



# 5<sup>TH</sup> TEAM MEETING 15 - 18 April 2024

Maritim Crystals Beach Hotel, Belle Mare,  
Republic of Mauritius

## BOOK OF ABSTRACTS



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MINISTRY OF AGRO-INDUSTRY AND FOOD SECURITY, REPUBLIC OF MAURITIUS

**FOOD SECURITY-SECURING OUR FRUIT FOR HEALTHY COMSUMPTION**

TEPHRITID WORKERS OF EUROPE , AFRICA AND THE MIDDLE EAST



Joint FAO/IAEA Centre  
Nuclear Techniques in Food and Agriculture



## WELCOME NOTE

Dear Colleagues,

We would like to welcome you all to the 5<sup>th</sup> TEAM 2024 meeting in Belle Mare, Mauritius.

We are thrilled with the strong participation received. We will be 125 participants in person and 21 participants virtual, all joining from 30 countries.

The scientific programme is now finalised. Over three days, we will cover 10 sessions, each comprising of oral and poster presentations. There are, in total, 49 oral presentations and 48 poster presentations. There are also three plenary talks, one on each day of the meeting, which will address salient issues pertaining to invasive species and their management. The programme presents a valuable platform for acquisition of new information which will inspire new ideas for research and practical applications.

As part of our commitment to support young researchers, we will award the best oral presentation and best poster presentation for student participants. The award for the best presentations will be on Wednesday 17<sup>th</sup> April 2024.

We encourage you to take this opportunity to exchange ideas with each other, build on existing collaborations and form new collaborations which will advance our field of work.

We hope you enjoy this meeting and derive the maximum benefit from this enriching experience.

Sincerely,

PREEADUTH SOOKAR

Chairperson: Local Organising Committee

ARUNA MANRAKHAN

Chairperson: Scientific Committee

## ORGANISERS

ENTOMOLOGY DIVISION, MINISTRY OF AGRO INDUSTRY AND FOOD SECURITY,  
REDUIT, MAURITIUS



## ACKNOWLEDGEMENT

The Organisers would like to thank public partners  
for their support of the 5<sup>th</sup> TEAM meeting.

### PUBLIC PARTNERS



Treasury Department, Ministry of Finance, Republic of Mauritius

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## PROGRAMME AT A GLANCE

## DAY 1

09.00

Welcome

10.00

BREAK &amp; Poster Viewing

10.30 PLENARY 1 : CONSERVATION OF BIODIVERSITY IN THE CONTEXT OF INVASIVE ALIEN SPECIES IN OCEANIC ISLAND MAURITIUS

## SESSION 1: BIOLOGY, BEHAVIOUR &amp; PHYSIOLOGY

11.30

Competitive interaction between wild *Bactrocera dorsalis* and *Ceratitis capitata* under different temperature regimes and host fruit species

11.45

Securing transmission of an essential symbiont: possible mediation by oviposition behavior in Olive flies (*Bactrocera oleae*)

12.00

The microbiome and tephritid behavior

12.15

Deterministic and stochastic effects drive the larval gut microbial diversity in cucurbit feeding fruit flies (Diptera, Tephritidae)

12.30

Controlling the response of *Bactrocera zonata* males to methyl eugenol

12.45

Development of a novel method of prior exposure of *Bactrocera zonata* to methyl eugenol and assessing its effectiveness on mating competitiveness and fly response to ME- Baited Traps

13.00

LUNCH

## SESSION 2: CHEMICAL ECOLOGY

14.00

Comparative olfactomics links ancestral saprophily to derived frugivory in tephritid fruit flies

14.15

Olfactory systems of polyphagous insects are tuned to host discrimination: Case of fruit flies

14.30

Odor based strategies for the management of the oriental fruit fly *Bactrocera dorsalis*

14.45

Optimal location and distribution of hydrolysed protein in a tree canopy for control of *Ceratitis capitata*, *C. cosyra* and *Bactrocera dorsalis* (Diptera: Tephritidae)

15.00

Flower and fruit volatiles of cucurbitaceae attract *Zeugodacus cucurbitae* females (Coquillett) (Diptera: Tephritidae)

15.15

Comparative transcriptomic analyses of odorant receptors in Tephritidae

15.30

BREAK &amp; Poster Viewing

## SESSION 3: ECOLOGY, HOSTS, DISTRIBUTION AND ABUNDANCE

16.00

Interspecific competition between *Bactrocera zonata* and *Ceratitis capitata*: Which mechanisms mediate larval interactions within the fruit

16.15

Diversity of fruit flies (Diptera: Tephritidae) infesting cucurbit crops in Maputo and Manica, Mozambique

16.30

Fruit fly species composition, seasonality, and fruit infestations in avocado orchards in Limpopo and Mpumalanga, South Africa

16.45

Detection of low-density populations of the Mediterranean fruit fly

17.00

An ecoinformatic approach to hierarchize multiscale environmental effects on the annual onset of *B. dorsalis* population growth in Senegalese Orchard

17.30

POSTER DISCUSSION (Sessions 1,2,)

## DAY 2

08.30 PLENARY 2: ECOLOGICAL AND GENOMIC INVESTIGATIONS ON THE EXPANSION OF THE INVASIVE *BACTROCERA DORSALIS*: INSIGHTS INTO THE INDIAN OCEAN ISLANDS

## SESSION 4: GENETICS &amp; TAXONOMY

09.30 Contrasts in temporal genetic variation of *Ceratitis capitata* in Europe

09.45 Differential dysregulation of the transcriptomic profiles of *Bactrocera dorsalis* by its parasitoids

10.00 A new empirical key for the identification of fruit fly larvae intercepted in the EU

10.15 Origin of *Bactrocera dorsalis* incursions in France : a global survey reveals multiple sources

10.30 BREAK & Poster Viewing

## SESSION 5: TRAPS AND ATTRACTANTS

11.00 Novel female attractant for *Bactrocera dorsalis* and *Zeugodacus cucurbitae* - An effective female lure for major fruit fly species of economic importance

11.15 Using different traps and attractants for monitoring and mass trapping *Ceratitis capitata* in an AW- IP management in Israel

11.30 Utilizing electronic traps for early detection of *Bactrocera dorsalis* (Diptera: Tephritidae) in South Africa

11.45 Does the reproductive status of the Mexican fruit fly affect its response to traps?

12.00 Trapping of the Afrotropical fauna of the Dacini: *Dacus* Fabricius in Botswana

12.15 Field evaluation of the attractiveness of zingerone and cuelure on the main *Dacus* (Diptera: Tephritidae) species in Mozambique

12.30 POSTER DISCUSSION (Session 3,4, & 5)

13.00 LUNCH

## SESSION 6: CONVENTIONAL AND BIOLOGICAL CONTROL

14.00 Host-symbiont-parasitoid tripartite interaction: a case of *Bactrocera dorsalis* and its associated natural enemies

14.15 Suitable areas for establishment of *Bactrocera dorsalis* (Diptera: Tephritidae) and its parasitoid *Diachasmimorpha longicaudata* (Hymenoptera: Braconidae): Implications for effective field releases in classical biological control

14.30 Preliminary inventory of natural enemies associated with fruit flies in Mauritius

14.45 Testing options for the control of cucumber fruit flies in Nigeria

15.00 Effect of compost and biochar on entomopathogenic nematode fruit fly control efficacy and persistence in mango orchards in northern Benin

15.15 POSTER DISCUSSION (Session 6)

15.30 BREAK & Poster Viewing

## SESSION 7: PHYTOSANITARY MEASURES

16.00 Current status of the oriental fruit fly, *Bactrocera dorsalis* (hendel) (diptera: tephritidae) presence in South Africa

16.15 Monitoring exotic tephritidae : results from official surveillance surveys in France

16.30 Defining areas of low prevalence for fruit fly (Diptera: Tephritidae) pests

16.45 ECOWAS research for development vision-strategies and intervention methodology : case study on cross-border pest fruit flies

17.00 POSTER DISCUSSION (Session 7)

## DAY 3

08.30 PLENARY 3: ADVANCING SIT: GENETIC BREAKTHROUGHS AGAINST FRUIT FLY PESTS

## SESSION 8: MANAGEMENT TECHNIQUES: SIT

09.30 Genetic sexing strains in support of sterile insect technique applications: past, present, and future

09.45 Study of the feasibility of the sterile insect technique against *B. dorsalis* in mango orchards in La Reunion10.00 Improving, rearing and control techniques with the integrated use of sit for *Bactrocera dorsalis*, *Bactrocera zonata* and *Zeugodacus cucurbitae*

10.15 Concluding remarks on the 25-year rise and fall of medfly SIT in Israel

10.30 POSTER DISCUSSION (Session 8)

10.30 BREAK

## SESSION 9: BIOTECHNOLOGY AND OTHER CONTROL TOOLS

11.00 Effectiveness of an Africa local plant in the control of tephritids (Diptera)

11.15 Comparison of electrophysiological and behavioral response of tephritid (Diptera: Tephritidae) pests to cucurbit host odor

11.30 Metabolomics-based exploration of tephritid metabolomes: a novel approach for evaluating male quality markers

11.45 POSTER DISCUSSION (Session 9,10)

12.00 LUNCH

## SESSION 10: AREA WIDE/IPM

13.00 Introduction to Area wide/IPM- Kenya Project results

13.15 Spatial modeling of fruit fly (*Bactrocera dorsalis*) abundance: harnessing the host tree suitability and climatic variables13.30 Decision support system for the management of Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann), in citrus orchards

13.45 The economics, food security, &amp; ecosystem health benefits of fruit fly integrated pest management

14.00 Establishment of area wide integrated pest management systems against fruit flies for mango fruit production in Kenya

14.15 Discussion on Area wide/IPM

14.30 CLOSING REMARKS HANDING OUT PRIZES

15.00 REMOVAL OF POSTERS

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## PROGRAM

## MONDAY 15 APRIL

09.00 WELCOME

10.00 BREAK &amp; POSTER VIEWING

10.30 PLENARY 1: FLORENS VINCENT

## SESSION 1: BIOLOGY, BEHAVIOUR AND PHYSIOLOGY

## Conservation of biodiversity in the context of invasive alien species in oceanic Island Mauritius

11.30 PO1 - ABSTRACT REF 78

Competitive interaction between wild *Bactrocera dorsalis* and *Ceratitis capitata* under different temperature regimes and host fruit species  
• HAFSI, ABIR

11.45 PO2 - ABSTRACT REF 42

Securing transmission of an essential symbiont: possible mediation by oviposition behavior in Olive flies (*Bactrocera oleae*)  
• BEN-YOSEF, MICHAEL

12.00 PO3 - ABSTRACT REF 13

The microbiome and tephritid behavior  
• YUVAL, BOAZ

12.15 PO4 - ABSTRACT REF 58

Deterministic and stochastic effects drive the larval gut microbial diversity in cucurbit feeding fruit flies (Diptera, Tephritidae)  
• HENDRYKS, WOUTER

12.30 PO5 - ABSTRACT REF 1

Controlling the response of *Bactrocera zonata* males to methyl eugenol  
• GAZIT, YOAV

12.45 PO6 - ABSTRACT REF 94

Development of a novel method of prior exposure of *Bactrocera zonata* to methyl eugenol and assessing its effectiveness on mating competitiveness and fly response to ME- Baited Traps  
• PATEL, NAUSHEEN

13.00 LUNCH

## SESSION 2: CHEMICAL ECOLOGY

14.00 PO7 - ABSTRACT REF 78

Comparative olfactomics links ancestral saprophily to derived frugivory in tephritid fruit flies  
• DEKKER, TEUN

14.15 PO8 - ABSTRACT REF 99

Olfactory systems of polyphagous insects are tuned to host discrimination: Case of fruit flies  
• RAMIARANJATOVO, GAELLE

14.30 PO9 - ABSTRACT REF 13

Odor based strategies for the management of the oriental fruit fly *Bactrocera dorsalis*  
• BIASAZIN, TIBEBE DEJENE

14.45 P10 - ABSTRACT REF 12

Optimal location and distribution of hydrolysed protein in a tree canopy for control of *Ceratitis capitata*, *C. cosyra* and *Bactrocera dorsalis* (Diptera: Tephritidae)  
• WELDON, CHRISTOPHER

15.00 P11 - ABSTRACT REF 98

Flower and fruit volatiles of cucurbitaceae attract *Zeugodacus cucurbitae* females (Coquillett) (Diptera: Tephritidae)  
• GESSESE, YITBAREK WOLDEHAWARIAT

15.15 P12 - ABSTRACT REF 3

Comparative transcriptomic analyses of odorant receptors in Tephritidae  
• PERSYN, EMMA

15.30 BREAK &amp; POSTER VIEWING

## SESSION 3: ECOLOGY, HOST, DISTRIBUTION AND ABUNDANCE

16.00 P13 - ABSTRACT REF 50

Interspecific competition between *Bactrocera zonata* and *Ceratitis capitata*: Which mechanisms mediate larval interactions within the fruit  
• HAMBURG, MAI

16.15 P14 - ABSTRACT REF 29

Diversity of fruit flies (Diptera: Tephritidae) infesting cucurbit crops in Maputo and Manica, Mozambique  
• BOTA, LUIS DOMINGOS

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Comparative olfactomics links ancestral saprophily to derived frugivory in tephritid fruit flies  
• GROVE, TERTIA

16.45 P16 - ABSTRACT REF 106

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## PROGRAM

## MONDAY 15 APRIL

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- 17.15 **POSTER DISCUSSION (SESSION 1, 2, 3)**

## TUESDAY 16 APRIL

- 08.30 **PLENARY 2: DELATTE, HELENE**  
Ecological and Genomic Investigations on the expansion of the invasive *Bactrocera dorsalis*: Insights into the Indian Ocean Islands

## SESSION 4: GENETICS AND TAXONOMY

- 09.30 **P19 - ABSTRACT REF 33**  
Contrasts in temporal genetic variation of *Ceratitis capitata* in Europe  
• DESCHEPPER, PABLO
- 09.45 **P20 - ABSTRACT REF 72**  
Differential dysregulation of the transcriptomic profiles of *Bactrocera dorsalis* by its parasitoids  
• GWOKYALYA, REHEMAH
- 10.00 **P21 - ABSTRACT REF 10**  
A new empirical key for the identification of fruit fly larvae intercepted in the EU  
• TADDEI, ANDREA
- 10.15 **P22 - ABSTRACT REF 28**  
Origin of *Bactrocera dorsalis* incursions in France : a global survey reveals multiple sources  
• CHARBONNEL, EMELINE
- 10.30 **BREAK AND POSTER BREAK**

## SESSION 5: TRAPS AND ATTRACTANTS

- 11.00 **P13 - ABSTRACT REF 109**  
Novel female attractant for *Bactrocera dorsalis* and *Zeugodacus cucurbitae* – An effective female lure for major fruit fly species of economic importance  
• NAYEM, HASSAM
- 11.15 **P14 - ABSTRACT REF 48**  
Using different traps and attractants for monitoring and mass trapping *Ceratitis capitata* in an AW- IP management in Israel  
• SILBERSTEIN, MIRIAM
- 11.30 **P15 - ABSTRACT REF 40**  
Utilizing electronic traps for early detection of *Bactrocera dorsalis* (Diptera: Tephritidae) in South Africa  
• SERFONTEIN, LEANI
- 11.45 **P16 - ABSTRACT REF 82**  
Does the reproductive status of the Mexican fruit fly affect its response to traps?  
• PEREZ-STAPLES, DIANA
- 12.00 **P17 - ABSTRACT REF 65**  
Trapping of the Afrotropical fauna of the Dacini: *Dacus Fabricius* in Botswana  
• SITHOLE, OFTENSE PAT
- 12.15 **P18- ABSTRACT REF 30**  
Field evaluation of the attractiveness of zingerone and cuelure on the main *Dacus* (Diptera: Tephritidae) species in Mozambique  
• CANHANGA, LAURA
- 12.30 **POSTER DISCUSSION**
- 13.00 **LUNCH**

## SESSION 6: CONVENTIONAL AND BIOLOGICAL CONTROL

- 14.00 **P28 - ABSTRACT REF 5**  
Host-symbiont-parasitoid tripartite interaction: a case of *Bactrocera dorsalis* and its associated natural enemies  
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• AZRAG, ABDELMUTALAB GESMALLA AHMED

## PROGRAM

## TUESDAY 16 APRIL

- 14.30 **P30 - ABSTRACT REF 110**  
Preliminary inventory of natural enemies associated with fruit flies in Mauritius  
• NAOJEE, KHAMINI BHYE
- 14.45 **P31 - ABSTRACT REF 47**  
Testing options for the control of cucumber fruit flies in Nigeria  
• UMEH, VINCENT CHUKWUEMEKA
- 15.00 **P32 - ABSTRACT REF 104**  
Effect of compost and biochar on entomopathogenic nematode fruit fly control efficacy and persistence in mango orchards in northern Benin  
• SINZOGAN, ANTONIO
- 15.15 **POSTER DISCUSSION (SESSION 6)**
- 15.30 **BREAK AND POSTER VIEWING**

## SESSION 7: PHYTOSANITARY MEASURES

- 16.00 **P33 - ABSTRACT REF 35**  
Current status of the oriental fruit fly, *Bactrocera dorsalis* (hendel) (diptera: tephritidae) presence in South Africa  
• MOKWELE, JULIE
- 16.15 **P34 - ABSTRACT REF 9**  
Monitoring exotic tephritidae : results from official surveillance surveys in France  
• MOUTTET, RAPHAELLE
- 16.30 **P35 - ABSTRACT REF 57**  
Defining areas of low prevalence for fruit fly (Diptera: Tephritidae) pests  
• MANRAKHAN, ARUNA
- 16.45 **P36 - ABSTRACT REF 103**  
ECOWAS research for development vision-strategies and interventon methodology : case study on cross-border pest fruit flies  
• SINZOGAN, ANTONIO
- 17.00 **POSTER DISCUSSION (SESSION 7)**

## WEDNESDAY 17 APRIL

- 08.30 **PLENARY 3: SCHETELIG MARC**  
Advancing SIT: Genetic breakthroughs against fruit fly pests

## SESSION 8: MANAGEMENT TECHNIQUES SIT

- 08.30 **P37 - ABSTRACT REF 16**  
Genetic sexing strains in support of sterile insect technique applications: past, present, and future  
• BOURTZIS, KOSTAS
- 09.30 **P38 - ABSTRACT REF 6**  
Study of the feasibility of the sterile insect technique against *B. dorsalis* in mango orchards in La Reunion  
• MOQUET, LAURA
- 10.00 **P39 - ABSTRACT REF 53**  
Improving, rearing and control techniques with the integrated use of sit for *Bactrocera dorsalis*, *Bactrocera zonata* and *Zeugodacus cucurbitae*  
• RAGHOO, SAVITRI
- 10.15 **P40 - ABSTRACT REF 111**  
Concluding remarks on the 25-year rise and fall of medfly SIT in Israel  
• YACOBI, GAL
- 10.30 **POSTER DISCUSSION (SESSION 8)**
- 10.30 **BREAK**

