: NOCTUIDAE) USING LARVAL MORPHOLOGICAL CHARACTERS, AND OBSERVATIONS ON ITS CURRENT LOCAL DISTRIBUTION IN THE PHILIPPINES

Mario V. Navasero[1*], Marcela M. Navasero[1], Gideon Aries S. Burgonio[1], Karen P. Ardez[1], Melvin D. Ebuenga[1], Marie Joy B. Beltran[1], Maeden B. Bato[1], Pablito G. Gonzales[1], Gil L. Magsino[1], Barbara L. Caoili[2], Aimee Lynn A. Barrion-Dupo[3], and Minda Flor G.M. Aquino[4*]

2 FAW management initiatives

FAW Biology

- Effect of temperature & host plants
- Genetic structure & morphological variation analyses

Biological Control

- Natural enemies
- Entomopathogens

FAW IPM

Pest Monitoring

- Early warning system
- Pheromone trap development

Insecticide Management

- Insecticide Resistance Management
- E-IRM APP

3 Microbial biological control research

Biological Control of Fall Armyworm, *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae) Using Entomopathogens

Project Leader: MM Navasero
Study Leaders: BL Caoili & MP Montecalvo
Duration: February 1, 2020 to July 31, 2022

Characterization, Mass Production, Formulation, and Utilization of *Metarhizium* sp. for Increased Potency against Armyworms

Project Leaders: MM Navasero, MV Navasero & MP Montecalvo
Duration: September 1, 2020 to August 31, 2022

Technical Evaluation of FAW IPM-PAMS Strategies and Technology Options

Component Leaders: MM Navasero & MP Montecalvo
Duration: April 1, 2022 to October 15, 2023

4 Entomopathogenic fungi

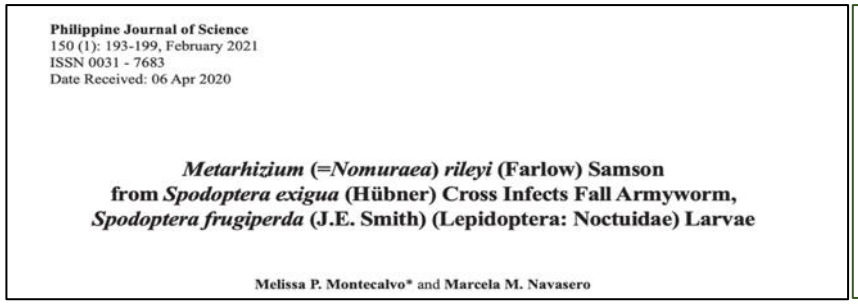
Healthy *S. frugiperda* larva

Metarhizium rileyi

M. anisopliae

Beauveria bassiana

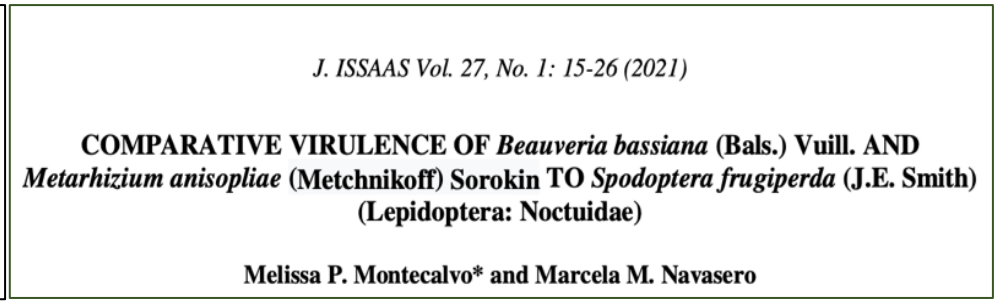
Hatchability of treated eggs	100%	46.48%	26. 84%
Lethal infection to instars	100.00% (1^{st} - 4^{th})	23.13% to 61.33% (1^{st} - 6^{th})	23.64 % to 97.42% (1^{st} - 6^{th})
Mean time to larval mortality	4.51 to 8.89 days	4.06 to 7.79 days	4.59 to 7.46 days



Philippine Journal of Science
150 (1): 193-199, February 2021
ISSN 0031 - 7683
Date Received: 06 Apr 2020

***Metarhizium* (=*Nomuraea*) *rileyi* (Farlow) Samson from *Spodoptera exigua* (Hübner) Cross Infects Fall Armyworm, *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae) Larvae**

Melissa P. Montecalvo* and Marcela M. Navasero



J. ISSAAS Vol. 27, No. 1: 15-26 (2021)

COMPARATIVE VIRULENCE OF *Beauveria bassiana* (Bals.) Vuill. AND *Metarhizium anisopliae* (Metchnikoff) Sorokin TO *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae)

