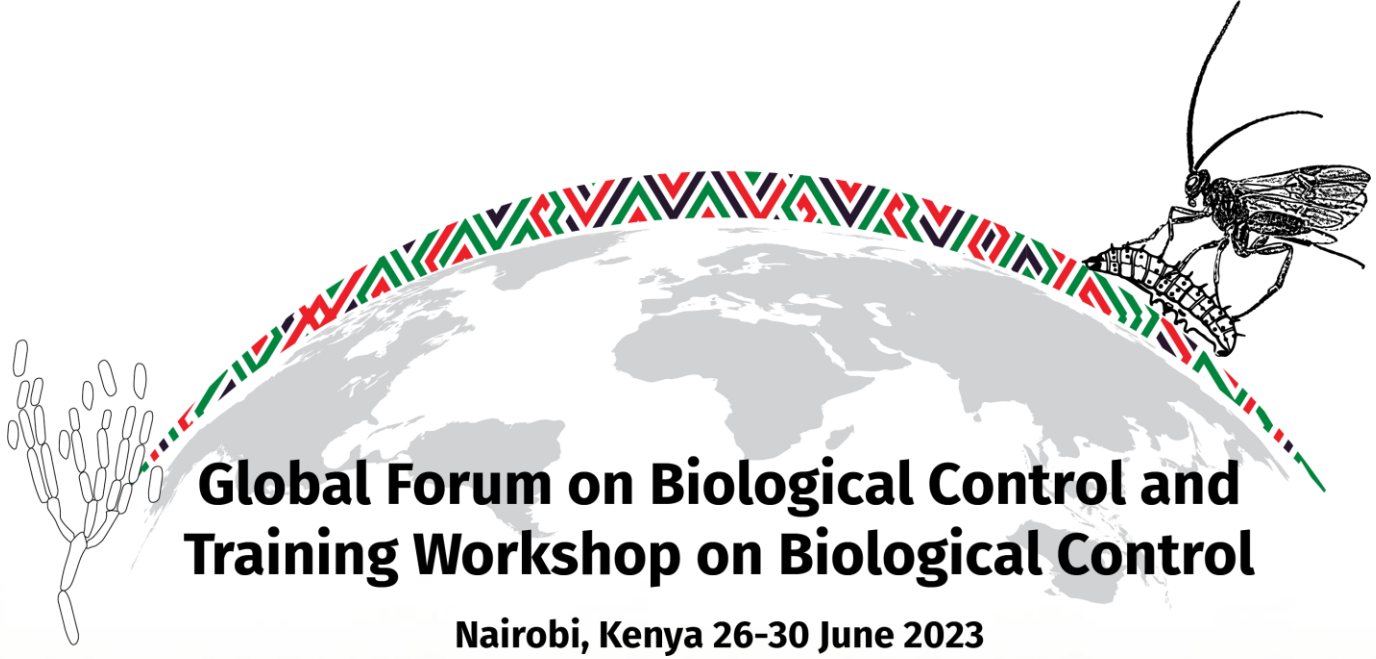

Global Forum on Biological Control and Training Workshop on Biological Control

Nairobi, Kenya 26-30 June 2023

Combining mycoinsecticides with promising native parasitoids for sustainable management of fall armyworm in Kenya

Junitor Chepkemoi, Ken Okwae Fening, Felicitas Chaba Ambele, Komivi Senyo Akutse

Co-organized by

Food and Agriculture Organization of the United Nations

icipe

Supported by

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german cooperation DEUTSCHE ZUSAMMENARBEIT

Implemented by

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Background and justification

- Maize is a major staple crop for over **300 million** people in sub-Saharan Africa (FAO 2010)

- Its production is constrained by biotic and abiotic factors that inflict 15–80% loss (Kfir et al. 2002)

- Recent invasion of **FAW**, *Spodoptera frugiperda* has aggravated the losses, threatening the food security in Africa