## SESSION 9: BIOTECHNOLOGY AND OTHER CONTROL TOOLS

- 11.00 **P41 - ABSTRACT REF 108**  
Effectiveness of an Africa local plant in the control of tephritids (Diptera)  
• MOKAM, DIDI GAELLE
- 11.15 **P42 - ABSTRACT REF 113**  
Comparison of electrophysiological and behavioral response of tephritid (Diptera: Tephritidae) pests to cucurbit host odor  
• BARAKI, YOSEPH
- 11.30 **P43 - ABSTRACT REF 36**  
Metabolomics-based exploration of tephritid metabolomes: a novel approach for evaluating male quality markers

## PROGRAM

## WEDNESDAY 17 APRIL

11.45 POSTER DISCUSSION (SESSION 9,10)

12.00 LUNCH

## SESSION 10: AREA WIDE/IPM

13.00 P44 - ABSTRACT REF 78

Introduction to Area wide/IPM- Kenya Project results

• TEUN, DEKKER

13.15 P45 - ABSTRACT REF 9

Spatial modeling of fruit fly (*Bactrocera dorsalis*) abundance: harnessing the host tree suitability and climatic variables

• ABDEL-RAHMAN, ELFATIH MOHAMED

13.30 P46 - ABSTRACT REF 92

Decision support system for the management of Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann), in citrus orchards

• LOMBARD, ANDERSON

13.45 P47 - ABSTRACT REF 11

The economics, food security, & ecosystem health benefits of fruit fly integrated pest management

• KASSIE, MENALE

14.00 P48 - ABSTRACT REF 98

Establishment of area wide integrated pest management systems against fruit flies for mango fruit production in Kenya

• KASINA, MUO

14.15 DISCUSSION ON AREA WIDE/IPM

14.30 CLOSING REMARKS HANDING OUT PRIZES

14.15 REMOVAL OF POSTERS



# 5<sup>TH</sup> TEAM MEETING

## 15 - 18 April 2024

Maritim Crystals Beach Hotel, Belle Mare,  
Republic of Mauritius

### ABSTRACT MONDAY 15 APRIL

#### PLENARY 1: FLORENS VINCENT

Conservation of biodiversity in the context of invasive alien species in  
oceanic Island Mauritius

#### BIOLOGY, BEHAVIOUR AND PHYSIOLOGY



## Competitive Interaction Between Wild *Bactrocera Dorsalis* And *Ceratitis Capitata* Under Different Temperature Regimes And Host Fruit Species

Hafsi, Abir<sup>1</sup>, Moquet, Laura<sup>1</sup>, Ben-Yosef, Michael<sup>2</sup>, Payet, Jim<sup>1</sup>, Glenac, Serge<sup>1</sup>, Delatte, Hélène<sup>1</sup>

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### ABSTRACT

Arrival and establishment of a new invasive fruit fly species can induce major problems for local biodiversity, as extinction or niche displacement of resident species. Results depend, often, on the strength and modes of interspecific interactions between introduced and resident species. We evaluated interspecific competition for resources between larvae of two polyphagous fruit flies (Diptera: Tephritidae); one recently invasive species *Bactrocera dorsalis* and one resident species *Ceratitis capitata*. The experiment was conducted in cherries, mango and guava hosts under two temperature regimes (20 °C and 30 °C). The oviposition sequence between invasive and native species was explored by setting competition trials between heterospecific larvae of different age combinations. Results showed that pupal weight, larva-adult survival rate, and larval development time of both tephritid species are affected significantly by the presence or age of the competitor and by temperature, except the pupal weight of *C. capitata*, which remained largely unaffected by interspecific competition. Results suggest that *B. dorsalis* larvae survive better, and are overall better at maintaining development rate in the presence of competition, in tested media fruits at 20 and 30 °C, compared to *C. capitata*, except in cherry at 20 °C.

**KEYWORDS:** Interspecific competition, Tephritidae, temperature, host fruit, invasion

## Securing transmission of an essential symbiont: possible mediation by oviposition behavior in olive flies (*Bactrocera oleae*)

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### ABSTRACT

The evolution of obligate associations between insects and microbes required the establishment of mechanisms for securing the maternal transmission of microbial partners. In many associations, cellular processes ensure the protection of endosymbionts during development, and ultimately - their perpetuation throughout host ontogeny. Where insects associate with extracellular symbionts, reliable transmission is facilitated by anatomical, physiological and behavioral adaptations, protecting the microbial partners from succumbing to the environment during transfer from female to offspring.

Herein we address the oviposition behavior of olive flies (*Bactrocera oleae*) comparably to other Tephritids, and in context of symbiont transmission. Differently from other family members, olive fly females do not opportunistically use existing wounds in the fruit for oviposition, and compulsively bore a small chamber into the pericarp each time an egg is laid. Additionally, any fruit exudates leaching from the wound are meticulously removed before an egg is deposited in the chamber. Finally, females show a clear preference for unripe over ripe olives - a deviation from the consensus tendency of other flies for oviposition in ripe fruit. We hypothesize that these behavioral patterns are essential for the reliable transmission of the extracellular bacterial symbiont, *Ca. Erwinia dadicola*, required by the larva in order to develop in the fruit. We provide supporting evidence for this by surveying for the presence of the bacterium in larvae and adults from unripe and ripe fruit, and quantifying the bactericidal effect of the fruit. Our results suggest that oviposition behavior in olive flies circumvent the antimicrobial properties of the fruit's defense chemistry and facilitate symbiont transmission by egg smearing.

**KEYWORDS:** symbiont transmission, egg-smearing, plant defense, female behavior

## The Microbiome and Tephritid Behavior

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Multicellular organisms maintain intimate relationships with diverse communities of microorganisms. These interactions have been studied in depth in many insect species, revealing significant and intricate effects of the microbiome on its host. In my talk, I will focus on the effects of gut symbionts on behavior of tephritid fruit flies. Specifically, I will describe studies on olive, Oriental, and Mediterranean fruit flies that show how the microbiome affects oviposition choices by females, and foraging decisions by adults and larvae. These studies suggest the presence of an active gut-brain axis, that is modulated by the microbiome to affect sensory and motor pathways adaptively.

**KEYWORDS:** Microbiome, Behavior, Ceratitis, Bactrocera

## Deterministic And Stochastic Effects Drive The Larval Gut Microbial Diversity In Cucurbit Feeding Fruit Flies (*Diptera, Tephritidae*)

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### ABSTRACT

Insect diversity is closely linked to the evolution of phytophagy with most phytophagous insects showing a strong degree of specialization for specific host plants. Recent studies suggest that the insect gut microbiome plays a crucial role in facilitating changes in the dietary range. This could imply the formation of stable insect-symbiont associations formed by insect host-associated processes. However, it remains unclear which processes shape the assembly of the insect gut microbiome and in particular the relative importance of “microbial filtering” by the insect host. In this study we investigated the relative roles of deterministic and stochastic processes in shaping the gut microbiome of wild populations of *Dacus bivittatus*, *D. ciliatus*, *Zeugodacus cucurbitae* (three predominantly cucurbit feeding fruit flies). We found that both stochastic, as well as deterministic processes, including microbial interactions and filtering by the host fly play a considerable role in shaping the larval gut microbiome. Our results also show that these processes are relatively consistent across fly species and diets. We also speculate that 65 microbial ASV's (Amplicon sequence variants), mostly composed of the families Enterobacterales, Sphingobacterales, Pseudomonadales and Betaproteobacterales, might be correlated with the cucurbit host plant specialization. Our data suggest that the larval gut microbiome assembly fits with the “microbiome on a leash” model.

**KEYWORDS:** insect pests, wild populations, microbial assembly, plant-insect interactions



## Controlling The Response Of *Bactrocera Zonata* Males To Methyl Eugenol

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**Background:** The attraction of the male of the peach fruit fly, *Bactrocera zonata* to the parapheromone methyl eugenol is not fully understood. This knowledge is important for the development of control strategies that combine the sterile insect technique and the male-annihilation technique. **Methodology:** The response of males of *B. zonata*, to methyl eugenol was studied using two different bioassays: A laboratory assay to assess the short-distance response of males to methyl eugenol, and outdoor large screen-cages were used to assess the attraction of released males to methyl eugenol traps in semi-field conditions.

In our study we characterized the male *B. zonata* response to methyl eugenol with respect to several physiological parameters such as: (a) age, and sexual maturation; (b) the larvae and adult diet; (c) males' sterility; and (d) pre-exposure to methyl eugenol. Our findings show that the response to methyl eugenol increases with both age and sexual maturation. We found that larval diet also influences adult response. The attraction to methyl eugenol among males that had been raised on artificial larval-rearing diets was higher than that observed among males that had been raised as larvae within fruit. In addition, we found that while methyl eugenol was toxic to the flies, exposure to its aroma significantly reduced the males' response to the attractant. This effect extended for at least 4 weeks and may be harnessed for developing sterile flies which are less responsive to methyl eugenol, when using the sterile-insect technique and the male-annihilation technique simultaneously as a control strategy against *B. zonata*.

**KEYWORDS:** aromatherapy; attraction; MAT; para-pheromones; SIT

## Development of a novel method of prior exposure of *Bactrocera zonata* to methyl eugenol and assessing its effectiveness on mating competitiveness and fly response to ME- Baited Traps

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Pre-release treatment of Tephritids with semiochemicals is recommended to improve sexual performance and reduce response of released flies to pheromone traps, which is the ultimate aim for a successful SIT. Existing research approaches have been done on a small scale, while the need today is production on a commercial scale implying the pre-treating and release of millions of flies daily. In Mauritius, irradiated flies are placed in emergence towers in preparation of release. Plain agar and adult feed (sugar: enzymatic yeast powder in a 3:1 ratio) is usually provided as from emergence. The methodology for the first part of this study was assessing the effect of 5 different concentrations of ME-supplemented agar as follows (0.05 %, 0.1 %, 0.15 %, 0.2 %, 0.25 % v/v) on mating competitiveness of flies. The second part was to assess the response of treated flies to ME-traps. Flies were fed for 10 days on ME-supplemented agar with the following concentrations (0.8, 0.9, 1, and 1.1% v/v). A comparative approach was done in parallel by exposing flies by aromatherapy. Mortality rates were recorded in all cases. The mean number of mating pairs collected for concentrations 0.15, 0.2, and 0.25 % v/v was significantly different for the treated and non-treated flies while for concentrations 0.05 and 0.1 % v/v, no significant difference was noted. Enhanced sexual maturity and an earlier mating schedule was observed for treated flies with peak mating record for 0.15 % v/v and above. The mortality rate was < 4 % and was not significantly different over the different concentrations tested. A significant interaction was observed between age and % mating. Flies that were fed on ME-supplemented agar and by aromatherapy were significantly less responsive to ME-traps, feeding being the most effective approach. When response was assessed over days, it was observed that the effect was still persisting after 15 days. However, the % mortality with ME-fed agar was > 10 % for concentration 1.0 and above. The novel method of exposure has given positive insights on mating competitiveness. However, as regards to the optimum concentration of ME to be applied to reduce attraction to pheromone traps, the mass rearing facility must balance the option of whether to increase the release ratios of semiochemical-treated flies to compensate for the loss due to ME exposure, or continue with sequential application of MAT and SIT, which has a subjective cost associated.

**KEYWORDS:** *Bactrocera zonata*, methyl eugenol, agar diet, mating competitiveness, trap responsiveness

## Comparative Olfactomics Links Ancestral Saprophily To Derived Frugivory In Tephritid Fruit Flies

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### ABSTRACT

A tens-of-millions-years-old adaptive radiation event drove tephritid flies from ancestral saprophily onto fresh fruits and vegetables. Here we mapped antennal responses of five tephritid and two drosophilid species to fermentation volatiles and appended these to an existing custom-built fruit odor response database. This surfaced a highly conserved preadaptive bridge supporting the shift to frugivory: a set of fermentation volatiles detected by all tephritids entirely overlapped with a previously described set of highly conserved fruit-odor responses. A blend of these shared volatiles was as attractive as fermentation substrate in a multichoice olfactometer. Besides conservation, the comparative analyses also revealed a strong niche-driven divergence in tephritids: ecology overrode phylogeny in responses to fermentation volatiles. The above evolutionary-ecological conservation and divergence of olfactory sensitivities were, however, not reflected in tephritid olfactory receptor (OR) sequences, which strictly followed phylogeny.

Linking the OR tree with known *D. melanogaster* OR sensitivities, revealed numerous and diverse ORs putatively underlying the detection of conserved volatiles. Possibly, if multiple ORs underlie detection of individual volatiles, evolutionary-ecological correlates may be obscured. In conclusion, comparative GC-EAD data links odor sensitivities to evolutionary-ecological contexts, provides input to further functional OR work, and links fundamental research with application prospects.

**KEYWORDS:** olfactory evolution, frugiphory, saprophily, attractants, olfactory receptors

## Olfaction in Tephritidae: a balance between detection and discrimination

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Host volatile compounds play an essential role in locating egg-laying sites for insects. In this study, we aim to understand the sensory mechanisms used by polyphagous Tephritidae fruit fly species to recognize their host-fruits. For generalist species, it is generally thought that among the various compounds emitted by the wide range of hosts, insects rely primarily on those shared by most hosts. To challenge this hypothesis, we analysed volatile emissions from 28 host-fruit species using gas chromatography and mass spectrometry (GC-MS). We identified 511 volatile compounds from intact fruits and 665 from sliced fruits. For each volatile compound, we estimated its sharedness among fruit species with an index of fruit  $\alpha$ -diversity. Next, we assessed the olfactory sensitivity of 8 fruit fly species to 37 synthetic compounds by GC coupled with a triple electroantennogram detector. We found for each species a significant negative correlation between the olfactory sensitivity of fruit flies and  $\alpha$ -diversity. Accordingly, a behavioral bioassay showed that at low concentration *B. dorsalis* prefers compounds specifically emitted by few fruits species than compounds which are shared among fruits. This unexpected result supports a new hypothesis: Tephritidae species are not only specialized in detecting their hosts, but also in discriminating them. Optimization of host-discrimination would have resulted in low sensitivity threshold for specific compounds and wider dynamic range for shared compounds. This new concept implies many selective advantages, including adaptation to the local background, and should also drive the search for more effective attractants.

**KEYWORDS:** *Bactrocera dorsalis*, Electroantennography, host range, kairomone, Olfactory system

**Odor based strategies for the management of the oriental fruit fly *Bactrocera dorsalis***

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The oriental fruit fly *Bactrocera dorsalis*, poses a substantial threat to global horticulture production as a highly destructive and invasive pest, with the detection of eggs or larvae in exported fruits deemed entirely unacceptable. Consequently, it is crucial to devise control strategies that specifically target female fruit flies to mitigate associated risks. Utilizing gas chromatography coupled to antennal / palpal detection (GC-EAD / GC-EPD), compounds eliciting responses in the maxillary palp and antenna of *Bactrocera dorsalis*, *Ceratitis capitata* and *Zeugodacus cucurbitae* were identified. Building upon the significance of compounds whose detection was shared among fruit flies, blends were composed, testing the idea that compounds active on the palps and antennae complement and possibly synergize. Three blends, a palpal, an antennal and a combined blend- formulated in a wax emulsion for slow release, were tested on *B. dorsalis* fruit flies in six-choice and large room laboratory assays, as well as field trials. Remarkably, the blend with both antennal and maxillary palp active compounds attracted more *B. dorsalis* than blends based on either antennae or palps alone and exhibited a female-bias in captures. Furthermore, the blend exhibited high selectivity by capturing very few non- target insects. The result has significant implications for advancing targeted pest control strategies, ultimately contributing to more effective management of the *B. dorsalis* population, and safeguarding global horticulture productivity.

**KEYWORDS:** Antennae, Attraction, Chromatography, Maxillary palp, Tephritidae



## Optimal Location And Distribution Of Hydrolysed Protein In A Tree Canopy For Control Of *Ceratitis Capitata*, *C. Cosyra* And *Bactrocera Dorsalis* (Diptera: Tephritidae)

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### ABSTRACT

Hydrolysed protein is the attractant used in either bait sprays or stations for fruit fly control. However, an understanding of how different species respond to hydrolysed protein, and its best location and distribution is needed to optimise fruit fly control. We determined the responses of *Ceratitis capitata*, *C. cosyra* and *Bactrocera dorsalis* to hydrolysed protein in a tree canopy. To do so, we first recorded the response of each species to baits placed at four heights in the canopy (ground, lower, mid-, and upper canopy) with regard to fly age (one- or 10-day-old), sex, and diet (protein-deprived or fed). Secondly, we evaluated the response by females of each species to baits applied at two densities: 10 droplets of 200 µL protein hydrolysate solution (high bait density) or a single drop of 2000 µL (low bait density). In both experiments, *C. capitata* responded more than the other species to baits. Response by all three species was highest to baits in the mid- to upper canopy. One-day-old protein-fed flies were least responsive, while 10-day-old protein-deprived flies were most responsive. Protein-deprived females responded to baits more than males with the same diet. Response was greatest at high bait density. When protein-fed, very few *B. dorsalis* or *C. cosyra* responded when bait density was low, but *C. capitata* still responded. Our results show that protein hydrolysate baits need to be in a tree canopy and evenly distributed in a tree to ensure fruit fly response, particularly when multiple species are being targeted.

**KEYWORDS:** Bait location, bait spray

## Flower And Fruit Volatiles Of Cucurbitaceae Attract *Zeugodacus Cucurbitae* Females (Coquillett) (Diptera: Tephritidae)

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### ABSTRACT

*Zeugodacus cucurbitae* (Coquillett) poses a global threat to fruits and vegetables worldwide, with a special preference for cucurbits. The damage inflicted by female fruit flies, which lay eggs on host plant fruits and flowers, leading to subsequent larval feeding, can result in substantial yield losses ranging from 30 to 100% unless effectively managed. Currently, semiochemical-based female attractants in tephritid fruit fly management lack selectivity, prompting the need to enhance their precision. This study aimed to identify physiologically and behaviorally relevant volatiles from host plants for monitoring and controlling female *Z. cucurbitae* flies. Volatile organic compounds were collected from various phenological stages of *Cucumis sativus* L., *Cucurbita pepo* L., and *Cucurbita mixta* L. in field conditions and analyzed using gas chromatography/mass spectrometry (GC-MS). Electrophysiological responses of sexually mature *Z. cucurbitae* females to host volatiles were recorded using gas chromatography coupled with electroantennogram detection (GC-EAD). Active compounds were then formulated into blends for behavioral assays conducted in a six-choice olfactometer. A total of 81 compounds were identified from the three phenological stages, of which 10 were confirmed with synthetic replication. Synthetic blends based on physiologically active compounds of flower and immature fruit headspace attracted more females than those mature fruit and the paraffin oil control ( $P < 0.0001$ ). Some identified physiologically active compounds were found to be behaviorally redundant. This study highlights the diverse volatilome within species and emphasizes the potential of physiologically active compounds to enhance the selectivity and sensitivity of female lures. However, the translation of these laboratory findings warrants further assessment of the different blends' performance in the field conditions.