Melissa P. Montecalvo* and Marcela M. Navasero

4 Entomopathogenic fungi

Small Corn Plot Experiment of *M. rileyi*

Initial Formulation

Mycosed larvae recovered in corn field sprayed with *M. rileyi* formulations

Philippine Journal of Science
150 (1): 193-199, February 2021
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***Metarhizium* (=*Nomuraea*) *rileyi* (Farlow) Samson from *Spodoptera exigua* (Hübner) Cross Infects Fall Armyworm, *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae) Larvae**

Melissa P. Montecalvo* and Marcela M. Navasero

International Journal of Agricultural Technology 2022Vol. 18(1):257-270
Available online http://www.ijat-aatsea.com
ISSN 2630-0192 (Online)

Lethal effect of native *Metarhizium rileyi* (Farlow) Samson isolate to invasive fall armyworm, *Spodoptera frugiperda* (J.E. Smith), infesting corn in the Philippines

Montecalvo, M. P.*, Navasero, M. M. and Navasero, M. V.

5 Nucleopolyhedrovirus

Spodoptera exigua MNPV

Initial Trial on FAW larva mortality at 1 x 10^{10} OBs/ml

Larval Instar	% Mortality
1st	100
2nd	98
3rd	96
4th	90
5th	16

6 Entomopathogenic nematodes

exeley
Article | DOI: 10.21307/jofnem-2018-024

JOURNAL OF NEMATOLOGY
Issue 2 | Vol. 50

Molecular Identification of Entomopathogenic Nematode Isolates from the Philippines and their Biological Control Potential Against Lepidopteran Pests of Corn

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[1]Institute of Weed Science, Entomology, and Plant Pathology, College of Agriculture and Food Science, University of the Philippines Los Baños, College Laguna, 4031 Philippines.

[2]Del Monte Philippines, Inc., Camp Philips, Manolo Fortich, Bukidnon, 8705 Philippines.

[§]Authors contributed equally in the manuscript preparation.

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The paper was edited by David Shapiro-Ilan.

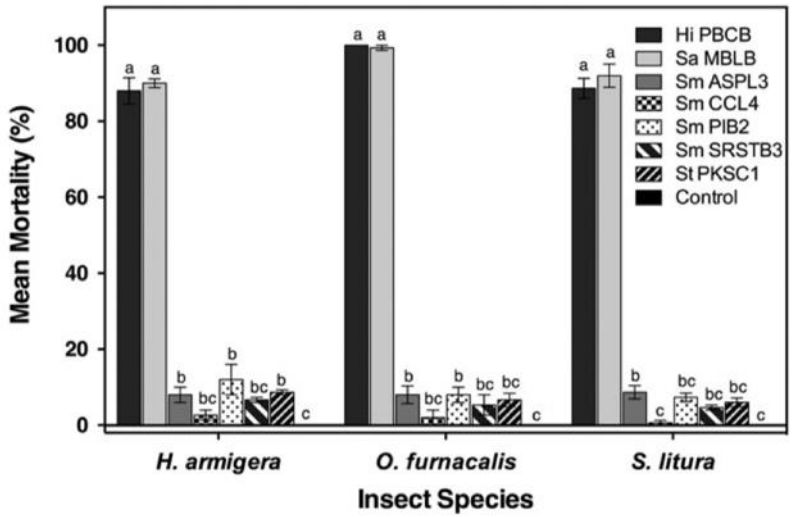
Received for publication November 29, 2017.