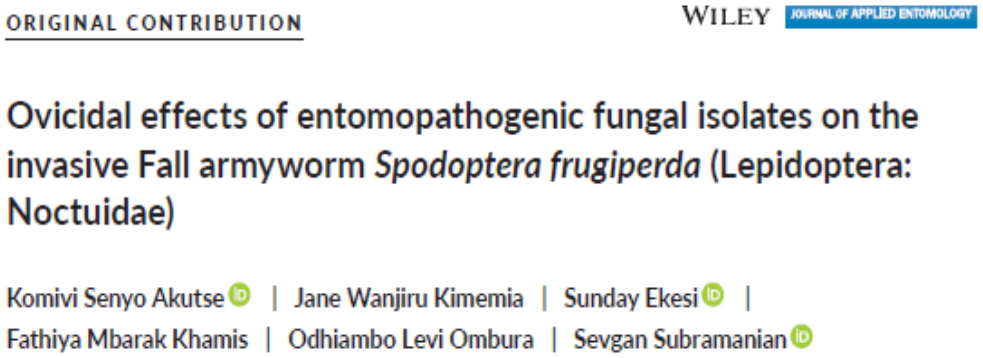
- Economic impact on maize – US$ 6.2 billion annually (CABI 2017)

- Use of pesticides was immediate control approach with negative impacts on human, environment and biodiversity including natural enemies

Background and justification

EPF against FAW eggs and newly emerged larvae

- *icipe* has identified potent fungal isolates to be developed as biopesticides against FAW eggs and larvae – *Metarhizium anisopliae* strains ICIPE 7, ICIPE 41, ICIPE 78



ORIGINAL CONTRIBUTION

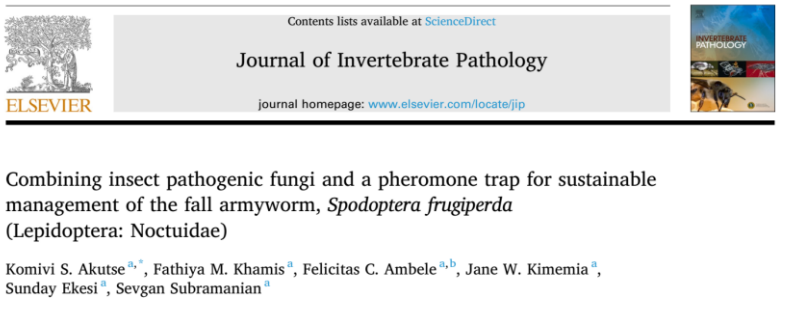
WILEY JOURNAL OF APPLIED ENTOMOLOGY

Ovicidal effects of entomopathogenic fungal isolates on the invasive Fall armyworm *Spodoptera frugiperda* (Lepidoptera: Noctuidae)

Komivi Senyo Akutse | Jane Wanjiru Kimemia | Sunday Ekesi | Fathiya Mbarak Khamis | Odhiambo Levi Ombura | Sevgan Subramanian

EPF against FAW adults

- *icipe* has also identified potent fungal isolates against FAW adults – *Metarhizium anisopliae* isolate ICIPE 7 and *Beauveria bassiana* ICIPE 621



Contents lists available at ScienceDirect

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journal homepage: www.elsevier.com/locate/jip