**KEYWORDS:** Cucurbitaceae, female attractants, electroantennogram, behavioral bioassay

## Comparative Transcriptomic Analyses Of Odorant Receptors In Tephritidae

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### ABSTRACT

Fruit flies of the Tephritidae family (Diptera) are among the main pests of fruit and vegetable production worldwide. Their olfactory system plays an important role in guiding them to food sources, mating partners, and oviposition sites. The odorant receptors (ORs), responsible for the reception of volatile cues, are transmembrane proteins expressed in antennae and maxillary palps of Tephritidae. Because of their highly diverse host preferences, fruit flies represent good models for comparative analyses of their OR diversity and evolution. However, we still lack genomic and transcriptomic resources on a large variety of fruit fly species to conduct such analyses. To address this, we used a RNAseq approach to identify the OR repertoires of thirteen Tephritidae species namely *Bactrocera curvipennis*, *Bactrocera dorsalis*, *Bactrocera psidii*, *Bactrocera tryoni*, *Bactrocera umbrosa*, *Bactrocera zonata*, *Ceratitis capitata*, *Ceratitis catoirii*, *Ceratitis quilicii*, *Dacus ciliatus*, *Dacus demmerezi*, *Neoceratitis cyanescens*, and *Zeugodacus cucurbitae*. Manual curation allowed us to annotate 60 to 80 OR transcripts per species, including the obligatory coreceptor *Orco*. Thanks to this study we report 762 new candidate OR sequences in these fruit fly species. Differential expression analyses were performed between antennae and maxillary palps, revealing that most ORs were expressed only in one of the two organs, with no difference between sexes. A constructed phylogenetic tree indicated that OR diversity matched the species taxonomy but several ORs were specific to polyphagous species regardless of phylogeny. This work not only pinpoints interesting ORs for further functional studies, but also provides master resources for the Tephritidae scientific community.

**KEYWORDS:** Odorant receptors, fruit flies, RNAseq, molecular phylogeny, differential expression

### Interspecific competition between *Bactrocera zonata* and *Ceratitis capitata*: Which mechanisms mediate larval interactions within the fruit

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The fruit fly family (Diptera: Tephritidae) is diverse and includes many pests. Some species of the genus *Bactrocera*, originating in Southeast Asia, are expanding globally in the last decade. Their establishment in new areas often involves interactions with local fruit fly species developing in the same fruit. Thus, interspecific competition for reproductive resources and development is a vital aspect of the invasion biology of these flies. This study explores competition mechanisms between the Mediterranean fruit fly (*Ceratitis capitata*) - an established species, and the peach fly (*Bactrocera zonata*) - an invasive species, both occurring in Israel. We examine larval interactions in controlled conditions with three fruit- based diets (mango/guava/cherry) at 20 C/30 C, and at different larval hatching orders. Initial results suggest that in mango diet at 30 C *B. zonata* survival rate is overall higher than that of *C. capitata*. When medfly larvae compete against one day older peach fly larvae their survival rate decreased. Additionally, development time was found to be shorter for both flies when larvae developed alone, but prolonged when developing together, especially when heterospecifics are one day older. We suggest that *B. zonata* has an advantage over *C. capitata* at high temperatures and when oviposition occurs early in the host. Additionally, the role of hosts is important in determining the outcome of competition.

**KEYWORDS:** invasiveness, *Bactrocera*, *Ceratitis*, interspecific competition, larvae

## Diversity Of Fruit Flies (Diptera: Tephritidae) Infesting Cucurbit Crops In Maputo And Manica, Mozambique

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Studies related to fruit flies (Diptera, Tephritidae) in Mozambique are mainly focusing on sweet fruits. Despite their economic importance, fruit flies associated to vegetables were not the object of research interest for many years. In this study, we present the first overview of the diversity of fruit flies infesting the main cucurbit crops (Cucurbitales: Cucurbitaceae): pumpkin (*Cucurbita moschata*), cucumber (*Cucumis sativus*) and melon (*Cucumis melo*), in two of the major horticultural-producing provinces: Manica and Maputo. Fruits were sampled weekly, depending on availability in the field from February 2020 to August 2021 and incubated for 25 to 30 days. All data related to fruit infestation, such as quantity of pupae and emerged adults were recorded. From all reared hosts, we recorded in Manica province the emergence of seven species: *Dacus bivittatus*, *D. punctatifrons*, *D. ciliatus*, *D. frontalis*, *D. vertebratus*, *D. pamela* and *Bactrocera dorsalis*. In Maputo province, in addition to the previously mentioned species (except *D. pamela*), an additional six species were recorded: *Ceratitis cosyra*, *D. lounsburyi*, *D. africanus*, *D. mulgens*, *D. ostiofaciens* and *D. eclipsis*. In both provinces, cucumber had generally higher infestation indices and co-infestation by more than three fruit fly species. *Dacus bivittatus* was the main species infesting cucurbits in Manica province, while *Dacus ciliatus* was more abundant in Maputo province. Melon showed no fruit fly infestation during the study period. No specimens of *Zeugodacus cucurbitae* emerged from the incubated cucurbit fruits.

**KEYWORDS:** fruit flies, cucurbitaceous, infestation, Manica, Maputo.



## Fruit Fly Species Composition, Seasonality, And Fruit Infestations In Avocado Orchards In Limpopo And Mpumalanga

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### ABSTRACT

Several fruit fly species (Diptera: Tephritidae) are known to attack different types of commercially grown fruit. The economic impact includes direct yield losses and indirect losses resulting from quarantine restrictions that are imposed by importing countries. The South African avocado industry consists of 15 439 ha of commercial avocado plantings, the majority of which are situated in the Limpopo and Mpumalanga provinces. The industry is export orientated and under increasing pressure to access new markets. The avocado is known to be a poor host for the development of fruit flies. However, fruit flies can develop in the fruit under certain conditions. Various indigenous *Ceratitis* spp. and the invasive Oriental fruit fly, *Bactrocera dorsalis* (Hendel) are associated with avocado production in South Africa. Fruit flies were monitored in different avocado production areas (Limpopo and Mpumalanga) in different 'Hass' type cultivars. Five monitoring systems were used in order to trap the different fruit fly species. Fruit were inspected for the presence of fruit fly lesions during the fruiting period. High *B. dorsalis* numbers were trapped in bucket traps with Invader-Lure™ (contains methyl eugenol) in 'Maluma' orchards prior to harvest in both Limpopo and Mpumalanga. 'Maluma' was the only cultivar where fruit fly lesions were found. The data gathered are especially important in developing a systems approach (as detailed in ISPM 14, ISPM 35) that integrates different measures for pest risk management, in order to meet a predetermined level of protection. In terms of host-pest relationships, a systems approach for fruit flies is particularly attractive on avocado which is a poor host and where low fruit fly infestation levels are present.

**KEYWORDS:** Avocado, *Ceratitis*, *Bactrocera dorsalis*, Systems Approach, 'Hass'

## Detection Of Low-Density Populations Of The Mediterranean Fruit Fly

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### ABSTRACT

Early detection of invasive pests is considered of outmost importance for implementing successful eradication or containment campaigns. Several biological, technical and strategic aspects may affect early detection of invasive fruit flies (Diptera: Tephritidae). These include propagule pressure, population growth rates in a "hostile" environment, performance of the trapping system considered as well as deployment of trapping networks and strategic execution of sampling schemes. In the framework of the Horizon 2020-funded project FF-IPM, and using *Ceratitis capitata* as model pest we performed novel release recapture studies to understand some of the biological and environmental factors that determine detection success. Both wildish males and females, subjected to different thermal acclimation treatments were used. As detection tool in all trials, we considered a trapping point with a combination of two trapping systems a plastic McPhail trap baited with ammonium acetate, putrescine and trimethylamine, and a Jackson trap with trimedlure. Our data highlight the complexity of factors involved in detecting low populations of *C. capitata*. Under a random invasion event scenario and considering a trapping network of five trapping stations/km<sup>2</sup> the detection efficacy was <1%. The probability of detecting a male was by far higher than female. However, females seem to remain for longer periods of time in a specific area. Thermal history of released adults, ambient temperature, the trapping system used and the existence of host trees are all related with detection efficacy.

The importance of our findings towards developing novel detection approaches for *C. capitata* and other tephritids is discussed.

**KEYWORDS:** medfly, alle effect, propagule pressure, establishment, Tephritidae.

## An Ecoinformatic Approach To Hierarchize Multiscale Environmental Effects On The Annual Onset Of *B. Dorsalis* Population Growth In Senegalese Orchards

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### ABSTRACT

Understanding the interactions between pest population dynamics and the heterogeneity of the agro-ecological landscape is necessary to implement effective pest management programmes, but remains challenging as it generally requires large amounts of data and their integration into multi-scale and spatio-temporal analysis frameworks. We developed a machine learning-based ecoinformatics approach to unravel the multi-scale environmental conditions that lead to early orchard re-infestation by *Bactrocera dorsalis*, a major pest of mango crops in Senegal. We first applied this approach to abundance time series collected between 2012 and 2014 in 65 orchards in the Niayes (~900 km<sup>2</sup>), one of the main Senegalese mango production basins. We found that temperature, humidity and landscape features, were the main factors explaining the spatio-temporal variability in the onset of annual *B. dorsalis* population growth in orchards. These results suggest that favourable microclimates provide refuges for the survival of small populations during the mango off-season, thus favouring the rapid re-infestation of neighbouring orchards the following season. This analytical framework is currently being applied to 2022-2023 abundance time-series from 56 orchards monitored in two environmentally-contrasted Senegalese mango production basins, namely Niayes and Basse-Casamance (~2000-3000 km<sup>2</sup> each), in order to better capture the environmental heterogeneity within and between basins. The joint results of these multi-scale analyses will allow further understanding of the ecological processes underlying the annual re-infestation of mango orchards by *B. dorsalis*, and thus help to define collective management actions, for example by prioritising the surveillance and preventive control measures in refuge areas during the mango off-season.

**KEYWORDS:** population dynamics, environment, ecoinformatics, *Bactrocera dorsalis*, mango crop

# 5<sup>TH</sup> TEAM MEETING

15 - 18 April 2024

Maritim Crystals Beach Hotel, Belle Mare,  
Republic of Mauritius

**ABSTRACT TUESDAY 16 APRIL**

**PLENARY 2: DELATTE, HELENE**

**Ecological and Genomic Investigations on the expansion of the invasive  
*Bactrocera dorsalis*: Insights into the Indian Ocean Islands**

**GENETICS AND TAXONOMY**



## Contrasts In Temporal Genetic Variation Of *Ceratitis Capitata* In Europe

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### ABSTRACT

The Mediterranean fruit fly (*Ceratitis capitata*) is a pest species of major concern in the fruit trade which has exhibited a large range expansion from Africa into Europe and other continents worldwide. Its phylogeography has been studied intensely and historical invasion pathways have been pin-pointed. Less is known about genetic variation on a temporal level. In European populations, we report changes in genetic composition over time linked to different demographic histories. Using whole genome sequencing and samples over four seasons within two years, we assess changes in genetic variation in populations that represent core (Italy), marginal (Croatia) or transient satellite populations (Austria). We present evidence of annual variation in genetic structure of natural populations in multiple locations including core and, more strongly, in marginal populations. For some there may be historically documented events being the cause of the observed spatial patterns of variation such as the Sterile Insect Technique (SIT) application in the Neretva valley (Opuzen, Croatia) starting in 2011, possibly resulting in a suppression of local population followed by shifts in the dominant genotype. In other cases, the cause of this annual variation is less obvious. The strong annual fluctuations in genetic composition of the studied satellite population could possibly be related to accidental, recurrent import of medflies through infested fruit. Conversely, results suggest the presence of a relatively homogeneous genotype in the whole of the Mediterranean basin with a moderate level of spatial genetic structuring. A better understanding of variation present in the surrounding matrix of focal populations could shed more light on local scale gene exchange and source-sink dynamics over time, ultimately providing us with a better insight of local population dynamics.

**KEYWORDS:** medfly, population genetics, WGS, demographic history

## Differential Dysregulation Of The Transcriptomic Profiles Of *Bactrocera Dorsalis* By Its Parasitoids

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Molecular mechanisms driving pest-parasitoid interactions are key to understanding pest defense against the natural enemies, thus, contributing to effective pest management. However, for the devastating horticultural pest, *Bactrocera dorsalis*, little is known about the mechanisms mediating its defense and/or susceptibility to parasitoids. Hence, this study employed transcriptomic sequencing to unravel the gene regulation profiles of *B. dorsalis* post- parasitisation by the virulent wasp, *Diachasmimorpha longicaudata* and the avirulent counterpart, *Psytalia cosyrae*.

We found that defense against *P. cosyrae* is mediated by the antipathogenic toll and immune deficiency pathways via activation of genes such as cecropin, attacin, and C-type lectin. Parasitisation by *P. cosyrae* also upregulated genes promoting cell activity (e.g., ras-related protein Rac1) and melanotic encapsulation (e.g., phenoloxidase-activating factor3), pathways that likely contribute to *B. dorsalis*' defense against this parasitoid. Conversely, parasitisation by *D. longicaudata* led to the suppression of host defenses through down-regulation of melanisation and antimicrobial peptides (e.g., lysozymes) coupled with the upregulation of genes promoting cell death and those inhibiting cell spreading. It is, therefore, plausible that it is the dysregulation of these pathways that facilitates the evasion of *B. dorsalis* immune defenses by *D. longicaudata*. Furthermore, genes regulating anti-viral and stress responses in *B. dorsalis* larvae parasitized by both parasitoids also identified.

The findings of this study provide insights into the previously unknown molecular pathways regulating host-parasitoid interactions and the role of anti-microbial defenses and regulation of cellular activity in the defense/susceptibility of *B. dorsalis* to parasitoid wasps.

**KEYWORDS:** Tephritid, Immunity, *Diachasmimorpha longicaudata*, *Psytalia cosyrae*, gene expression



## A new empirical key for the identification of fruit fly larvae intercepted in the EU

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Larvae of fruit flies (Diptera: Tephritidae) are among the most frequently encountered harmful arthropods during inspection of imported fruits and vegetables in Europe. Regulation (EU) 2021/2285 greatly expanded the list of quarantine fruit flies for the European Union, which now includes 75 taxa (species and genera) whose introduction must be prevented.

Whereas under the previous legislation the National Reference Laboratories (NRL) in the member states could report all exotic flies as “non-EU Tephritidae”, they must now identify them at the species or genus level. This is not an easy task, as only exist few diagnostic protocols exist, especially for larvae. Reference specimens and DNA sequence records in databases are also lacking for most of the listed taxa. In an effort to tackle this issue, the EURL staff collected real data on interceptions over the past three decades and reanalysed “non-EU Tephritidae” larval specimens using both morphological and molecular methods. The goal was to build a clear and comprehensive picture of the Tephritidae taxa actually intercepted in the EU and their respective import pathways (origin-host plant association). Collected data showed that few taxa have been intercepted over time and that most of them can be identified morphologically, provided that pathways are known. A simplified dichotomous key was developed for the rapid morphological identification of third instar larvae intercepted at the EU points of entry. A first hands-on training for NRL staff on the use of this key, including the preparation of specimens for slide mounting, was organised in 2023 in the EURL facilities.

**KEYWORDS:** plant health, quarantine fruit flies, import control, larvae identification, morphology

## Origin Of *Bactrocera Dorsalis* Incursions In France : A Global Survey Reveals Multiple Sources

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### ABSTRACT

A systematic and comprehensive approach has been implemented to determine the geographical origin of the increasing number of specimens of the Oriental fruit fly *Bactrocera dorsalis* (Hendel, 1912) trapped on the French mainland territory. Whereas the surveillance and trapping plan managed in France by the French Ministry of agriculture allowed to catch 143 Methyl-Eugenol-attracted specimens between 2019 and 2022, we established and coordinated a network of collaborators in 31 countries and French overseas territories that allowed us to sample significantly both native and other invaded areas (68 populations). All 2,082 individuals were identified carefully to species level and genotyped using an adapted RAD-capture protocol with specific probes to generate high-quality and informative SNPs (Single Nucleotide Polymorphisms). The genetic variation within and across 59 populations successfully genotyped has been assessed with  $F_{ST}$  (Fixation index) and visualised through a Principal Component Analysis. Together with the use of the ADMIXTURE software, this methodology described eleven distinct genetic groups. When assigned to these groups with a Support vector machine method, the incursion individuals trapped in France could be linked with confidence to North and West Africa (76%), continental Asia (11%) and La Réunion island (4%). When cross-referenced with interception data at import, our results would allow to refine surveillance towards certain imported commodities and exporting countries, and would increase relevance of establishment risk assessment studies. Including incursion samples from other countries would strengthen the European Union's ability to mitigate related threats to agriculture and biodiversity.

**KEYWORDS:** Oriental fruit fly, RAD-capture, genetic structure, invasive pest, risk assessment

**Novel female attractant for *Bactrocera dorsalis* and *Zeugodacus cucurbitae* -  
An effective female lure for major fruit fly species of economic importance**

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This study assesses the efficacy of the specialized female attractant, Biodelear, for controlling *Bactrocera dorsalis* (oriental fruit fly) and economically important *Bactrocera cucurbitae* (cucurbit fruit fly). Biodelear has previously shown effectiveness against *Ceratitis capitata* (Medfly) and *Bactrocera oleae* (Olive fly). The research, conducted from September to December 2023, involved three half-hectare plots for each species, each equipped with 50 McPhail traps loaded with 17 g of Biodelear. Comparative analysis included one plot with traps using a hydrolyzed protein lure and one conventional plot treated with insecticides as controls. Results indicate that Biodelear effectively attracts female fruit flies and leads to a significant reduction in *B. dorsalis* and *B. cucurbitae* populations compared to standard insecticide control. Fruits in Biodelear-treated plots showed lower infestation rates and reduced crop damage, making Biodelear an encouraging and cost-effective alternative to other commercially available lures. These initial findings strongly suggest that the Biodelear attractant can be used for mass trapping of the oriental fruit fly, *B. dorsalis*, and cucurbit fruit fly, *B. cucurbitae*, utilizing the novel attractant. The results are particularly encouraging due to the lower cost and negligible toxicity of Biodelear compared to other commercially available lures.