Abstract

In search for local entomopathogenic nematode (EPN) species as a biological control agent of lepidopterous insect pests of corn, a survey for EPN in the major islands in the Philippines was conducted. Seven EPN populations from 279 soil samples were isolated using *Ostrinia furnacalis*, the key target insect pest of corn in the country, as bait. Analysis of the ITS1-5.8S-ITS2 ribosomal DNA sequence revealed the presence of *Steinernema abbasi*, *Steinernema minutum*, *Steinernema tami*, and *Heterorhabditis indica*. The pathogenicity of these EPN was tested in *Ostrinia furnacalis*, *Spodoptera litura*, and *Helicoverpa armigera* larvae under laboratory conditions. All the EPN isolates were pathogenic to the lepidopteran species with, *H. indica* PBCB and *S. abbasi* MBLB exhibiting the highest virulence (88%–99.33% and 90%–100% mortality, respectively) at 48 hr post infection (HPI) and thus, further studies were done on these two EPN. The highest penetration rate at 48 HPI was observed in *H. armigera* infected with *S. abbasi* MBLB (28.15%), while the lowest was in *O. furnacalis* infected with *H. indica* PBCB (14.25%). Nonetheless, based on LC_{50} at 48 HPI, *H. indica* PBCB was most virulent to *S. litura* (8.89 IJ per larva), but not significantly different from *O. furnacalis* (10.52 IJ per larva). *Steinernema abbasi* MBLB was most virulent to *O. furnacalis* (10.98 IJ per larva), but not significantly different to *S. litura* (17.08 IJ per larva). LT_{50} estimates showed that *O. furnacalis* was significantly the most susceptible to *H. indica* PBCB (21.90 hr) and *S. abbasi* (21.18 hr). Our results suggest that *H.* indica PBCB and *S. abbasi* MBLB are good candidates as biological control agents against these insect pests of corn. Moreover, *O. furnacalis* as alternative bait for EPN was discussed. To date, this is the most extensive research on Philippine EPN, comprised of wide sampling coverage, molecular identification and bioefficacy assays.

Key words

Biological control, Entomopathogenic nematode, *Helicoverpa armigera*, *Heterorhabditis indica*, Internal transcribed spacer, *Ostrinia furnacalis*, Ribosomal DNA region, *Spodoptera litura*, *Steinernema abbasi*.



Philipp Ent 36 (1): 25-43 ISSN 0048-3753 January-June 2022

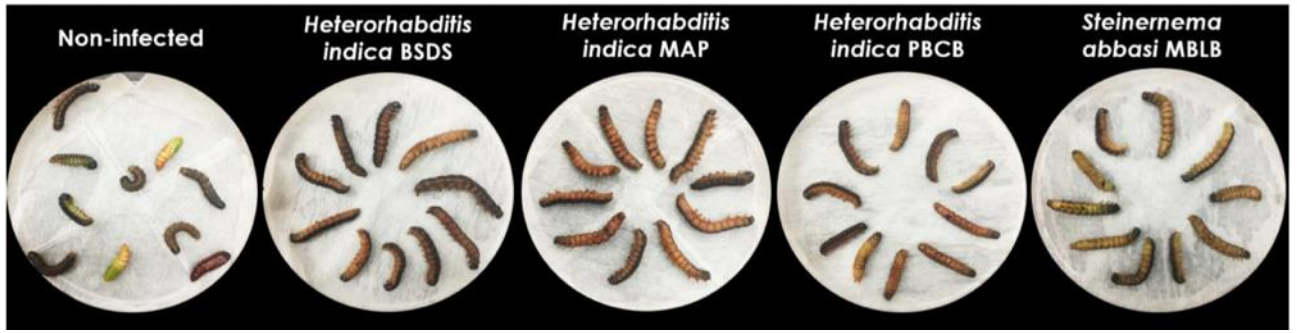
CHARACTERIZATION OF THREE PHILIPPINE *HETERORHABDITIS INDICA* ISOLATES BASED ON MORPHOMETRIC, MOLECULAR, AND VIRULENCE DATA[1]

Eugine D. Ramos[2], Romnick A. Latina[3] and Barbara L. Caoili[3]

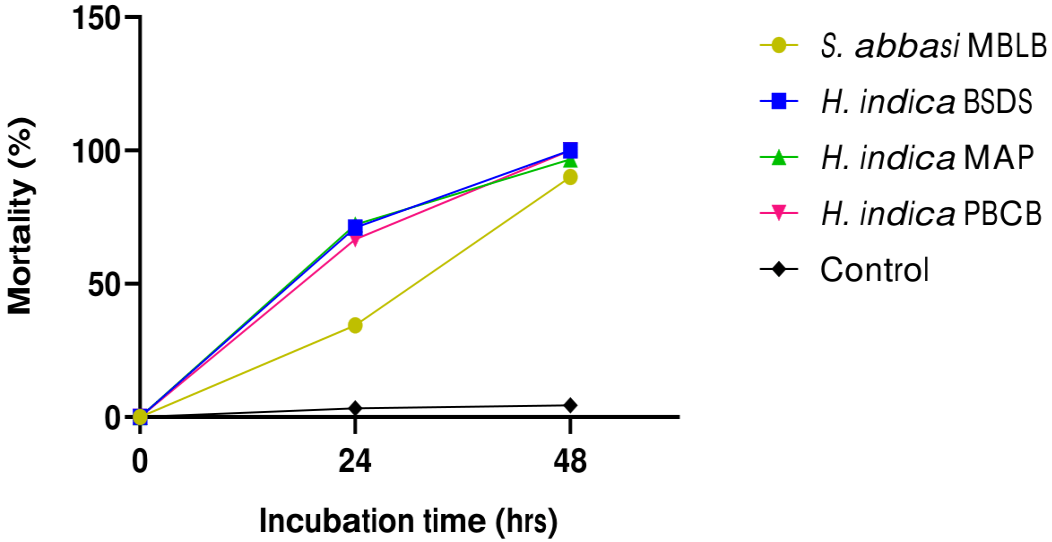
[1]Part of the MS Entomology thesis of the senior author, under the supervision of the co-authors.