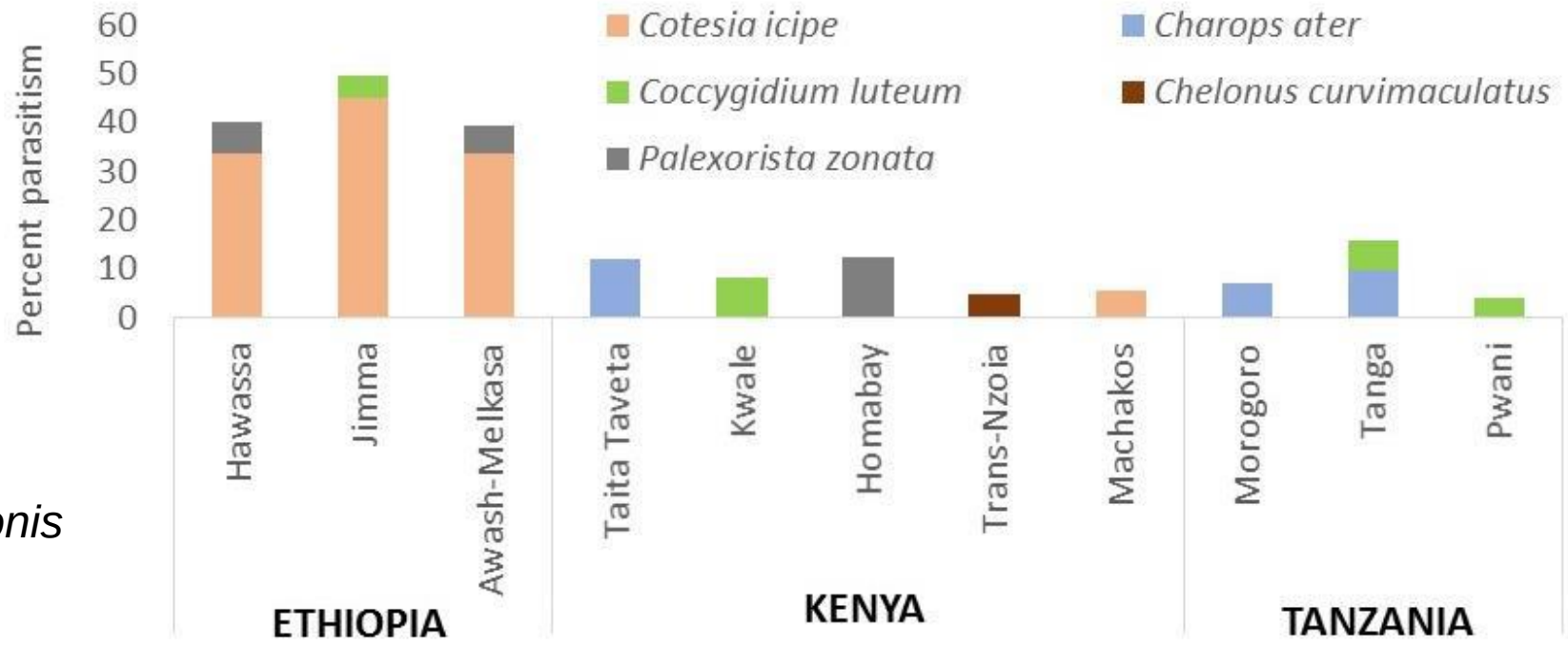
ELSEVIER

Combining insect pathogenic fungi and a pheromone trap for sustainable management of the fall armyworm, *Spodoptera frugiperda* (Lepidoptera: Noctuidae)

Komivi S. Akutse[a,*], Fathiya M. Khamis[a], Felicitas C. Ambele[a,b], Jane W. Kimemia[a], Sunday Ekesi[a], Sevgan Subramanian[a]

Major parasitoid species and parasitism rates in FAW invaded areas

- *Telenomus remus*
- *Trichogramma chilonis*




Cotesia icipe


Chelonus curvimaculatus


Charops ater


Palexorista zonata


Coccygidium luteum

Parasitoids host stages preference and suitability

Chelonus curvimaculatus parasitizing eggs

Cotesia icipe parasitizing young larvae

Diversity of indigenous parasitoid on FAW in East Africa

Scientific Name	Order	Family	Host Stage
Cotesia icipe	Hymenoptera	Braconidae	Larva
Telenomus remus	Hymenoptera	*Scelionidae*	Egg
Trichogramma chilonis	Hymenoptera	*Trichogrammatidae*	Egg
Chelonus curvimaculatus	Hymenoptera	Braconidae	Egg
Charops ater	Hymenoptera	Ichneumonidae	1st and 2nd Larval Instar
Palexorista zonata	Diptera	Tachinidae	4th, 5th and 6th Larval Instar

Objectives of the study

General objective

- Establish the interactions between potent fungal-based biopesticides and FAW associated parasitoids for effective management of the pest under maize production systems in Kenya

Specific objectives

1. Assess the direct effects of the potent *M. anisopliae* isolates ICIPE 7, ICIPE 78 and ICIPE 41 and *Beauveria bassiana* ICIPE 621 on adult *Telenomus remus* and *Cotesia icipe*

2. Evaluate the indirect effects of the potent fungal isolates of *M. anisopliae* and *B. bassiana* on the performance of *T. remus and C. icipe*

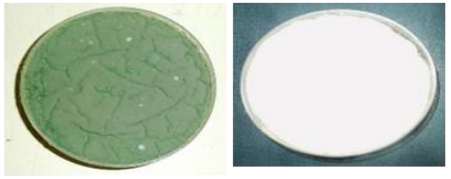
3. Compare the parasitism rates of the two parasitoids exposed to fungal infected and non-infected eggs/larvae

MATERIALS AND METHODS

Direct infection - Pathogenicity of EPF on adult parasitoids

Cotesia icipe

Telenomus remus



Fungal isolates

Harvesting

Contamination device/plastic jars

Exposure of infected parasitoids to FAW larvae/Eggs (100 each)