**KEYWORDS:** Female fruit fly attractant, Biodelear, *Bactrocera dorsalis*, *Bactrocera cucurbitae*,

## Using Different Traps And Attractants For Monitoring And Mass Trapping Ceratitis Capitata In An Aw- Ip Management In Israel

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*Ceratit*s capitata Wiedeman (MedFly) is one of the key pests of fruits in Israel. As part of AW-IPM activities against MedFly in the cultivated hosts' orchards, covering 8,000 hectares in Israel, we used males' traps (with Trimadlure as attractants) and females monitoring traps, where in a comparison between two different female attractance ("Biolor" & "Toptrap"), we found they differ in their attractance efficiency.

To streamline and refine monitoring, two automatic transmitter traps were tested ("Agrinet" and "Scare-Crew") and compared with traditional traps. The results were very good and enabled a transition to future technologies.

For mass trapping (instead of areal spray) different baits with different devices were examined over the years and differences were found in the attractiveness of the different traps. TopTrap (Sedec, Rimi Ltd.), Cera Trap (Bioiberica, Gadotagro Ltd.), Luretect (Ronpal, Adama-Agan), NMF (Bio-Bee) and Freedome (Biofeed). Device type for mass trapping was selected according to the host and the environmental conditions, emphasizing the usage of suitable monitoring device type. Two key factors that make it the most efficient: Using the same trap throughout a large area, and with a continuity over period of years.

After ten years' experience in implementing regional pest control for the MedFly, we can conclude a successful significant reduction in chemical pesticide treatments without any increase of fruit damages, even though Medfly populations are still high and there is a multiplicity of hosts.

**KEYWORDS:** *Ceratit*s capitata Wiedeman, MedFly, Mass trapping, attract and kill, automatic monitoring traps.ression

## Utilizing electronic traps for early detection of *Bactrocera dorsalis* (Diptera: Tephritidae) in South Africa

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### ABSTRACT

*Bactrocera dorsalis* (Diptera: Tephritidae) was declared present in the northern and north eastern areas of South Africa in 2013. The pest still has a restricted distribution in South Africa, being absent in the western and most of the south eastern parts. Monitoring for early detection of *B. dorsalis* in pest free areas in South Africa is routinely carried out. Conventionally, *B. dorsalis* populations have been monitored using ME (Methyl Eugenol) in bucket traps containing a toxicant strip (Conventional Trap). Traps are checked manually at specified intervals. Recently a McPhail type electronic trap (E-Trap) with a yellow sticky pad (to retain flies), a camera and a network device for image relay was developed to enable remote monitoring of *B. dorsalis* populations. The study aimed to assess the comparative efficacy of the E-trap and the conventional trap as early detection tools for *B. dorsalis*. The conventional trap and E-trap were compared in two locations (Schoemanskloof and Ermelo) in Mpumalanga Province, South Africa.

At Schoemanskloof 11 conventional traps and three E-traps were placed across 459 ha and at Ermelo seven conventional traps and six E-traps were placed across 1709.69 ha. In each area, traps were at least 1 km apart. The trapping systems were monitored over 16 months (November 2022 - February 2024). Conventional traps were checked fortnightly and E-trap images were checked daily. The first incursions of *B. dorsalis* in 2023 was detected by the Conventional trap in Schoemanskloof (2023/01/10; average flies/trap/day = 0.1) and by the E-trap in Ermelo (2023/01/10; average flies/trap/day = 0.006). The first incursions of *B. dorsalis* in 2024 were detected by Conventional traps in Ermelo (2024/01/18; average flies/trap/day = 0.004) and Schoemanskloof (2024/01/24; average flies/trap/day = 0.008). This suggests that conventional traps may be more reliable for early detection, but the number of traps and trap placement may also play an important role in *B. dorsalis* detection.

**KEYWORDS:** *Bactrocera dorsalis*, electronic-trap, detection, South Africa, Tephritidae

## Does The Reproductive Status Of The Mexican Fruit Fly Affect Its Response To Traps?

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### ABSTRACT

Monitoring of pest tephritid flies through baited traps is key to the successful implementation of area-wide integrated pest management. However, the physiological state of a female can impact her response to traps, either through diet, previous exposure to baits, stage of sexual development or mating status. Here, we explored how mating with sterile or wild Mexican fruit fly males, *Anastrepha ludens*, affected female response to traps, and how different components of the ejaculate modified female visitation. Mated females change their olfactory behavior when they receive an ejaculate with all the components which include male seminal fluid proteins and sperm. Recent proteomic studies suggest that a change in olfactory memory may also be involved in postmating changes. We found in field cage experiments, that when females mated with sterile males, they were slower to visit Multilure traps baited with Ceratrap as opposed to females mating with wild males. Furthermore, unmated females were also slower to visit traps compared to females that had only received male seminal fluid proteins, but not sperm, by mating with testectomized males. Sterile males transfer lower quantities of sperm than wild males. Thus, both these results suggest that sperm in the ejaculate may play some role in promoting female visitation to food-based traps. A better understanding of how female physiology affects response to traps can aid monitoring efforts during sterile insect release, population modelling, and can give us insight into making traps more efficient or tailoring them to a particular subset of the pest population.

**KEYWORDS:** Behaviour, sterile males, mating, traps



## Trapping Of The Afrotropical Fauna Of The Dacini: Dacus Fabricius In Botswana

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The sustainable management of fruit flies of economic importance is mainly reliant upon accurate detection of the fruit fly species. A synopsis on the current knowledge of the trapping of the Dacus Fabricius fruit flies in Botswana- where the cultivation of Cucurbitaceae is affected by the oviposition activity of the female Dacus species is discussed. A total of 10 fruit fly species occur in different districts of the country, all of which belong to the Dacinae subfamily and genus Dacus; Dacus bivittatus (Bigot, 1858); Dacus frontalis Becker, 1922; Dacus fuscatus Wiedemann, 1819; Dacus vertebratus Bezzi, 1908; Dacus ciliatus Loew, 1862; Dacus rufus Bezzi, 1915; Dacus kariba Hancock, 1985; Dacus famona Hancock, 1985; Dacus bistrigulatus Bezzi, 1908; Dacus siliqualactis Munro, 1939; genus Bactrocera; Bactrocera dorsalis (Hendel, 1912) Fruit fly trapping was done using para-pheromone (Methyl Eugenol, Pumpkin Fruit Fly Pherolure and 3- Component Pherolure (3C) and with Dichlorvos 20% W/W (DDVP) strip (insecticide)) -baited Chempac<sup>®</sup> fruit fly traps during 2016-2018. The Geographic coordinates were recorded using a Garmin etrex<sup>®</sup> receiver throughout the trap network. The main afrotropical species of fruit fly caught in the Methyl Eugenol pherolure trap were the Dacus species. Dacus ciliatus was detected in the Pumpkin Fruit fly Pherolure trap. Dacus ciliatus and Dacus vertebratus were abundant, whereas the other species were less prevalent.

**KEYWORDS:** Trapping, Afrotropical, Dacus, para-pheromone, Cucurbitaceae

## Field Evaluation Of The Attractiveness Of Zingerone And Cuelure On The Main *Dacus* (Diptera: Tephritidae) Species In Mozambique

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Synthetic lures are a vital component of fruit fly (Diptera: Tephritidae) surveillance programs and targeted management of their incursions. Depending on the species, knowing the right lure can greatly improve its detection and management. We compared the efficacy of zingerone, against cuelure, in attracting *Dacus* fruit flies at ten trapping sites in low (Maputo province) and medium (Manica province) altitude regions. From February 2020 to August 2021, traps were monitored once a week. In both locations, the three most abundant *Dacus* species trapped were *D. bivittatus*, *D. punctatifrons* and *D. frontalis* with higher relative abundance of *D. frontalis* (37%) in Maputo while in Manica *D. bivittatus* had highest captures (79.15%). When comparing the number of *Dacus* species captured, zingerone tended to capture a greater diversity of fruit flies (20 species) than cuelure (18 species). In Maputo as well as in Manica, cuelure attracted significantly more *D. bivittatus* (69% and 79.7% respectively), followed by *D. punctatifrons* (16% and 87%, respectively), while zingerone was significantly more attractive to *D. frontalis* (77% and 60.8%, respectively). Neither cuelure nor zingerone was effective in attracting *D. ciliatus*, which is a challenge for the country since this is the most cucurbit infesting fruit fly species in Maputo province. These results may confirm previous discussions on the zingerone attracting fruit flies responding to cuelure as well as other lures such as methyl eugenol, suggesting, therefore, a complementarity between the two lures.

**KEYWORDS:** fruit flies, cucurbits, attractiveness, lures, Mozambique

## Host-Symbiont-Parasitoid Tripartite Interaction: A Case Of *Bactrocera Dorsalis* And Its Associated Natural Enemies

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It is commonly known that host-symbiont-parasitoid interactions influence the management of the target pest. Nevertheless, little is known about the *Bactrocera dorsalis*-symbiont-parasitoid system. We employed 16S-rRNA sequencing to investigate the bacteriome of *Diachasmimorpha longicaudata* and *Psytalia cosyrae* and the effect of parasitisation on the bacteriome of *B. dorsalis*. The potential synergy between symbiont and biocontrol agents was also investigated. Parasitism by *D. longicaudata* and *P. cosyrae* induced perturbations in the microbiome of *B. dorsalis*, though this was more pronounced in the former species. The bacteriome of *B. dorsalis* larvae shifted from sugar-digesting bacteria (e.g. *Acetobacter*) dominance to more pathogenic ones (e.g. *Stenotrophomonas*). Following parasitisation, some bacteria were found to be shared between the host and the parasitoids, suggesting horizontal-symbiont transfer from the parasitoids to the host. *Arsenophonus nasoniae* was the most abundant bacterium in *P. cosyrae*. While this symbiont is known for its male-killing trait, its effects on *P. cosyrae* are yet to be unravelled. Additionally, some *B. dorsalis*-associated symbionts influenced the efficacy of this pest's biocontrol agents. For example, *Lactococcus lactis*, increased the susceptibility of the pest to the biocontrol agents (*D. longicaudata*, *Fopius arisanus*, *Metarhizium anisopliae*). This symbiont-mediated-synergism could be attributed to down regulation of the defence responses of *B. dorsalis*.

Our findings present the first report of the parasitism-induced gut-perturbations in *B. dorsalis* revealing host-gut-homeostasis as a possible driver of parasitoid virulence. The impacts of symbionts on the efficacy of biocontrol agents of *B. dorsalis* and their possible integration in the management of this pest is also discussed.

**KEYWORDS:** Gut microbiome; Parasitoids; Symbiotic bacteria; Tephritid; Biological control

## Suitable areas for establishment of *Bactrocera dorsalis* (Diptera: Tephritidae) and its parasitoid *Diachasmimorpha longicaudata* (Hymenoptera: Braconidae): Implications for effective field releases in classical biological control

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### ABSTRACT

The spread and establishment of invasive species in new environments are increasing worldwide at an unprecedented rate due to human activities and climate change. These species always arrive in new habitats without their co-evolved natural enemies, posing a serious threat to crop production. This was the case with the oriental fruit fly, *Bactrocera dorsalis*, that invaded the African continent in 2003. The invasion of this pest caused massive economic losses due to direct damage to fruits and vegetables and quarantine restrictions on African produce imposed by importing countries. In this regard, the International Centre of Insect Physiology and Ecology (icipe), initiated classical biological control against this pest. The endoparasitoid *Diachasmimorpha longicaudata* was imported from Hawaii to control *B. dorsalis* in Africa. In this study, we predicted the suitable areas for *B. dorsalis* and *D. longicaudata* establishment under current and future climate scenarios to guide the effective field releases of the parasitoid for classical biological control against the pest. The model showed that suitable areas for *B. dorsalis* under the current scenario are largely confined to sub-Saharan Africa, South America, and Southeast Asia, and that of *D. longicaudata* are confined within the same localities that are suitable for *B. dorsalis*. Under future climatic conditions, an expansion in suitable areas for *B. dorsalis* is expected, especially in Southern Africa. Fortunately, the parasitoid will be able to follow the range expansion of *B. dorsalis* in the future. The outcome of this study provides vital information to guide the release of *D. longicaudata* in Africa and other similar ecologies for classical biological control of *B. dorsalis* and other closely related *Bactrocera* species.

**KEYWORDS:** Larval parasitoid, fruit fly, climate change, integrated pest management, ILCYM.

## Preliminary Inventory Of Natural Enemies Associated With Fruit Flies In Mauritius

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### ABSTRACT

The Tephritid fruit flies are a major pest worldwide, causing severe economic losses. The study aimed to identify the diversity of natural enemies (parasitoids) of fruit flies and was conducted in two different climatic zones in Mauritius namely humid and sub humid. An inventory of parasitoids associated with fruit flies in mango, guava and Indian almond was undertaken from 2020 to 2022. The collected fruits were incubated on a layer of sand in a tray covered with muslin cloth. Only one species of fruit fly, *Bactrocera dorsalis* (Diptera: Tephritidae), emerged from all fruits collected. Two species of tephritid parasitoids recovered belonged to two families namely Braconidae and Eulophidae. *Fopius arisanus*, (Hymenoptera: Braconidae) was the most abundant parasitoid (97.6 %) while *Tetrastichus giffardianus* Silvestri (Hymenoptera: Eulophidae) was the least abundant (2.4 %). The parasitism was highest in Indian almond (78.2 %) followed by guavas (15.2 %) and mangoes (6.6 %). Indian almond fruits were found to be a major host for *B. dorsalis* and parasitoids, *F. arisanus*. This inventory of tephritid parasitoids in Mauritius provides critical baseline data for biological control efforts in the future.

**KEYWORDS:** Tephritid, fruit flies, parasitoids, biological control

## Testing options for the control of cucumber fruit flies in Nigeria

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### ABSTRACT

Cucumber production has been in the increase over the years in Nigeria. However, one of the major constraints in its production is the infestation of cucumber fruits by fruit flies. To minimise fruit fly damage and increase marketable yields, control options were tested. Cucumber variety "Market Moore" was plated in two successive cropping seasons at the National Horticultural Research Institute (NIHORT) in Ibadan, South West Nigeria (7° 22'36.24 N and 3° 56'23.22 E). The treatments included: i. staking ii GF-120 (Success Appat) spray at the rate of 1.5L/ha iii combination of staking + GF 120 spray iv. the control with no treatment. The first crop was planted 21 July 2023, while the second crop was planted in 18 August 2023, Each crop received the same treatment. Application of GF-120 was done at 2 week intervals starting from tender (non-mature) fruit stage till maturity. A total of three applications were made. Torula yeast traps were placed in all the treatment plots and the control to monitor fruit fly populations. The field was laid out in a randomised complete block design. Five fruits were sampled at randomly per plot at harvest in two harvest regimes; totalling ten fruits per plot. These were cultured in the laboratory to allow for the emergence of adult fruit flies used to authenticate the damaging species and to determine the level of damage in each treatment plot. The results showed that four species of fruit flies were prominently recorded. They included *Zeugodacus cucurbitae*, *Dacus bivittatus* *D. ciliatus* and *D. punctatifrons*; with *Z. cucurbitae* dominating. The mean number of fruit flies captured in the traps were significantly ( $P < 0.05$ ) higher in the the control compared to the sprayed and staked + sprayed plots. The mean number and mean weight of marketable fruits were higher in the staked and treated plots than all the other treatment plots . However, this was only significantly ( $P < 0.005$ ) higher than the control. The mean number of externally observed damaged fruits was higher in the control plots than other treatment plots; although it was not significantly ( $P > 0.005$ ) different in both the first and second crops. Incubated harvested fruit samples also followed the same trend; with fruits of the control plots recording higher mean number of emerging fruit flies than the other treatment plots. In conclusion, plots having the combination of staking and Gf-120 spray gave higher fruit fly control and marketable cucumber fruit yield than the other treatment plots but this was only significantly ( $P < 0.05$ ) different from the control. Plots with only GF-120 spray had less damaged fruits but was not significantly different from staked or control plots.

**KEYWORDS:** *Dacus bivittatus*, *Dacus ciliatus*, *D. punctatifrons*, *Zeugodacus cucurbitae*, Nigeria

## Effect of compost and biochar on entomopathogenic nematode fruit fly control efficacy and persistence in mango orchards in northern Benin

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The control of agricultural pests by entomopathogenic nematodes (EPNs) is affected by environmental conditions, especially drought. To overcome this issue, semi-field and field experiments were conducted, respectively, in a greenhouse and two mango (var. Eldon) orchards naturally infested with mango fruit flies in the northern part of Benin. The experiments were set up to evaluate the protective effect of EPNs by compost and biochar for the control of fruit flies in the greenhouse and on the persistence of the nematodes in the orchards. In the greenhouse, two nematode isolates i.e. 168d (*Steinernema kandii*) and 9a (*Heterorhabditis taysearae*) were formulated in compost, biochar and the combinations of the two and applied. Control treatments comprised the nematodes alone or treatment without nematodes. The populations of fruit fly (*Bactrocera dorsalis*) larvae, pupae and adults were evaluated 17, 18 et 19 days following the experimental set up. Prior to setting up the field experiment, the initial infestation levels of the orchards by mango fruit flies and the diversity of soil organisms were evaluated. Five naturally infested mango fruits were randomly collected on the ground under the canopy of each of 20 mango trees selected for the experiment in each village. The fruits were incubated under greenhouse conditions for 35 and 30 days, respectively. Hundred grams of soil samples collected from the same mango canopies were used to extract and identify prevailing living organisms. For the nematode persistence experiment, four treatments replicated each five times were applied in each orchard under the canopies of the 20 selected trees: 100% compost + nematodes, 75% biochar + 25% compost + nematodes, sterilized soil + nematodes, control (no nematode, compost and biochar applied). The treatments were applied on 3m x 2m weeded areas at the rate of 2kg under each mango tree. Inside each cage were placed five naturally infested mangoes and torula solution trap in the middle of the treated areas. Cages 2m x 1m x 1m were used to capture fruit flies that emerged from infested mango fruits. In the greenhouse, the results indicated that the nematodes were able to significantly reduce the populations of larvae and pupae of the pest, preventing them to reach the adult stage. *H. taysearae* was more efficient than *S. kandii*. 100% compost and 75% biochar + 25% compost were the best substrates protecting the nematodes in the formulations. In the orchards, three species of insects were observed: *Bactrocera dorsalis* (the most abundant), *Ceratitis cosyra* and the parasitoid *Fopius arisanus*. Korobororou was most infested than Tchatchou by *B. dorsalis* and *C. cosyra*. Ten types of living organisms were extracted. The most populated organisms were earthworms and ants observed in all treatments at pre- and posttreatment applications. For most of the treatments, living organisms' population densities decreased following application of the different treatments. The persistence of nematodes varied with the applied treatments and with the experimental sites. Three months after treatments' application, a decrease in nematode population density was observed for all treatments but less in 100% compost outside and inside the cages than in 75% biochar + 25% compost and in the control treatment. The perspective of this study is to develop efficient, environmentally-free and sustainable mango fruit fly by using EPNs.