[2]Institute of Weed Science, Entomology, and Plant Pathology, College of Agriculture and Food Science, University of the Philippines Los Baños, Laguna. 4031
[2]Department of Agricultural Sciences, College of Agriculture, Food and Sustainable Development, Mariano Marcos State University, Batac City, Ilocos Norte. 2906
[3]Institute of Weed Science, Entomology, and Plant Pathology, College of Agriculture and Food Science, University of the Philippines Los Baños, College. 4031 Laguna, Philippines
Corresponding author: blcaoili@up.edu.ph

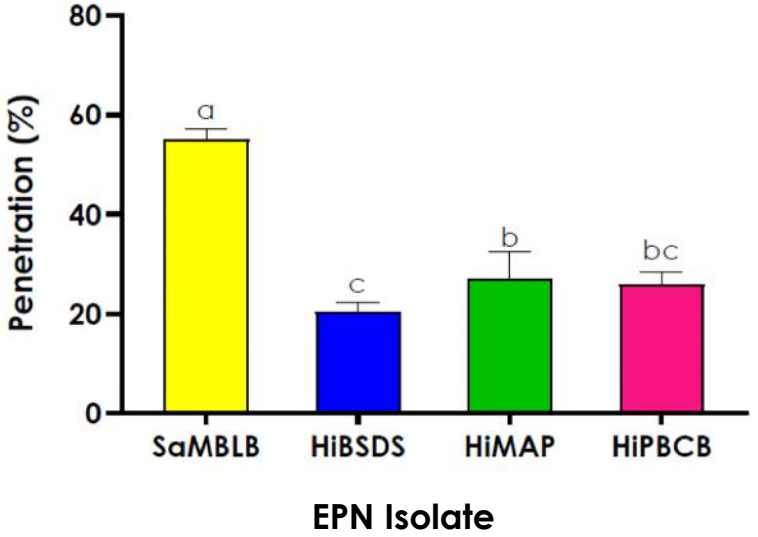
6 Entomopathogenic nematodes



Average percentage mortality of *S. frugiperda* exposed to different Philippine EPN isolates



Percentage penetration of SaMBLB and HiBSDS, HiMAP, HiPBCB at 48 hpi in *Spodoptera frugiperda*



6 Entomopathogenic nematodes

Infective juvenile emergence from EPN- infected pupa and larva

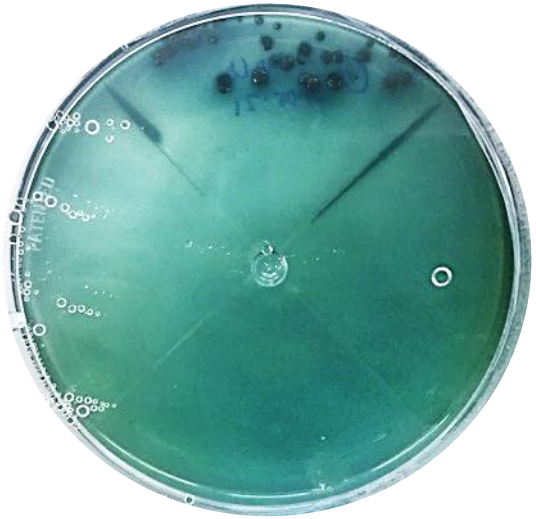
Manifestation of EPN Infection in *Spodoptera frugiperda* pupae