Glass vial for *T. remus*

Perspex cages for *C. icipe*

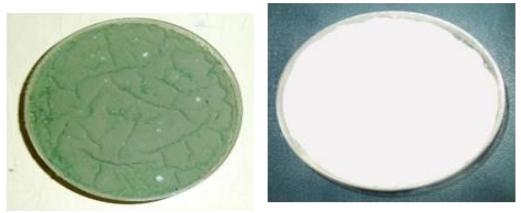
20 virgin parasitoids contaminated with 1 g dry conidia for 3 mins

- FAW eggs/larvae mortality
- Parasitism rates
- Mycosis test

Control – jar without fungal conidia
Experimental Design: CRD with four replications each/ four rep

Mortality recorded daily for 7 days

Indirect infection - Pathogenicity of EPF on adult parasitoids



4 EPF isolates

Harvesting

Suspension

Eggs/larvae treated by fungal suspension @ 1×10^5, 1×10^6, 1×10^7, 1×10^8 and 1×10^9 conidia ml^{-1}

Burgerjon's spray tower

Exposure of infected FAW larvae /Eggs (100 each) to parasitoids (20 each – 1:2 ratio)

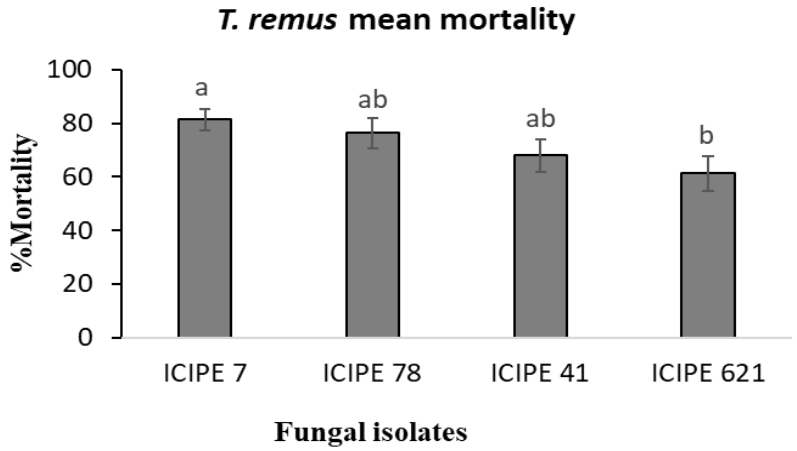
Hatchability & mortality assessed daily for 7 days

- FAW eggs/larvae mortality
- Parasitoids mortality
- Parasitism rates
- Mycosis test

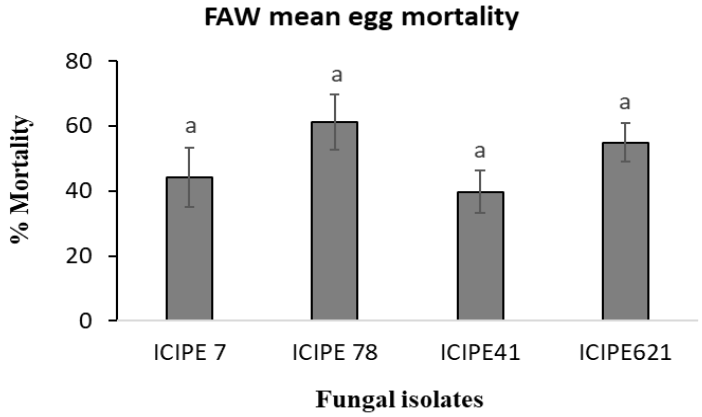
Control – sterile distilled water containing 0.05% Triton X-100
Experimental Design: CRD with four replications each/ with 4 replicates

RESULTS

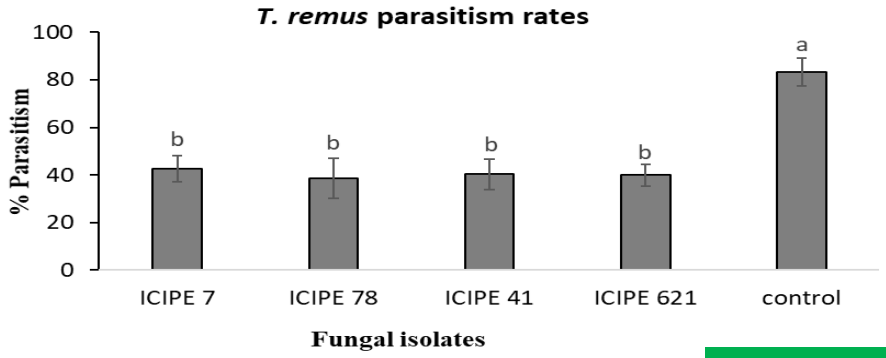
Non target effects on major FAW parasitoids – Direct effects