**KEYWORDS:** Benin, biological control, fruit fly, mango, soil organism



## Current Status Of The Oriental Fruit Fly, *Bactrocera Dorsalis* (Hendel) (Diptera: Tephritidae) Presence In South Africa

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### ABSTRACT

The Oriental fruit fly, *Bactrocera dorsalis* is one of the world's most destructive horticultural pests. It is of Asian origin and was first detected in continental Africa at the Kenyan coast in 2003. In 2006, the South African National Plant Protection Organization (NPPO) started a surveillance program to detect exotic fruit flies. The NPPO, together with various role players in the fruit industry, put together a steering committee to ensure appropriate contingency and a pest specific action plan for *B. dorsalis*. In 2010, *B. dorsalis* was detected in the northern part of the country. Affected areas were quarantined, delimited, and eradicated. Re-incursions appeared after one year of no detection and eradication actions were repeated. By 2013, eradication could no longer be achieved in the northeastern parts of South Africa. In 2015, *B. dorsalis* was declared present in various district municipalities of the Limpopo, North-West, Mpumalanga, Gauteng, and KwaZulu-Natal provinces. The Northern, Western and Eastern Cape, and the Free State Provinces remained pest free. Although isolated incursions were detected in pest free areas, they were successfully eradicated by cooperation between the public and private sectors. The status of *B. dorsalis* in one area in the Eastern Cape, the Sunday River Valley was changed from absent to present at low prevalence in 2021. Control measures for *B. dorsalis* in South Africa are Regulation 110 of the Agricultural Pests Act 36 of 1983, restricting the movement of affected host material to pest free areas. National surveillance continues for exotic fruit flies. Suppression measures for *B. dorsalis* in infested areas and corrective measures are applied in cases of noncompliance.

**KEYWORDS:** Oriental fruit fly, *Bactrocera dorsalis*, Pest Free Area, Tephritidae

## Monitoring Exotic Tephritidae : Results From Official Surveillance Surveys In France

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### ABSTRACT

In Europe, the list of quarantine fruit flies (Diptera : Tephritidae) includes 75 taxa whose introduction and spread over the EU territory must be promptly detected and prevented. In this list, two species of *Bactrocera*, *B. dorsalis* and *B. zonata*, are considered as priority pests, meaning that member states are required to carry out annual surveys to detect their presence on their territory.

In France, the official surveillance targeting these priority pests consists of a network of methyl eugenol traps combined with visual inspections. The intensity of the surveillance is adapted across administrative regions according to a risk analysis that considers climatic conditions, the vicinity of points of entry and potential host plants.

In the last five years, adults of four exotic *Bactrocera* species have been found occasionally or repeatedly: *B. dorsalis*, *B. zonata*, *B. correcta* and *B. latifrons*. Most trapping events occurred around Paris, but also in four more regions. However, no fruits infested with larvae of exotic Tephritidae were found yet and therefore no establishment is formally documented. These findings are thus considered as incursions related to the entry of infested exotic fruits, rather than outbreaks.

Larval sampling targeting exotic Tephritidae confirmed the significant expansion and growing threat of *Ceratitis capitata* in France. The species is well present in the northern part of the country and is shown to affect some unusual crops. Official surveillance also revealed the presence of an unexpected species of Muscidae, *Atherigona orientalis*, on peppers in southern France.

**KEYWORDS :** France, quarantine fruit flies, official surveillance, invasive species, priority pests

## Defining Areas Of Low Prevalence For Fruit Fly (Diptera: Tephritidae) Pests

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### ABSTRACT

Areas of low fruit fly prevalence may form part of a systems approach for fruit fly pest risk management in fruit commodities. Fruit fly prevalence levels are determined by catches in attractant-based traps. Trap catches that define levels of low prevalence (trap thresholds) should be established in relation to fruit fly infestation risk. A study was conducted in South Africa and Mozambique to determine trap thresholds for fruit flies by establishing a relationship between trap catches and infestation. Fruit fly pests studied were *Ceratitis capitata* and *Bactrocera dorsalis*. Surveys were conducted, over two years, in selected commercial orchards of mandarin, orange, avocado, litchi, nectarine, plum and mango to record fruit fly trap catches at least four weeks before harvest and fruit fly infestation at harvest. A General Linear Model was used to relate probability of infestation at harvest with weeks before harvest and trap catches. Model performances were determined using existing trap thresholds on citrus. Fruit fly infestation was only recorded, albeit low, on mandarin, litchi and mango. Model parameter estimates could only be obtained for mandarin. On mandarin, *C. capitata* was the only species reared from infested fruit. Significant relationships, as determined by Wald's tests, between catches of *C. capitata* (males and females) and fruit fly infestation were found. For two attractants- Capilure (male lure) and Questlure (protein hydrolysate), these relationships were significant in the four to 12 weeks before harvest. All models had high specificity scores in predicting no infestation but had low sensitivity scores in prediction infestation.

**KEYWORDS:** trap threshold, fruit infestation risk

## ECOWAS R4D Vision, Strategies and Intervention Methodology : case study on cross- border pest fruit flies

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### ABSTRACT

Strategic objective no. 2 of the ECOWAS agricultural policy (ECOWAP), is to "Promote contractual, inclusive and competitive agricultural and agri-food value chains oriented towards regional and international demand". In this context, the Horticultural sector in West Africa remains a privileged sector. But since 2008 the sector has been facing a major problem: Fruit Flies. They destroy 50 to 80% of fruit production and a financial loss estimated at around 9 million euros in 2016.

In this context, ECOWAS has initiated in 2016 a regional plan for the control of Fruit Flies in West Africa. A second 4-year phase of the implementation of the plan entitled "Innovative Regional Fruit Fly Control System in West Africa - SyRIMAO" started from 2020. The big question is how to make external technologies more relevant, easier to evaluate, and more accessible to local contexts and needs and supported by private actors so that they can be adopted sustainably and by a large majority? As part of this phase, ECOWAS experiment the methodology for implementing its Research for Development (R4D) vision aiming to establish close links between research, innovation, training, and development which will result in a real adoption by producers of effective and environmentally friendly prevention and control practices against transboundary pests. Two strategies/methodologies were deployed to implement this vision: i) Strengthening regional and national research systems and their coordination so that they can provide producers with efficient control techniques with low environmental impact; ii) develop technologies and disseminate at large-scale through the research for development methodology -Stakeholder Learning Group (SLG)- a participatory development approach to pest control technologies coupled with capacity building including the development of educational materials - technical sheets and videos - and the training of trainers and then producers for the sustainability of the efforts made both at orchard level that at the community level.

As result, the National Specialization Center - Fruits and Vegetables (CNS-FL) has become a Regional Center of Excellence (CRE-FL). This transformation establishes the regionalization of research programs, the existence of tools to support the sovereignty of the sub-region for rapid action in the event of pest (fruit flies) invasion and the strengthening of the capacities of National Agricultural Research Systems through the training of technicians to run national laboratories and train producers. A second important result is the development of two effective and registered fruit fly control technologies with very low environmental impact. The first formulation developed is a mass trapping strategy with an essential oil from a shrub and a trap without insecticides. The second formulation is a food attractant composed essentially of proteins obtained from plant processing by-products.

Large-scale dissemination is now the next objective, through the mass production of end-products resulting from the technologies developed, the production of didactic tools on these technologies (Farmer to Farmer videos) and the training of producers through pilot orchards.

**KEYWORDS:** West Africa, Horticultural sector, Fruit Fly control; Research, innovation, learning platform.

# 5<sup>TH</sup> TEAM MEETING

15 - 18 April 2024

Maritim Crystals Beach Hotel, Belle Mare,  
Republic of Mauritius

**ABSTRACT WEDNESDAY 17 APRIL**

**PLENARY 1: SCHELIG MARC**

Advancing SIT: Genetic breakthroughs against fruit fly pests

**MANAGEMENT TECHNIQUES: SIT**



## Genetic Sexing Strains In Support Of Sterile Insect Technique Applications: Past, Present, And Future

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### ABSTRACT

The sterile insect technique (SIT) has been used successfully in the suppression, prevention, containment, and eradication of insect pests, including tephritid species, worldwide as a component of area-wide integrated pest management (AW-IPM) programmes. It has been shown that the availability of genetic sexing strains (GSS), that allow the separation of males from females, can improve the efficiency and efficacy of the SIT application. The most successful and widely used GSS is that of the Mediterranean fruit fly (*Ceratitis capitata*), the VIENNA 8. This strain was developed through classical genetic approaches, and it required almost two decades of efforts to reach from the laboratory to the field. As there has been an increasing demand by FAO and IAEA Member States to develop and implement the SIT against other insect pest species, there is a need in developing high quality GSS in a more efficient way. In this talk, we will present the past, present, and future in the development and evaluation of GSS in support of SIT application against insect species with an emphasis on tephritid pests of the genera *Anastrepha*, *Bactrocera*, *Ceratitis*, and *Zeugodacus*. We will also present data supporting the development of a generic approach for the development of GSS in SIT-targeted insect pest species.

**KEYWORDS:** mass-rearing, irradiation, translocation, selectable marker, genome editing, quality control

## Study Of The Feasibility Of The Sterile Insect Technique Against *B. Dorsalis* In Mango Orchards In La Reunion

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### ABSTRACT

The Oriental fruit fly (*Bactrocera dorsalis*, Tephritidae) is one of the most invasive and polyphagous pests of fruits and vegetables worldwide. Since its invasion in 2017 in La Réunion, *Bactrocera dorsalis* has caused considerable damage to crops of economic importance, such as mango, and current management practices are not enough to control this pest. The Sterile Insect Technique (SIT) is a sustainable biological tool for managing fruit fly species, and this technique is under consideration to control *B. dorsalis* in La Reunion. To implement this strategy, detailed knowledge of essential bioecology parameters of the pest, such as its capacity to remate, its host range, and its dispersal, are key to the success of area-wide management programs based on the SIT. We carried out a series of experiments to investigate the mating and dispersal behaviour of *B. dorsalis*. Under laboratory conditions, we presented sterile or fertile males to virgin females. Then, we studied the capacity of males to induce a refractory period, dissected females to assess sperm transfer in the spermathecae, or tested female preference. In addition, dispersal capacity was assessed in the laboratory with flight-mill experiments and in the field with mark-release-recapture experiments. In both types of experiments, sterile flies used were from laboratory strains of *B. dorsalis* from La Réunion, reared and sterilised by the IAEA in Vienna. Our results may have important practical implications for area-wide management strategies for *B. dorsalis* and could be integrated into models for determining the number and frequency of sterile male releases.

**KEYWORDS:** SIT, Biological control, Bioecology, Mating behaviour, Dispersal behaviour.



## Improving Rearing And Control Techniques With The Integrated Use Of Sit For *Bactrocera Dorsalis*, *Bactrocera Zonata* And *Zeugodacus Cucurbitae*

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The melon fruit fly, *Bactrocera cucurbitae* (Coquillett) (Diptera: Tephritidae), is a major pest of cucurbitaceous vegetables. About 30 to 100 % losses may occur, depending on the cucurbit species and the season. The sterile insect technique is an important control tactic in area-wide integrated pest management programmes against these fruit flies of economic importance. In Mauritius, the artificial larval diet for *Bactrocera dorsalis*, *B. zonata* and *Zeugodacus cucurbitae* is composed of sugarcane bagasse (6%), ground maize (6%), cane sugar (11%), waste brewery yeast (6%), wheat bran (6%), benzoic acid (0.1%), nipagin (0.1%), hydrochloric acid (0.008%) and water (64.8%). This larval diet has many drawbacks and to overcome these problems, liquid and gel diets have emerged as promising alternatives. In this study, a liquid diet for rearing melon flies was developed. The objective of the experiment is to assess the efficacy of modified waste brewery yeast as a replacement of commercial brewery yeast in liquid and gel diets. The common variable factor will be the ratio of the % composition of modified waste brewery: commercial yeast. The experiment is designed to evaluate main (waste brewer yeast vs. commercial brewer yeast), and interactive effects (waste brewer yeast + commercial brewer yeast combinations) of the yeast sources on production and quality parameters of fruit flies (% egg hatch, % fly emergence, % pupal recovery, pupal weight and flight ability). No significant difference has been observed for pupal recovery. The pupal weight, the adult fly emergence and the proportion of fliers decreased linearly as the proportion of commercial yeast in the diet decreased. The pupal weight of individuals from diets with 15.06 % commercial yeast was on average 10.2 % higher than those from the diet with 15.06 % waste brewery yeast. The experiment shall be repeated over five generations.

**KEYWORDS:** melon flies, mass rearing, artificial liquid diet, sterile insect technique

### Concluding remarks on the 25-year rise and fall of medfly SIT in Israel

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Area-wide control of *Ceratitis capitata* using SIT is a well-established methodology that has been applied in many regions around the world. However, due to social, logistical, and economic constraints, this methodology is generally applied by large organizations such as states or national entities, and not by the end user - the farmers. In Israel, collaborating with Jordan, SIT for medfly started in the late 1990s as a pivot in the eradication program of the medfly from the hyper-arid Arava region, followed by intensive suppression programs in the north and south of the country. Among the targeted crops were citrus, mango, table grapes, apples, and other deciduous cultivars. A unique socio-economic model involving government growers and private operational entities has been used and tested for almost two decades in the country. We evaluated the effectiveness of medfly suppression in both area-wide and farm scales. Additionally, we assessed the minimal geographical unit for the application of SIT in different cultivars and climatic areas in Israel. Our findings suggest that SIT can be applied on a farm-based level and can significantly reduce the use of pesticides. Our biological measures included pest dynamics, pesticide applications, sterile flies distribution, and growers' agrotechnical scheme such as sanitation. We also discuss social and economic constraints that cause a lack of sustainability on farms and area-wide scales, which revealed operational stoppages after 25 years of medfly SIT in Israel.

**KEYWORDS:** Ceratitis, SIT, Spatial Scale, Farm, Economy

### Effectiveness of an African local plant in the control of tephritids (Diptera)

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Tephritids (Diptera) remain a serious threat to crop production. In sub-Saharan Africa, chemical products are one of the main strategies used to protect crops, despite their harmful effects on humans and the environment. Therefore, alternative methods need to be considered to ensure the sustainability of this industry. This study was conducted to promote integrated pest management through the use of a semiochemical against tephritids. The plants used in this study were collected during two seasons: the rainy season (August 2023) and the dry season (February 2024) in Ngaoundéré (Adamawa - Cameroon) and transported to the laboratory for hydro-distillation. The resulting essential oil was tested for its efficacy in controlling tephritids. Cotton treated with essential oil was placed in Tephri traps with a contact insecticide before being placed in two mixed orchards at Mamwi and Haut-plateaux locations. The rainy season essential oil was attractive to 1304 tephritids representing three economic pest species: *Bactrocera dorsalis*, *Zeugodacus cucurbitae* and *Dacus bivittatus*, while no attraction was observed in the dry season. This oil was a para-pheromone when comparing the abundance of males (98.38%) to the abundance of females (1.62%). Tephritid composition varied with host-plant utilization, *Z. cucurbitae* and *D. bivittatus* were found in Mamwi, dominated by cucurbits, while *B. dorsalis* was found in Haut-Plateaux, dominated by mango, guava and citrus. Essential oils from local plants may represent an important and cost-effective tools that could provide valuable avenues for chemical ecology research.

**KEYWORDS:** tephritids, crop, essential oil, attractive, cost-effective.

## Comparison Of Electrophysiological And Behavioral Response Of Tephritid (Diptera: Tephritidae) Pests To Cucurbit Host Odor

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### ABSTRACT

Tephritid fruit flies are significant pests of fruits and vegetables worldwide. Female flies lay eggs on fruits and flowers resulting in decay and reduced marketability of the fruits. However, female-specific control tools are still the missing link in the tephritid integrated management. A comparative study of taxonomically closely related insects that differ in their ecology offers an opportunity to unravel the neuronal circuits mediating differential behaviors and design and improve monitoring and control tools. We compared the physiological and behavioral responses of generalist and oligophagous female tephritids to volatile compounds emitted by cucurbit flowers and fruits. Odor samples were collected from flowers and fruits of *Cucumis sativus* L., *Cucurbita pepo* L., and *Cucurbita mixta* L. and analyzed using gas chromatography/mass spectrometry (GC-MS). Electrophysiological responses of female flies to host volatiles were recorded using gas chromatography coupled with electroantennogram detection (GC-EAD). Behavioral assays were conducted in a six-choice olfactometer to assess the responses of sexually mature females to host odor-based synthetic blends. 28 antenna-active compounds were identified, with eight shared among all three tephritid species. A subset of five components attracted all three tephritid species in behavioral assays. There was no clear separation of antennal response spectra among the tephritids, and their ecological niche difference was not reflected in their peripheral olfactory circuitry. Hence, the preference hierarchy towards their hosts displayed by these flies might result from alteration of the olfactory sensory inputs at higher brain centers. With further optimization, the performance of these promising blends should be assessed in the field.

**KEYWORDS:** Behavior, Bioassay, Cucurbitaceae, Electroantennogram, Tephritidae

## Metabolic Profiling Of Tephritid Organs: A Novel Approach For Evaluating Male Quality Markers

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### ABSTRACT

The efficacy of the Sterile Insect Technique (SIT) hinges on the mating competitiveness of - reared sterilized males. However, improving established quality control tests for tephritid fruit flies is hindered by labor-intensive processes. To address this, our study aims to explore potentially novel biomarkers for mating ability. These biomarkers could play a crucial role in rapidly assessing the impact of production enhancements on the performance of sterile males and act as proxies for evaluating male quality in newly developed strains.

In this study, we exploited metabolomics, a systematic approach for identifying and quantifying low molecular weight compounds within a system. This method was utilized to generate metabolomic fingerprints for male reproductive organs and guts in the Mediterranean fruit fly, *Ceratitis capitata*, as well as in two invasive pests of EU priority, namely *Bactrocera dorsalis* and *B. zonata*. We adopted an untargeted metabolomics approach to investigate how external factors like irradiation, larval nutrition, and laboratory colonization may influence the metabolomes of these species and alter the behavior of mass-reared males. A metabolomics pipeline, utilizing Liquid Chromatography-Mass Spectrometry (LC-MS), was developed and is currently in use for analyzing 6,000 samples.