inhibited pupal development

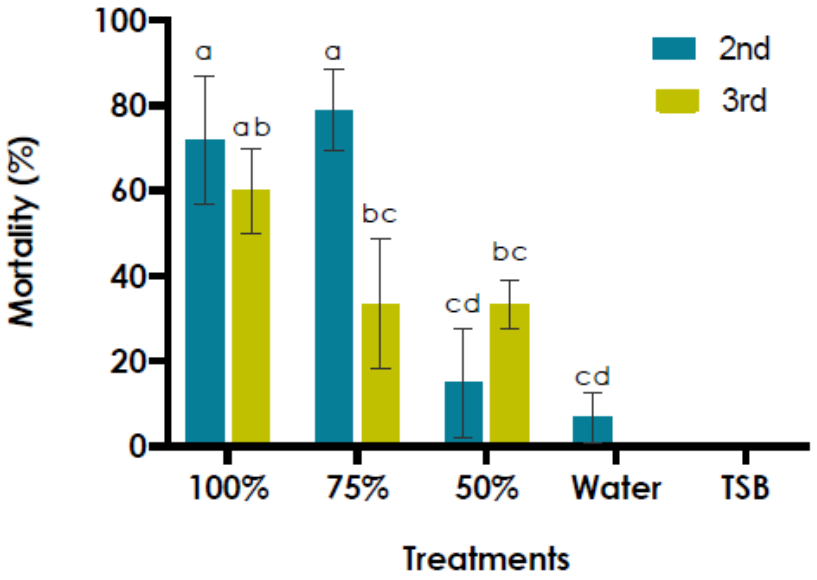
wrinkled with discoloration

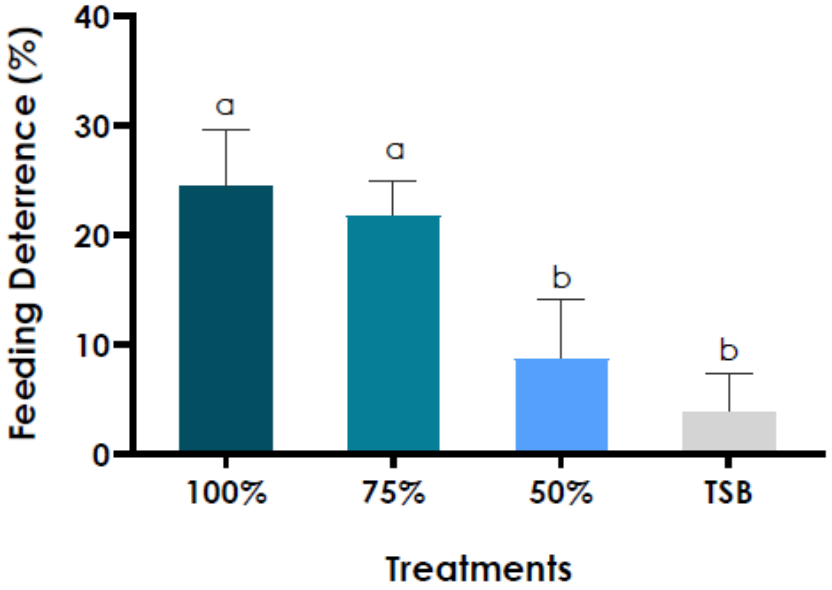
6 EPN associated bacterium

Xenorhabdus colony on NBTA



Mortality of fall armyworm larvae five days post-exposure to different concentrations of *Xenorhabdus* cell-free culture filtrates.





7 Small field validation of biocon-based Package of Technology

Trial Duration
Trial 1: February to April 2023
Trial 2: May to July 2023

Trial Field Location
B-9, Central Experiment Station, CAFS, UPLB

Field Dimensions
- Area: 50m x 100m = 5,000m^2
- Rows: 66 rows, at 0.75m/m between rows
- 4 replications; 3 rows in-between reps; 1-2 rows border; 2m in-between plot
- Plot size: 10m x 12m = 120m^2

TREATMENTS	COMPONENTS	DATE OF APPLICATION (DATE AFTER SOWING)
Metarhizium rileyi + Earwig	*M. rileyi*	9, 16. and 44
	Earwig	25 and 32
Metarhizium rileyi + *Heterorhabditis indica* BSDS	*M. rileyi*	9, 16. and 44
	EPN Hi BSDS	27 and 30
Metarhizium rileyi + Nucleopolyhedrovirus (NPV) FAW + *Heterorhabditis indica* BSDS	*M. rileyi*	9, 16, and 44
	NPV FAW	23
	EPN Hi BSDS	27 and 30
Nucleopolyhedrovirus (NPV) FAW + *Beauveria bassiana* (BPI)	NPV FAW	23
	B. bassiana	30 and 44
Metarhizium anisopliae + *B. bassiana*	Alternate application of *Metarhizium* sp. and Beauveria sp.	14, 16, 23
No treatment		

7 Small field validation of biocon-based Package of Technology

First Trial

(February 1 to April 13 2023)

Second Trial

(May 31 to July 31, 2023)

Global Forum on Biological Control and Training Workshop on Biological Control. 26-30 June 2022. Caoili BL et.al. Microbial Biological Control against Fall Armyworm in the Philippines

Thank you.

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