ICIPE 7 caused the highest mortality rate at 81.40%



ICIPE 78 caused the highest (61.25%) FAW eggs mortality

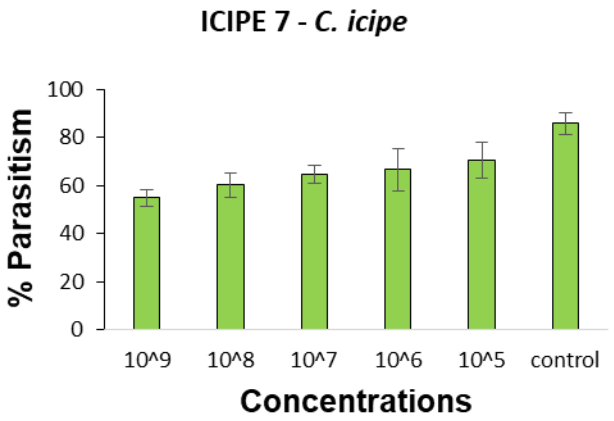


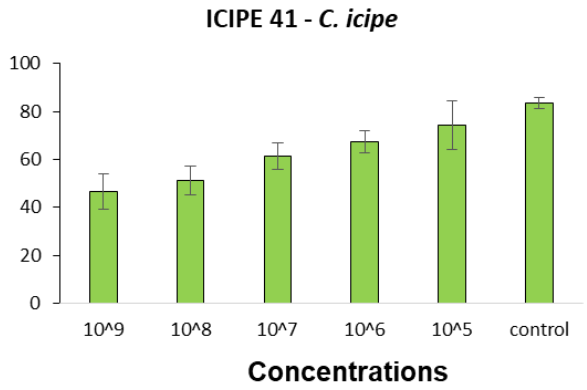
Cotesia icipe

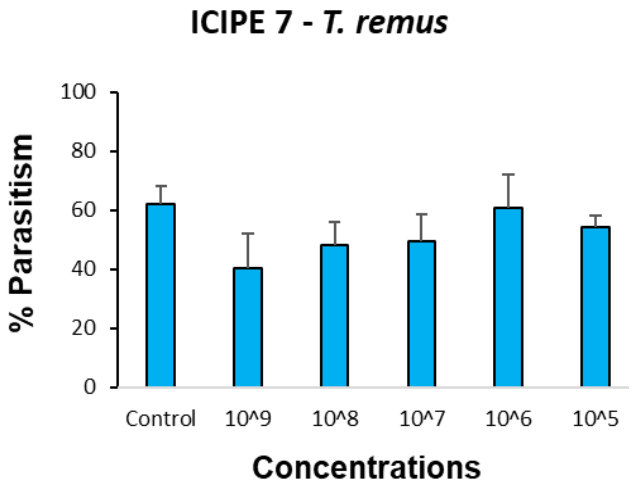
Fungal isolates	Mean mortality%	Larval mortality	Parasitism rates	Sex ratios (F:M)	*Cotesia icipe* LT_{50}
M. anisopliae ICIPE 7	73.95±7.49a	55.25±6.74a	35.75±4.80b	2:1	2.3±0.03a
M. anisopliae ICIPE 78	33.63±6.63b	28.25±4.41b	62.00±5.02a	2:1	5.2±0.06c
M. anisopliae ICIPE 41	66.33±7.29a	53.75±3.91a	36.75±3.82b	2:1	2.8±0.04b
B. bassiana ICIPE 621	36.59±6.65b	31.00±5.29b	58.00±5.24a	2:1	5.0±0.06d

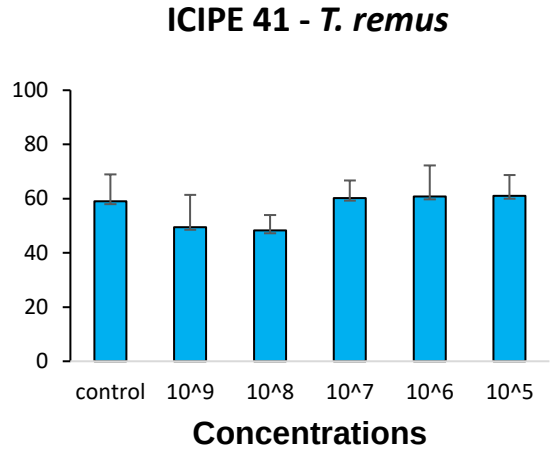
High parasitism rates were obtained in ICIPE 78 and ICIPE 621 & ICIPE 7 and ICIPE 41 had lowest LT_{50}