The collected biochemical information, cross-referenced with behavioral parameters, aims to pinpoint metabolites that could potentially serve as quality markers for male performance. The successful development of biochemical assays based on these markers has the potential to revolutionize quality control in mass-reared fruit fly colonies worldwide, ultimately benefiting tephritid pest management. This study is funded through the project REACT (Horizon Europe, 101059523).

**KEYWORDS:** testes, male accessory glands, gut, diet, sterile insect technique.

## Comparative Olfactomics Links Ancestral Saprophyly To Derived Frugivory In Tephritid Fruit Flies

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### ABSTRACT

A tens-of-millions-years-old adaptive radiation event drove tephritid flies from ancestral saprophyly onto fresh fruits and vegetables. Here we mapped antennal responses of five tephritid and two drosophilid species to fermentation volatiles and appended these to an existing custom-built fruit odor response database. This surfaced a highly conserved preadaptive bridge supporting the shift to frugivory: a set of fermentation volatiles detected by all tephritids entirely overlapped with a previously described set of highly conserved fruit-odor responses. A blend of these shared volatiles was as attractive as fermentation substrate in a multichoice olfactometer. Besides conservation, the comparative analyses also revealed a strong niche-driven divergence in tephritids: ecology overrode phylogeny in responses to fermentation volatiles. The above evolutionary-ecological conservation and divergence of olfactory sensitivities were, however, not reflected in tephritid olfactory receptor (OR) sequences, which strictly followed phylogeny. Linking the OR tree with known *D. melanogaster* OR sensitivities, revealed numerous and diverse ORs putatively underlying the detection of conserved volatiles. Possibly, if multiple ORs underlie detection of individual volatiles, evolutionary-ecological correlates may be obscured. In conclusion, comparative GC-EAD data links odor sensitivities to evolutionary-ecological contexts, provides input to further functional OR work, and links fundamental research with application prospects.

**KEYWORDS:** olfactory evolution, frugiphory, saprophyly, attractants, olfactory receptors

## Spatial modeling of fruit fly (*Bactrocera dorsalis*) abundance: harnessing the host tree suitability and climatic variables

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The devastating invasive fruit fly *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae) poses serious threats to fruit production in southern Africa. This is due to their ability to infest and damage a wide range of fruits. Among their preferred host fruit trees are mango and guava. To manage such a devastating pest, the spatial distribution and abundance of the pest are needed. This information is of paramount importance for site-specific deployment of management options such as integrated pest management (IPM) technologies. Therefore, this study aimed to harness machine learning spatial modeling tools, host suitability, topo-edaphic, and climatic variables to predict the abundance of fruit fly in southern Africa. The suitability of mango (*Mangifera indica*) and guava (*Psidium guajava*) as host trees was initially generated and input together with other predictor variables to assess the spatial abundance of fruit fly. Fruit fly abundance observations were collected using traps with Methyl Eugenol lures, which is a highly effective attractant. After selecting a few, yet relevant predictor variables, six machine learning modeling algorithms were employed and evaluated for predicting fruit fly abundance. The results indicated that about 64% of the variability in the fruit fly abundance can be explained by the predictor variables. Moreover, the study shows that temperature, suitability of mango tree, and precipitation are the most relevant variables to the abundance of fruit fly in southern Africa. The findings of this study can guide the upscaling of IPM options to manage fruit fly.

**KEYWORDS:** machine learning, species distribution model, mango, guava, southern Africa



## Decision Support System For The Management Of Mediterranean Fruit Fly, *Ceratitis Capitata* (Weidemann), In Citrus Orchards

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### ABSTRACT

There is a zero tolerance for fruit fly pests in citrus produced in South Africa. Traditionally, the risks of these pests have been managed by fruit fly control starting in mid-summer and continuing until harvest with control adjusted based on trap catches. Control is mainly done by application of insecticidal attract and kill products as well as orchard sanitation. In order to optimise fruit fly control efforts in citrus orchards in South Africa, a Decision Support System (DSS) was designed to assist farm managers with decisions regarding the management of a major fruit fly pest, the Medfly, *Ceratitis capitata*. The goal of the DSS is to improve the timing of application of control products in citrus orchards by incorporating a wide range of factors affecting Medfly populations and activity. Different mathematical models were used to allocate numerical values to a range of criteria. The Stanford Certainty Theory was then used to determine an overall value which is then used for decision making. The factors include number of flies in the nearest trap, adjacent host information which includes proximity and susceptibility, orchard susceptibility, fruit quality, temperature effect on Medfly development, Medfly population trend based on previous captures, and nearby Medfly population (a value determined by combining captures of all traps within a certain radius). It is expected that the DSS will allow growers to improve management by making more informed decisions. This should result in limiting application of control products while at the same time reducing fruit fly risk in fruit.

**KEYWORDS:** citrus, *Ceratitis capitata*, pesticides, Decision Support System, management

## The Economics, Food Security, & Ecosystem Health Benefits Of Fruit Fly Integrated Pest Management

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Insect infestations pose a severe threat to the livelihoods, food supply, and ecological diversity of sub-Saharan Africa (SSA). The prevalent use of synthetic pesticides for pest control is associated with considerable ecological disruption, biodiversity attrition, and health hazards. Integrated Pest Management (IPM), particularly Fruit Fly IPM (FF-IPM) approaches, provides a viable, sustainable alternative, enhancing safe food production and healthy fruit consumption. Despite demonstrable benefits, FF-IPM adoption is sporadic across SSA. This study examines the economic benefits, food security implications, and environmental effects of both individual and combined FF-IPM applications. Additionally, it scrutinizes the heterogeneous economic impacts of FF-IPM across varying scales of fruit production and non-economic drivers influencing FF-IPM adoption in SSA. Our findings indicate that IPM methods significantly elevate income levels, environmental health, and human well-being, with the greatest impact achieved when farmers implement a combination of IPM tactics. These strategies not only contribute to food security and poverty alleviation but also exhibit a high return on investment, making them economically attractive. The profitability of FF-IPM methods, however, varies with the scale of fruit farming, with smaller-scale farmers experiencing more pronounced relative financial benefits than medium and large-scale mango producers. Such findings are essential in shaping the development and application of informed pest management policies.

## Flower And Fruit Volatiles Of Cucurbitaceae Attract *Zeugodacus Cucurbitae* Females (Coquillett) (Diptera: Tephritidae)

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### ABSTRACT

*Zeugodacus cucurbitae* (Coquillett) poses a global threat to fruits and vegetables worldwide, with a special preference for cucurbits. The damage inflicted by female fruit flies, which lay eggs on host plant fruits and flowers, leading to subsequent larval feeding, can result in substantial yield losses ranging from 30 to 100% unless effectively managed. Currently, semiochemical-based female attractants in tephritid fruit fly management lack selectivity, prompting the need to enhance their precision. This study aimed to identify physiologically and behaviorally relevant volatiles from host plants for monitoring and controlling female *Z. cucurbitae* flies. Volatile organic compounds were collected from various phenological stages of *Cucumis sativus* L., *Cucurbita pepo* L., and *Cucurbita mixta* L. in field conditions and analyzed using gas chromatography/mass spectrometry (GC-MS). Electrophysiological responses of sexually mature *Z. cucurbitae* females to host volatiles were recorded using gas chromatography coupled with electroantennogram detection (GC-EAD). Active compounds were then formulated into blends for behavioral assays conducted in a six-choice olfactometer. A total of 81 compounds were identified from the three phenological stages, of which 10 were confirmed with synthetic replication. Synthetic blends based on physiologically active compounds of flower and immature fruit headspace attracted more females than those mature fruit and the paraffin oil control ( $P < 0.0001$ ). Some identified physiologically active compounds were found to be behaviorally redundant. This study highlights the diverse volatilome within species and emphasizes the potential of physiologically active compounds to enhance the selectivity and sensitivity of female lures. However, the translation of these laboratory findings warrants further assessment of the different blends' performance in the field conditions.

**KEYWORDS:** Cucurbitaceae, female attractants, electroantennogram, behavioral bioassay

# 5<sup>TH</sup> TEAM MEETING

15 - 18 April 2024

Maritim Crystals Beach Hotel, Belle Mare,  
Republic of Mauritius

## ABSTRACT OF POSTERS



## The Influence Of Mating Status, Age, And Restricted Diet On Starvation Resistance Of The Olive Fruit Fly

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We investigated the impact of a restricted diet (sugar) on the survival of adult male and female olive fruit flies, *Bactrocera oleae* (Rossi) (Diptera: Tephritidae), at various ages and mating status in a laboratory setting. This was accomplished by placing adults in individual cages and monitoring their survival under different treatments (mating status and age). Upon emergence, adults were placed in individual cages with water and food (only sugar). On the 10th day of their life, groups of adults of the same gender (virgin) or both genders (only those in which mating was observed) were transferred to plexiglass cages with water and food. At the end of the 10th day, insects were returned to their individual cages. To record survival in the absence of food, ten adults from each treatment at a specific age were transferred to new individual cages deprived of food and their survival was recorded every 4 hours. Our results revealed that virgin individuals of both genders survived for longer period than mated ones across different age classes. Furthermore, survival decreased with age. Importantly, statistically significant differences were observed between virgin males and virgin females, whereas no differences were found between mated males and mated females. Our results suggest that mating is associated with a high cost, manifested as shorter survival period following food deprivation. The differences between age classes may be attributed to young adults carrying nutritional reserves from the larval stage, which are depleted as adults age.

**KEYWORDS:** *Bactrocera oleae*, aging, starvation, mating, lifespan

## Differential Cold Tolerance On Immature Stages Of Geographically Divergent *Ceratitis Capitata* Populations

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### ABSTRACT

*Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae), also known as the Mediterranean fruit fly, is a notorious pest of fruits and vegetables worldwide. Cold tolerance of adult medflies has been extensively studied but the effect of subfreezing temperatures on the immature stages remains poorly investigated, especially as far as different populations are regarded. We estimated the acute cold stress response of three geographically divergent populations from Crete, Volos (Greece) and Dubrovnik (Croatia) by exposing immature stages (eggs, larvae, pupae) to subfreezing temperatures. Initially, we determined the Lethal Temperature (LT50) for each immature stage following one hour of exposure to different temperatures. Then eggs, larvae and pupae of the different populations were exposed to their respective LT50 for one hour (LT50 = -11°C, LT50 = -4.4°C, LT50 = -5°C for eggs, larvae, and pupae, respectively). Overall, the populations exhibited different responses to acute cold stress depending on their developmental stage. The population of Dubrovnik (northernmost) was the most cold-susceptible at the egg stage, whereas that of Crete (southernmost) was at the larval and pupal stage. The population of Volos (intermediate) was the most cold-tolerant at all developmental stages. The egg stage was the most cold-tolerant, followed by 4 days old pupae and finally the 3rd instar wandering larvae. Our findings broaden the existing knowledge on cold tolerance of medfly and can be used for the development of population and invasion dynamics models providing data for important parameters that determine its successful establishment to unfavorable environments with an emphasis on range expansion to the northern, more temperate regions of Europe.

**KEYWORDS:** immatures, acute cold stress, subfreezing temperatures, biotypes, Tephritidae

### Anna Karenina As A Promoter Of Microbial Diversity In A Tephritid Agricultural Pest (Diptera, Tephritidae)

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Microbial associations are critical in determining the evolutive success of fruit fly phytophagous pests (Diptera, Tephritidae), facilitating their adaptation to suboptimal environmental conditions and to plant allelochemical defenses. An important source of variation for the microbial communities of fruit flies is represented by the crop on which larvae are feeding. However, a "crop effect" is not always the main driver of microbial patterns, and it is often observed in combination with other and less obvious processes. In this work we verify if environmental stress and, by extension, changing environmental conditions, might promote microbial diversity in larvae of *Zeugodacus cucurbitae* (Coquillett). With this objective, we tested differences in the microbial profiles of wild melon fly populations in an experimental setup in Eastern Central Tanzania. Our results show that  $\alpha$  and  $\beta$  microbial diversities change as *Z. cucurbitae* gets closer to its altitudinal distribution limits and in farms where pesticides and agrochemicals are used. The microbial patterns indicate that Anna Karenina effects significantly contribute to the microbial diversity and that these effects occur in stressful environmental conditions. A "crop effect" was comparably weaker and detected as not consistent changes across the experimental sites. We speculate that the impressive adaptive potential of polyphagous fruit flies is, at least in part, related to the Anna Karenina principle, which promotes stochastic changes in the microbial diversity of populations exposed to suboptimal environmental conditions.

**KEYWORDS:** Tephritidae, microbiome, environmental stressors, adaptation, agroecology



## Metabolic Rate Of Male *Bactrocera Dorsalis* (Hendel) (Diptera: Tephritidae) At A Range Of Temperatures When Fed Protein And Semiochemicals

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### ABSTRACT

The sterile insect technique (SIT) is being investigated as a tactic for control of oriental fruit fly, *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae), populations in South Africa after its successful use in other parts of the world. Pre-release nutritional and semiochemical treatments for sterilised *Bactrocera* males can enhance their competitiveness against wild males in SIT programmes, with semiochemical feeding improving mating performance and activity levels that may have an energetic basis. The aim of this study was to measure the effect of a protein or semiochemical supplemented diet on the resting metabolic rate (RMR) of male *B. dorsalis* over a range of temperatures. Males were fed sugar or a diet enriched with yeast hydrolysate (YH) and/or containing semiochemicals [either methyl eugenol (ME) or eugenol (EU)]. Their RMR was then measured using flow-through respirometry at four constant temperatures (15, 20, 25 and 30°C). The RMR of male *B. dorsalis* increased with temperature, and it was significantly elevated by the addition of YH to the diet. Semiochemical feeding reduced RMR across all temperatures, but particularly at temperatures of 25 and 30°C. Inclusion of YH in fruit fly diets can enhance male reproductive development, which may explain the higher RMR found in this study. However, the lower RMR of males fed ME or EU does not coincide with observations of higher activity in semiochemical-fed *B. dorsalis* from other studies, although the strong benefits for mating performance still recommend its use as a pre-release treatment for SIT.

**KEYWORDS:** IPM, methyl eugenol, resting metabolic rate, semiochemical, SIT

## Daily Activity Profiles Over The Lifespan Of Medflies As Biomarkers Of Aging

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### ABSTRACT

Age-specific and diurnal patterns of locomotory activity, can be considered as biomarkers of aging in model organisms. The relationship between the early-age detailed locomotory activity of Mediterranean fruit flies (medflies) (Diptera: Tephritidae) and their lifespan has remained relatively unexplored in contrast to their correlation with lifespan, senescence and nutrition. The aim of our study was to assess intra-day and day-to-day activity profiles of female medflies and their role as biomarker of longevity and to explore the relationships between these activity profiles, diet, and age-at-death throughout the lifespan. Locomotor activity of medflies recorded by using the Locomotor Activity Monitor (LAM25system) and advanced statistical methods from functional data analysis (FDA) were applied. Three distinct patterns of activity variations in early-age activity profiles were determined. A low-caloric diet was associated with a delayed activity peak, in contrast with the high-caloric diet that was linked with an earlier activity peak. Age-at-death of individual medflies was connected to activity profiles in early life. Increased risk of mortality was associated with increased activity in early age, as well as with a higher contrast between daytime and nighttime activity. Inversely, flies fed a medium-caloric diet were more likely to have longer lifespan, while daily activity of longer-lived flies was more evenly distributed across the early-age span. The before-death activity profile displayed two before-death patterns, one characterized by slowly declining daily activity and another by a sudden decline in activity that was followed by death. Our results indicate the strong connection between daily activity in early age and subsequent mortality, demonstrating that the locomotor activity profiles can be used as biomarkers of functional senescence.

**KEYWORDS:** biomarkers, locomotion, senescence, model organism, *Ceratitis capitata*

## Landscape Connectivity Of The Fruit Fly Pest, *Ceratitis Quilicii* (Diptera: Tephritidae) In Southern Africa

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Several species of Tephritidae are important agricultural pests in southern Africa, particularly the ones of quarantine importance. The phytosanitary risk in commercial fruit is mitigated by several management strategies to enable safe trade. The spatial scale at which these management strategies should be employed can be improved by determining dispersal pathways based on landscape friction and identifying potential management units. *Ceratitis quilicii* De Meyer et al., is a polyphagous pest of some cultivated fruit crops in southern Africa, but to date information regarding this species' dispersal pathways across southern Africa remains unknown. Here, we explored the dispersal pathways of *C. quilicii* across southern Africa to construct friction maps and facilitate the identification of potential management units. Information from the friction maps will allow us to (1) identify landscape and environmental features that constrain genetic connectivity, (2) predict how future landscape changes might influence genetic connectivity, and (3) explain the ecological processes that influence spatial genetic structure. *Ceratitis quilicii* was trapped at 31 locations across South Africa and southern Mozambique between 2020 and 2021. Whole Genome Sequencing (WGS) and population genomics allowed estimating levels of gene flow between individuals from the different trapping sites. Through the integration of population genetic data and environmental factors (such as temperature, rainfall, vegetation type and elevation) we generated friction maps to identify and predict the most likely dispersal pathways of *C. quilicii*. This information allowed us to identify genetic clusters and management units in which control measures can be implemented.

**KEYWORDS:** *Ceratitis quilicii*, management, friction maps, population genetics, dispersal pathways

## First Characterization Of The Microbiome Of The Jointed Pumpkin Fly, *Dacus Vertebratus* Bezzi (Diptera: Tephritidae)

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### ABSTRACT

This study is part of a larger experimental setup testing differences in the microbial diversity of fruit flies attacking cucurbits in the Morogoro area (TZ) and provides a first characterization of the microbiome of *Dacus vertebratus*. Third instar larvae were collected from infested watermelon (*Citrullus lanatus*) at two different sites and across four plots subject to agroecological or conventional pest management, and identified via DNA barcoding. A subset of 43 samples of *D. vertebratus* was subjected to 16S rRNA metabarcoding. The DADA2 bioinformatic pipeline resulted in a final dataset including 19,995 filtered Amplicon Sequence Variants (ASVs) and allowed the identification of 22 phyla, 212 families, and 465 genera of bacteria. More than 99.8% of ASVs belonged to 10 phyla dominated by Bacteroidota (50.1%) and Proteobacteria (33.5%). The 10 most abundant bacterial families contributed to 88.4% of the ASVs, with Rhizobiaceae (30.78%) and Weeksellaceae (20.62%) being the dominant taxa. More than 75.4% of the ASV belonged to 10 genera, with *Sphingobacterium* (15.2%) and *Flaschrobactrum* (14.2%) as the most abundant taxa. No significant differences in  $\alpha$  or  $\beta$  diversity could be observed between larvae sampled from different sites and plots. Comparisons with samples collected in the experimental setup suggested complex patterns of inter-specific variation across *D. vertebratus* and other fruit flies feeding on watermelon (*D. bivittatus*, *D. ciliatus* and *Zeugodacus cucurbitae*). These data will contribute to a better understanding of the drivers of microbial diversity in cucurbit-feeding Tephritidae and, in the longer term, the development of microbial approaches to insect pest management.

**KEYWORDS:** *Dacus verterbratus*, core microbiome, microbial diversity, pest management

## A Flywalk-Type Olfactometer To Measure Tephritidae olfactory Orientation To A Wide Range Of Compounds

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### ABSTRACT 17

Studying the chemical ecology of pest species is essential to develop new attractants for controlling their populations. In particular, Tephritidae fruit flies are attracted to pheromones emitted by conspecific, to plant metabolites involved in sexual communications, such as methyleugenol, or to kairomones emitted by food sources or host-fruits. However, the wide range of volatile compounds with which polyphagous species interact hinders the identification of powerful, specific female attractants. A technical limitation lies in the difficulty to test the behavioural response to a number of compounds and/or compound combinations with typical olfactometers. The flywalk olfactometer, initially designed for studying olfactory behaviours of *Drosophila* species, overcomes this. It involves precisely controlling the timing at which an insect is exposed to an odour, using a specially designed apparatus operated by a microprocessor, and video-tracking the induced trajectory. For such precise control, an insect needs to be in a small-diameter tubular chamber, where it can mostly display a walking behaviour- hence the name flywalk. Here, we designed a flywalk-type olfactometer to study the olfactory orientation behaviour of Tephritidae species. The olfactometer comprises 16 chambers operating simultaneously, each with different odours. As a proof of concept, we showed a dose-dependent increase in the degree of attraction of male *Bactrocera dorsalis* to methyl eugenol. We also found contrasted degrees of attraction of male *B. dorsalis*, *Bactrocera zonata*, *Dacus demmerezi* and *Zeugodacus cucurbitae* to a range of 15 compounds derived from various male attractants. Our olfactometer enables behavioural screening of numerous potential attractants for fruit flies.

**KEYWORDS:** Chemical ecology ; attractants; olfaction; traps; methyl eugenol; behaviour

## The essential oil of *Ocimum americanum* from Senegal and Gambia as a source of methyleugenol for the control of *Bactrocera dorsalis*, fruit fly

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### ABSTRACT

The fruit fly, *Bactrocera dorsalis* (Diptera: Tephritidae) is one of the most important pests in all mango- producing areas, particularly in West Africa. In Senegal, *Ocimum americanum* leaves have been used for several years to control this fly. However, to our knowledge, no chemical studies have been carried out. Thus, the aim of this study is to determine the chemical composition of the essential oil of *O. americanum* leaves collected in Senegal and Gambia. The essential oil obtained by hydrodistillation of these leaves are analyzed by GC/FID and GC/MS. Yields of essential oils from *O. americanum* leaves are 3.84% and 2.13%, respectively. Analysis of these essential oils by GC/FID and GC/MS allowed the identification of 23 compounds representing almost 100% of the total compositions. These essential oils are mainly dominated by methyleugenol (72.0% and 75.8%, respectively). Other components in significant percent are trans-  $\beta$ -caryophyllene (13.9% and 13.0%, respectively), germacrene D (4.1% and 3.7%, respectively),  $\beta$ -elemene (3.3% and 0.9%, respectively). Due to the high methyleugenol content, this study explains the attractive potential of *O. americanum* towards *B. dorsalis*. In perspective, we plan to evaluate the attractive effect of the essential oil and leaf powder of *O. americanum* against *B. dorsalis*, a real pest of mango orchards in Senegal.

**KEYWORDS:** leaf chemical compounds, GC/MS, major mango pest, West Africa,

## Competition And Displacement Between Mediterranean Fruitfly, *Ceratitis Capitata* And Peach Fruitfly, *Bactrocera Zonata* In The Baghdad Orchards Environment

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### ABSTRACT

Mediterranean Fruitfly, *Ceratitis capitata*, and Peach Fruitfly, *Bactrocera zonata*, are among the pests that caused hug damage in fruit crops. Their infestation rate ranges between 30-75%, depending on the fruit season, and their control does not end at national borders. The research was carried out in a field survey to compare the population densities of insects during the years 2014 and 2022-2023 in the environment of Baghdad orchards. In this study were used many pheromones and traps.

Results indicated that the presence of the Mediterranean fruit fly, *C. capitata*, and the absence of the peach fruit fly, *B. zonata*, during 2014, while the results indicated that the presence of the peach fruit fly, *B. zonata*, and the absence of the Mediterranean fruit fly, *C. capitata*, during 2022-2023, which indicates that The peach fruit fly, *B. zonata*, competed with the Mediterranean fruit fly, *C. capitata*, and caused its displacement, reaching a density of the Mediterranean fruit fly, *C. capitata* in 2014: 436, 580, 88 insects/trap/week during the apricot, fig and citrus season, respectively, compared to: 0, 0, 0 for the peach fruit fly *B. zonata* respectively, while in 2022-2023: 0, 0, 0.14 for the Mediterranean fruit fly *C. capitata* compared to 519, 221, and 208 during the apricot, fig, and citrus season, respectively. When comparing the effectiveness of several types of pheromones, the results indicated that all of the pheromones used in the experiments were very effective in attracting the two insects, but the Novagric pheromone was the most attractive to the peach fruit fly. These results show that the peach fruit fly, *B. zonata*, competed Mediterranean fruit fly, *C. capitata*, and caused its displacement. These results can serve in the use of attractive pheromones and appropriate control measures for each type of fruit fly that spreads in orchards.

**KEYWORDS:** fruit flies, *Ceratitis capitata*, *Bactrocera zonata*, competition, displacement.



## The Relative Abundance Association Between Fruit Flies *Bactrocera* Spp. In Sudan

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### ABSTRACT

Flies (Diptera: Tephritidae) are the most destructive insect pests of fruits and vegetables in the world. In Sudan the production of fruits and vegetables is affected by fruit flies (*Bactrocera* spp.) that may play a major role in reducing production and limiting the exportation capabilities. The objective of the present study was to investigate the relative abundance and association between fruit flies (*Bactrocera zonata* and *Bactrocera invadens*) (Diptera: Tephritidae). Several field surveys were conducted in Wad Medani Area, Gezira State, Sudan during season 2016/2017. Three locations were selected in the study area and three sites were selected at each location. An orchard was randomly selected at each site and five directions at each orchard were determined Methyl Eugenol trap was used to estimate the seasonal abundance of the fly among locations and sites. Data were subjected to descriptive analysis and regression analysis. The relative abundance of *Bactrocera dorsalis* (76.9 %) was higher compared to the *Bactrocera zonata* (23.1 %) at Wad Medani area, Gezira State, Sudan throughout the season 2016/17. In conclusion, the finding of this study could be utilised in sustainable pest management strategy for fruit flies (*Bactrocera* spp.) in the agro-ecological system of Gezira State, Sudan

**KEYWORDS:** Abundance, *Bactrocera*, fruit fly, methyl eugenol, Sudan

## Potential European Ornamental And Wild Plants For Two Invasive Tephritid Species *Bactrocera Dorsalis* And *Bactrocera Zonata*

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### ABSTRACT

Climate is a critical factor considered in predicting the potential distribution of phytophagous species. However, the availability and distribution of susceptible host plants is another important constraint that need to be considered in predictive analyses of invasive insect pests, particularly for frugivorous insect species. *Bactrocera dorsalis* and *Bactrocera zonata* are among the most notorious pests of fruits and vegetables all over the world, causing direct loss to produce, resulting in the imposition of severe regulations, particularly in Europe. The host range of both polyphagous tephritid species is known for several cultivated and wild growing plants in tropical areas but not for European flora. In the present study, we evaluate the suitability of widely distributed ornamental and wild growing plants in southern Europe as potential hosts of both *Bactrocera* under laboratory conditions. For each plant species, we investigated female acceptance based on non-choice experiments and we measured larval performance based on larva-adult survival rate. Results showed that not all tested plant are able to sustain larval development of both tephritid species. Females of both fruit flies are able to oviposit in all tested fruits with significant difference of preference. The role of such hosts on facilitating establishment and dispersion of both target species is discussed.

**KEYWORDS:** Tephritidae, host fruit, invasion, female acceptance, larval performance

## Species Diversity, Distribution And Population Dynamics Of Fruit Flies In Oman

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### ABSTRACT

Fruit flies are important pests of fruits and vegetables worldwide. A study was conducted to investigate fruit fly species in Oman and their population dynamics throughout the year. Infested fruit samples were collected from different locations across Oman and five para-pheromones were used in McPhail traps to monitor fruit flies. Fruit flies collected from fruits then underwent morphological and molecular characterization. Results showed that there were nine fruit fly species in Oman. The polyphagous *Bactrocera dorsalis* and *Bactrocera zonata* were collected from fruits of different trees, while *Dacus ciliatus* and *Zeugodacus cucurbitae* were collected from cucurbit fruits. Furthermore, *Carpomya vesuviana*, *Carpomya incompleta*, *Dacus persicus*, *Bactrocera oleae* and *Capparimyia savastani* were collected from different locations and hosts. Only four types of fruit flies were caught in traps named *B. zonata*, *B. dorsalis*, *D. ciliatus*, and *Z. cucurbitae*. Methyl eugenol was the best pheromone to attract *B. zonata* and *B. dorsalis* and Cuelure to attract *Z. cucurbitae*. The highest population densities of *B. zonata* occurred between February and May and in fall season between August and October. The highest population densities of *B. dorsalis* occurred in February and May. Higher catches of *Z. cucurbitae* occurred from March to April and in June. The findings of this research can help in implementing effective fruit fly control measures in the proper time and using the proper pheromone for the available species.

**KEYWORDS:** Population dynamic, pheromone lures, *Bactrocera zonata*, *Bactrocera dorsalis*, McPhail trap.

## Seasonal Abundance Of Fruit Fly On Cucurbits In Mozambique

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### ABSTRACT

Surveying the abundance of fruit flies in cucurbit crops is important to understanding their impact on production and allowing the development of control and prevention strategies. However, this information is scarce for Mozambique. Thus, the study was conducted to assess the seasonal abundance of fruit flies infesting cucurbits. The study took place in Maputo and Manica provinces from March 2020 to March 2022. Traps were monitored once a week. 24 species were captured using traps, 15 in Maputo and 23 in Manica, belonging to *Bactrocera* (1), *Ceratitis* (5), *Dacus* (20), *Zeugodacus* (1), and *Perilampus* (1) genera. In Maputo, *Dacus frontalis* (37%) and *D. bivittatus* (35%) were the most abundant, while in Manica, *D. bivittatus* (69%) and *D. punctatifrons* (21%) were predominant. The invasive species *Zeugodacus cucurbitae* was collected once in Manica until March 2022. The peak occurrence of *D. bivittatus* in Maputo was observed in December/21 (FTD - 0.22) and in Manica in July/21 (FTD - 2.21). Statistical analysis showed significant differences in FTD between the two provinces, with Manica having the highest density of this species. *Dacus punctatifrons* peaked in Maputo in November 2021 (FTD - 0.77) and in September/2021 in Manica (FTD - 1.74). The predominant species in the study area were *D. bivittatus*, *D. punctatifrons* and *D. frontalis*. These species have been present in all seasons, but with different peaks of occurrence, conditioned by the viability of their preferred hosts. Therefore, the development of integrated fly management strategies to reduce yield losses in cucurbit crops is recommended.

**KEYWORDS:** Fruit flies, cucurbits, abundance, *Dacus*

## The Dacine Fruit Flies (Diptera, Tephritidae, Dacinae) Of Tanzania

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### ABSTRACT

**Background:** Dacine (Diptera: Tephritidae: Dacinae) fruit flies include several pest species of economic significance. Having a clear understanding of the species diversity for this particular taxonomic group is essential in order to deploy further scientific and pest management activities. However, no such comprehensive checklist is available for Tanzania.

**Objective:** To provide a review of all dacine fruit flies reported from Tanzania.

**Methodology:** The dacine fruit fly fauna from Tanzania was studied, based on recent surveys, verified specimen records in natural history collections and literature records.

**Results & Conclusions:** In total, 117 Dacinae species are reported from the country, including six endemics and 20 pest species of major and minor economic importance. The fauna is further compared with that of neighbouring countries. The endemism and distributional patterns within Tanzania are briefly discussed.

**KEYWORDS:** faunistics, diversity, Afrotropical, agricultural pests

## Use Of Semiochemicals To Control Tephritid Fruit Flies Threatening Cucurbits In Vegetable Crop Production Systems In Ivory Coast

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### ABSTRACT

The global ongoing agroecological transition turns agronomic research towards control methods of pests inspired by natural processes and regulations that need to be integrated and implemented at different scales in an Integrated Pest Management strategy. The efficacy of pest control first requires the correct identification of pests and relations with their hosts and natural enemies. The aim of our study is to characterize such a tritrophic system including cucurbit-infesting Tephritids in Ivory Coast. Damaged cucumber and zucchini were collected in Korogho, Bouaké, Yamoussoukro and Abidjan, from February to October 2023. Then, they were incubated in the lab to assess the infestation level, the fly species and their potential natural enemies. Direct observations and producer interviews were also performed to describe the cropping system, its environment, the level of damages and characterize agricultural practices and level of knowledge on fruit flies. Overall, the level of damages in the field was 30% and the infestation rate in the lab was 17 pupae per 100 g fruit in average. 5 fly species were identified: *Dacus ciliatus*, *Zeugodacus cucurbitae*, *D. bivittatus*, *D. punctatifrons*, *D. vertebratus*, as well as 2 parasitoid species. 63% of cucurbit fields were treated with lambda-cyhalothrine, a wide-spectrum and systemic pesticide active ingredient. 82% of responding producers reported to have already observed fruit flies but 71% leave damaged fruit in the field zone. 19% of producers were using alternative control methods such as *Carapa procera* or neem oil, plant extracts, biofertilizers and beneficial microorganisms. A deeper ongoing statistical analysis will allow to highlight which factors shape the field damages and infestation levels, the relative abundances and spatiotemporal distribution of fruit fly species in Ivory Coast. Moreover, these results justify the need for broadening the research spectrum of solutions against fruit flies in vegetable crop systems.

**KEYWORDS:** tritrophic system, field samplings, damages, infestation, alternative methods

## Occurance Of Fruit Fly (Diptera:tephritidae) In River Nile, Sennar And North Kordofan States,Sudan

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### ABSTRACT

The infesting species and their infestation indices of fruit flies were determined for guava genotypes grown in River Nile, Sennar and North Kordofan states. Twenty genotypes were selected from each state to be evaluated. Infestation indices were estimated by means of total number of pupae/fruit. Results showed that Guava fruit were infested by four species *Ceratitiscosyra*, *C. quinaira*, *C. capitata* and *Bactrocera dorsalis* constitute (82.2), (0.8), (16.7), (0.3%) and 28.35, 0.01, 10.1 and 61.56% in River Nile and Sennar State respectively. While in North Kordofan state Guava were infected by *Ceratitiscosyra*, *C. capitata* and *Bactrocera dorsalis* 98.4, 0.4, and 1.2% respectively. All evaluated genotypes in River Nile and Sennar states were infested by the fruit fly with varying degrees only two genotypes 15 red flesh and 19 white flesh fruit in Kordofan state were found free from fruit fly infestation. Infestations were much higher in Sennar and River Nile states (32 and 29 pupae/fruit) respectively compared to North Kordofan (1.6 pupae/fruit). The higher infestation rate occurred in ripe Guava fruit (33) compared to 18 and 6 pupae/fruit in mature green and immature green fruit respectively.

**KEYWORDS:** Fruit fly - Species - Indices - Guava - Sudan.



### Thermal Fertility Limits Of The Mediterranean Fruit Fly, *Ceratitis Capitata* (Wiedemann) (Diptera: Tephritidae)

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Heat waves are occurring more frequently due to climate change, and it is therefore important to better understand their impact on the population dynamics of pest insects. *Ceratitis capitata* is present in most fruit producing regions worldwide and is capable of surviving and reproducing over a wide range of temperatures. Since, variation in environmental temperature can alter the invasive potential, distribution, and population dynamics of agricultural pest via impacts on fertility and fecundity we determined the thermal fertility limits of *C. capitata*. Adult male and female (+/- 1800) flies were exposed to four temperatures (32, 36, 38, and 40°C) for different time durations (60, 120, 180, and 240 minutes) and the reproductive output were assessed. Treated flies (F0 generation) were paired with untreated flies from the opposite sex and kept at room temperature for a mating period of two days after which, the number of eggs produced, number of pupae, adult emergence, and offspring (F1 generation) survival over 14 days were determined. Flies exposed to temperatures between 38-40°C together with longer exposure times show reductions in fertility, and with little apparent thermal fertility limit variation between sexes. We found thermal fertility limits to be relatively close to thermal limits for adult survival observed in other studies, suggesting that *C. capitata* is able to reproduce and survive during heat waves, unlike other cosmopolitan Diptera (e.g., *Drosophilidae*), which probably contributes to their invasiveness and broad distribution. These results can be coupled with other physiological trait data to refine population dynamic models of abundance, distribution and invasion potential.

**KEYWORDS:** *Ceratitis capitata*, thermal infertility, climate change, survival, fecundity

## Diversity Of Fruit Flies (Diptera Tephritidae) In Madagascar, A Continental Island, With A High Biodiversity

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Tephritid fruit fly species are known as one of the major pests of many horticultural crops. The hotspot of biodiversity of Madagascar is no exception, and its fruits and vegetables are also affected by fruit flies, which are endemic or exotic ones. Old records of Tephritidae diversity on the island mention the presence of 74 species, 32 of them are frugivorous, and others include gall feeders and non pests which play very useful roles in plant pollination. Among those species, 23 are endemic and 5 are of economic importance from different agro-ecological zones. Our objective was to make an update of the diversity of frugivorous species of Tephritidae present in Madagascar. To do so, we collected fruits of 66 plant species from 2016-2022, in different agroecological areas throughout the island, mainly in agricultural lands. Further surveys will be done in protected natural areas in order to ensure to have an exhaustive sampling programme. The study of species of fruit flies and their host fruits, even from wild areas, will help us to have the knowledge on their native habitats prior to applying any pest control.