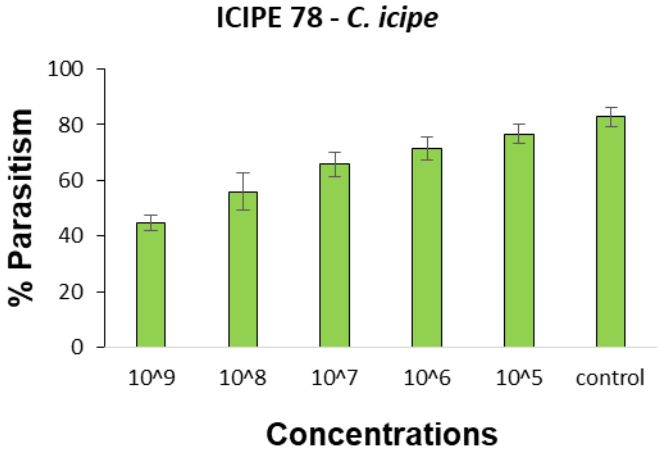
Non target effects on major FAW parasitoids – Indirect effects

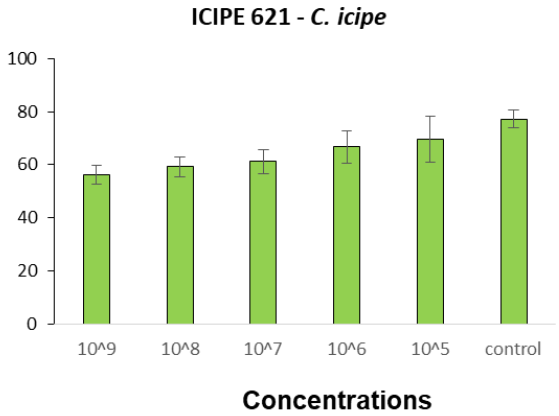


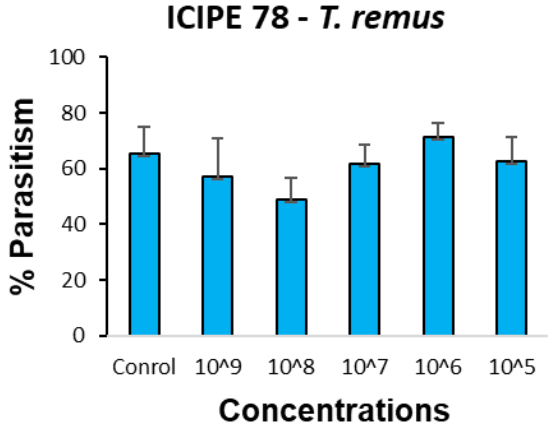


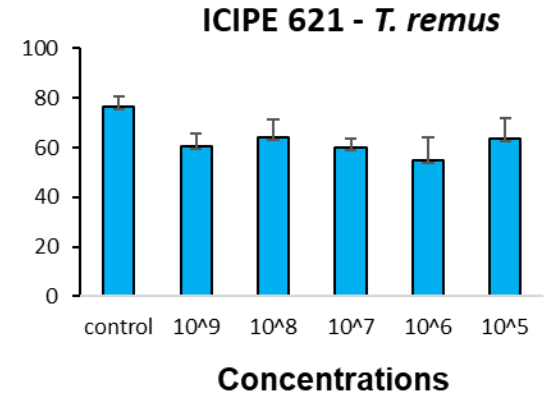












Cotesia icipe

Indirect application **of the biopesticides at lower concentrations could be applied together with the parasitoids without affecting their performance**

Telenomus remus

Conclusion

- ✓ Direct infection of the different fungal isolates caused high mortalities to both parasitoid species with *M. anisopliae* isolates were more virulent as compared to *B. bassiana*

- ✓ The parasitoids infected with *M. anisopliae* isolates also showed a higher conidial transfer to their host FAW eggs/larvae and induced high mortality to the host

- ✓ Parasitoid emergence was significantly affected by direct application, while indirect application of the biopesticides did not affect *T. remus* at low concentrations – *indicating that lower concentrations could be applied together with the parasitoid releases with no negative effects on their performance*

- ✓ Field evaluations are necessary to validate these findings

Thank you

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