**KEYWORD:** Tephritidae, fruit flies, diversity, horticulture, island

## Population dynamics of fruit flies (Diptera: Tephritidae) in mango orchards in the southeastern mango enclave of Ghana

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Understanding the population dynamics of fruit flies is important for developing effective management strategies to control their populations and minimize crop damage. Areawide management strategies have been proposed to control fruit fly populations, which involve coordinated efforts across large areas to suppress or eradicate the pests. In agricultural settings, rapid population growth can lead to significant crop damage, as fruit flies lay their eggs in fruits and vegetables. This can result in economic losses for farmers. To determine the population dynamics of fruit fly species in the southeastern mango enclave of Ghana, a year-long trapping of fruit flies was done in three farms. Five traps baited with Methyl eugenol (ME), Cuelure (CL), Terpinyl acetate (TA), Torula yeast (TY) or Trimedlure (TML) were placed in the three farms. A total of 172, 617 fruit flies were captured and collected from the traps. The fly densities were 143.10, 10.19, 4.03, 0.26 and 0.03 per trap per day for ME-, TY-, CL-, TA-, and TML-baited trap respectively. Ten fruit fly species namely *Bactrocera dorsalis* (Hendel), *Ceratitis cosyra* (Walker), *C. capitata* (Wiedemann), *C. penicillata* (Bigot), *Dacus bivittatus* (Bigot), *D. punctatifrons* Karsch, *D. langi* Curran, *D. longistylus* Wiedemann *D. ciliatus* Loew and *Zeugodacus cucurbitae* (Coquillett) were captured in the farms. *Dacus langi* and *D. longistylus* were for the first time identified in Ghana. The population of *B. dorsalis* and *Z. cucurbitae* fluctuated from April to July with that of *B. dorsalis* peaking in April, May and June. The periods of the peak population of *B. dorsalis* coincided with the major mango- growing season in the southeastern mango enclave. Knowledge of this seasonal variation in the population of the fruit flies could be harnessed for effective management of the major fruit fly pests in the study area. Particularly, interventions aimed at managing *B. dorsalis*, a major insect pest in the enclave, could be executed from April to July when this insect is most abundant.

**KEYWORDS:** attractant, *Bactrocera dorsalis*, mango, population, fruit fly

## Area wide fruit fly management Options by the small scale Mango growers in the Kingdom of Eswatini.

By Nzima Bheki A., Principal Plant Protection Officer in the NPPO of the Kingdom Of Eswatini.

### ABSTRACT

The Northern Hhohho of the Kingdom of Eswatini is predominantly the Mango *Mangifera indica* L. (Anacardiaceae), producing area. Mango farming is still at a subsistence level. Fruit fly pests attack Mango and wild guavas plants in most farmers homesteads. The *Bactrocera* and *Ceratitis* species are responsible for many fruit losses, and three *Ceratitis* species are mostly collected in our traps, the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann); the Marula fruit fly *Ceratitis cosyra* (Walker) and *Ceratitis rosa* Karsch and a. The Oriental fruit fly *Bactrocera dorsalis* (Hendel), is believed to have invaded Africa from Asia and was found in Kenya for the first time in 2003. *Bactrocera dorsalis* was first detected in the Kingdom of Eswatini in 2013 in the Northern Hhohho region. Fruit fly monitoring remains the first step towards the area wide pest management practices. Fourteen species, dominated by *Bactrocera dorsalis* 47.5 %, *Ceratitis capitata* (20.2%), *C. rosa* (12.7%) and *Dacus bivittatus* (12.7%) were collected from mango growers in the Northern Hhohho. There were significant differences in the number of flies trapped per day per trap between lures ( $p > 0.05$ ) and estates ( $p = 0.0204$ ). Only 9 species, dominated by *C. rosa*, (76.35%) were collected from border posts and markets. There were significant differences in the number of flies trapped between border gates ( $p > 0.05$ ) and none were trapped from the national marketing board. Monitoring is the first step towards the management of fruit flies. Control measures used in the past need to be amended due to the presence of *B. dorsalis* in production areas. *Bactrocera dorsalis* can be controlled effectively with the bait application technique (BAT) in the form of bait sprays or bait stations in combination with the male annihilation technique (MAT). Orchard sanitation is also fundamental and widely accepted by small scale farmers in the suppression of fruit flies. Thus there are three important steps involved in management of the fruit fly complex by small scale farmers, i.e. BAT, MAT and sanitation.

**KEYWORDS:** *Bactrocera* species, *Ceratitis* species, MAT, bat, sanitation

## Competition and displacement between Mediterranean fruit fly, *Ceratitis capitata* and Peach fruit fly *Bactrocera zonata* in the Baghdad orchards environment

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Mediterranean Fruit fly, *Ceratitis capitata*, and Peach Fruit fly, *Bactrocera zonata*, are among the pests that caused huge damage in fruit crops. Their infestation rate ranges between 30-75%, depending on the fruit season, and their control does not stop at national borders. The research was carried out in a field survey to compare the population densities of insects between 2014 and 2022-2023 in the environment of Baghdad orchards. Many lures were used in this study: *Ceratitis capitata*, Alpha Scents, Inc and Akdeniz Meyre Sinegi to attract *C. capitata* and pheromones Zoatrac, Novaagric, Alpha Scents, Inc, Kapar and Methyl eugenol to attract *B. zonata*. These lures used with Jackson sticky traps.

Results indicated the presence of *C. capitata*, and the absence of *B. zonata*, during 2014, while the inverted presence of *B. zonata*, and the absence of *C. capitata*, during 2022-2023, which indicates that *B. zonata*, competed with *C. capitata*, and caused its displacement. *C. capitata* reached a density in 2014 of: 436, 580, 88 insects/trap/week during the apricot, fig and citrus season, respectively, compared to: 0, 0, 0 for the *B. zonata* respectively, while in 2022-2023: 0, 0, 0.14 for the *C. capitata* compared to 519, 221, and 208 for *B. zonata* during the apricot, fig, and citrus season, respectively. When comparing the effectiveness of several types of pheromones, the results indicated that all of the pheromones used in the experiments were very effective in attracting the two insects, but the Novagric pheromone was the most attractive to the *B. zonata*. These results can serve in the use of attractive pheromones and appropriate control measures for each type of fruit fly that spreads in orchards.

**KEYWORDS:** fruit flies, pheromones, Mediterranean fruit fly (*Ceratitis capitata*), peach fruit fly (*Bactrocera zonata*), competition, displacement.

## Assessment Of Losses Due To Fruit Flies On Four Mango Cultivars in Burundi

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### ABSTRACT

Mango is a tropical fruit that generates substantial income for growers. Unfortunately, in the absence of Integrated Pest Management, losses and damage caused by fruit flies are still unknown. The aim of the study was to determine the infestation rate of four mango varieties, and estimate the losses caused by fruit flies for each variety. Fruits were collected in two orchards in Bujumbura in January 2023. 80 fruits were collected, with 20 fruits for each of the four varieties: Kent, Boribo, Valencia, and Sindano. Only one species, *Bactrocera dorsalis*, emerged from the four varieties. Boribo was the most infested with 42.28 fruit flies/kg, followed by Valencia (35.31), Sindano (22.58), and Kent (11.22). Analysis of variance showed that there was no significant difference in infestation levels between varieties ( $P > 0.05$ ). When infestation was analyzed between fallen and harvested fruit, there were no significant differences ( $P > 0.05$ ). Analysis of losses revealed that for Kent, Boribo, and Valencia, 95% of production is unfit for consumption and marketing, while for Sindano, losses are estimated at 65%. *Bactrocera dorsalis* is the main pest of mango in western Burundi.

**KEYWORDS:** mango, variety, fruit flies, losses, infestation rate

## Wings Of Change: Exploring Insect-Host-Landscape Interactions Shaping Fruit Fly Wing Morphology

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### ABSTRACT

Wing morphology can influence the foraging efficiency and invasiveness of fruit flies by affecting their ability to fly. Variations in wing morphology may be triggered by host plant quality, while landscape composition may also play a role in filtering the ability of variants to colonise new habitats. We investigated how intraspecific variation in wing morphology in fruit flies is mediated by host preference and the role of landscape in filtering this variation. We used *Ceratitis capitata* as a model because the existence of morphotypes that undertake long- and short-distance flights has been proposed previously. *Ceratitis capitata* populations of peach, fig and mandarin hosts at nine sites were analysed. We analysed wing geometry and aspect ratio to understand the interplay between wing morphology, host preference and landscape dynamics. Sexual dimorphism was observed in all populations of *C. capitata* studied, with females exhibiting longer and larger wings compared to males. These aerodynamic wings give females greater flight endurance, which facilitates their role in dispersing to new areas. Differences in wing shape were observed in *C. capitata* collected from mandarins compared to other hosts such as peach and fig. Sterile flies, regardless of sex, exhibited narrower and shorter wings, resulting in reduced flight ability. The aspect ratio values (<10) found here suggest that all *C. capitata* population types have wings suited to shorter distance and more maneuverable flights, with the ability to carry heavier loads (eggs) if needed. Traditional morphometric methods confirmed variability attributable to host plant diversity, with fly populations from mandarin fruit exhibiting higher flight parameters. Our results suggest that local resources and landscape features generate interacting bottom-up effects that influence morphological variation of *C. capitata* within habitat.

**KEYWORDS:** medfly, wing shape, aspect ratio, flight performance



## Virtual Collections: An Essential Tool In Fruit Fly (Diptera: Tephritidae) Species Identification

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### ABSTRACT

An accurate and unambiguous species identification is essential in any fundamental and applied research component, in particular for organisms of economic significance. While identification keys provide a first indication of identity, comparison with reference material is required for confirmation. However, comprehensive reference collections of correctly identified specimens are not available for all taxa as these require large investments in setting up, cross-reference and maintenance. Modern digitization technologies provide suitable alternatives by producing high resolution, multi-stacking images of voucher material, including different angles and close-ups of the main diagnostic characters, which are made publicly available through open access websites.

Dacine (Diptera: Tephritidae: Dacinae) fruit flies include several pest species of economic significance. Over the last years a vast majority of Afrotropical representatives of this group has been digitized based on material preserved in the collections of the Royal Museum for Central Africa (RMCA, Tervuren, Belgium). The focus has been on representatives of the genera *Bactrocera* Macquart, *Ceratitis* MacLeay, *Dacus* Fabricius and *Zeugodacus* Hendel. More than 2000 multi-stacking images were produced. They represent close to 190 different species, comprising about two-thirds of the known fauna for these groups in Africa and all known pest species. This virtual collection is publicly available through a dedicated website: <https://virtualcol.africamuseum.be/providence/pawtucket/>.

**KEYWORDS:** multistacking, digitization, Afrotropical, agricultural pests

## Investigating The Bioecology Of The Lesser Pumpkin Fly (*Dacus Ciliatus*) On Butternut Squash (*Cucurbita Moschata*) In The Western Cape, South Africa

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### ABSTRACT

The Tephritidae family, within the Diptera order, constitutes nearly 5,000 species with several being of high economic importance. Their adaptability to diverse climatic regions, expansive host ranges, and intricate life cycles contribute to their widespread impact. A Tephritidae species indigenous to the African continent, *D. ciliatus*, commonly targets cucurbitaceous crops. Within the Western Cape of South Africa, *D. ciliatus* is the predominant pest on butternut squash. Despite this, limited research has been conducted on this pest and a gap remains regarding the development of effective management tools. Presently, no target specific male lures or insecticides are available on the market. Therefore, this study investigates the bioecology of *D. ciliatus* within commercial butternut plantations, with the overarching aim to improve management decisions and control measures. The main objectives include the development of an optimized trapping system, a better understanding of the species' spatial-temporal distribution and quantifying the extent of fruit damage. Preliminary results for the trapping experiment indicate that a lower trap height will improve trapping efficacy. In addition, a comparison between the effectiveness of two market available protein lures, Biolure (Ammonium Acetate, Trimethylamine hydrochloride and 1,4-diaminobutane (Putrecine)) and Questlure (Protein hydrolysate plus plant extracts) suggest that Questlure is a more suitable attractant. Furthermore, a strong correlation is expected between the fruit phenology and the prevalence of the species in and around the plantation. It is also expected that higher levels of fruit flies per trap per day (F/T/D) will be found in natural vegetation sites bordering the butternut plantations compared to the butternut crop plantation sites during the growing season. These results will provide critical insights, serving as the foundational knowledge necessary for subsequent research endeavors focused on the effective management of *D. ciliatus*.

**KEYWORDS:** *Dacus ciliatus*, Cucurbitaceae, Monitoring, Spatial-temporal distribution.

## Field Evaluation of Various Dispensers for Cue-Lure in India, an Attractant of *Zeugodacus cucurbitae* (Coquillett) (Diptera: Tephritidae)

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### ABSTRACT

The attractiveness and longevity of cue lure dispensers to melon fly, *Zeugodacus cucurbitae* (Coquillett) was tested in a cucurbit orchard in Kashmir, India. Cue-lure [4-(4-acetoxyphenol)-2-butanone] and 1 ml Malathion 500 EC applied on plywood block captured male flies efficiently up to 10 weeks. Although the mean number of males captured during 1st week in traps with plywood dispenser, the actual number increased during 2nd week and thereafter decreased again. Contrary, for the other dispenser, the trap captures decreased continuously after the 2nd week. Our results suggest that plywood block is the most attractive and long-lived cue-lure dispenser for capturing *Z. cucurbitae* and has potential for monitoring and area wide management of tephritid fruit flies in India.

**KEYWORDS:** *Zeugodacus cucurbitae*; Male annihilation technique; [4-(4-acetoxyphenol)-2-butanone]; Dispensers; Monitoring

## Effect Of Trap Color, Cultural And Sanitation Measures On Density Of *Bactrocera Zonata* In Sudan

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Horticulture is one of the most important agricultural sub-sectors in Africa, providing income, creating jobs and enhancing food and nutrition security. Fruit flies, *Bactrocera* spp., are among the most destructive fruit/vegetable eating agricultural pests in the world, particularly in African countries such as Sudan. The objective of this study was to investigate the effect of trap colour, cultural and sanitation Measures on density of peach fruit fly, *Bactrocera zonata* (Saunders) (Diptera: Tephritidae). Several field surveys were conducted in the Gezira State, Sudan during season 2016/2017. Three locations were selected in the study area and three sites were selected at each location. An orchard was randomly selected at each site and five directions at each orchard were determined. Methyl Eugenol trap was used to estimate the effect of colour, cultural and sanitation measures on density of the fruit flies. Data were subjected to descriptive analysis and analysis of variance procedure. The results showed that during the flowering period of mango, peach fruit fly (*Bactrocera zonata*) was highly attracted to other colours rather than the yellow colour, while, during the fruiting the insect was highly attracted to the yellow colour compared to the other colours. The density of the insects was significantly low in the well managed orchards (8.7 insects per trap per week) compared to the poor managed orchards (36.9 insects per trap per week). So the trap colour, composition of the horticultural crops, well cultural practices and good sanitation measures should be addressed when dealing with the control of peach fruit fly.

**KEYWORDS:** *Bactrocera*, colour, methyl eugenol, peach fruit fly, sanitation

## Chemical Description Of The Volatile Component Of Mango Orchards At Different Phenological Stages And Its Relationship With The Parasitic Activity Of *Fopius Arisanus* On *Bactrocera Dorsalis*

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The development of fruit flies belonging to the Tephritidae family causes significant ecological and economic damage. In La R  union, various methods have been employed to control these species, including the introduction of natural enemies. In this context, *Fopius arisanus*, a koinobiont endoparasitoid, was introduced on the island in 2003 to control a new invasive pest: *Bactrocera zonata*. In 2017, a new invasive species was detected on the island: *Bactrocera dorsalis*. The rate of parasitism of *F. arisanus* assessed on this species in 2018, and was unfortunately low (around 17%) compared to the expected rate of parasitism of the same species in other countries. In order to understand if local environmental factors might underlie this difference, we sought to investigate the host-seeking process of the parasitoid. In particular, given that insect behavior patterns unfold according to olfactory cues, we sampled ambient volatile compounds from four mango plots during different phenological time periods and analyzed them by gas chromatography - mass spectrometry. For each period and plot, the parasitism activity of *F. arisanus* was measured by a trapping system consisting of a banana artificially infested with *B. dorsalis* eggs. Volatile compounds were systematically observed within a mango orchard and constitute its chemical signature. We also found a chemical variability that will be analyzed in relation to the observed parasitism rate, mango phenology, and landscape variables. Ultimately, these results will help optimizing the recruitment of the parasitoid in areas where pest control is needed.

**KEYWORDS :** Chemical ecology ; biological control ; parasitoid ; *Fopius arisanus*

## Comparing Fruit Fly Infestations In Agroecological And Conventional Cucurbit Farming. A Test Case In East-Central Tanzania

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The adoption of agroecological farming practices is a promising approach to reduce or eliminate the use of pesticides against fruit flies and other pests in agriculture. In this study we provide a comparative analysis of fruit fly infestations in agroecological and conventional cucurbit farming in the Morogoro area (East-Central Tanzania). Infestation patterns were inferred from more than 22,000 adult flies emerging from cucurbits from a large experimental setup established in 2022-2023. The diversity of fruit fly taxa was generally low and included only eight relatively common species dominated by the melon fly, *Zeugodacus cucurbitae* (69.3% of specimens observed). *Dacus vertebratus* (14.6%), *D. ciliatus* (7.6%) and *D. bivittatus* were also abundant, while *Bactrocera dorsalis* (0.13%), *D. punctatifrons* (0.13%) and *D. lounsburyi* (0.05%) were recorded as rare taxa. Multivariate and univariate analyses detected complex interactions between the effects promoted by crop management (agroecological vs. conventional), altitude (500m a.s.l. vs 600-900m a.s.l.) and cucurbit crop (cucumber vs. squash vs. watermelon) and showed significantly different infestation patterns between agroecological and conventional farming. These results contribute to a better understanding of processes driving fruit fly infestations in pesticide-free agriculture, and will ultimately promote agroecological farming.

**KEYWORDS:** Agroecology, cucurbits, fruit fly, infestation rates, management

## Effective Chemical Control of Fruit Flies (Diptera: Tephritidae) Pests in Zucchini in North Al Batinah, Oman

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Fruit flies (Diptera: Tephritidae) are a major pest of agricultural commodities throughout the world. Causing 30 to 100 per cent yield losses. Thus, preventive measures are taken to reduce their damage. The objective was to evaluate the effectiveness of Success Sumi- Alpha (Esfenvalerate), Delta 2.8 EC (Deltamethrin), Actara (Thiamethoxam), and Alert 2.8 EC (Lambda\_ cyhalothrin) against fruit flies. 500 seedlings of zucchini were planted in an area of 1,320 square metres; the lines planted with the zucchini have been treated with those pesticides. Four replicates were done for each pesticide in RCBD, taking into consideration four replicates for the control. One spray was applied every week, and two readings were taken after each spray. The affected fruits of the zucchini and the unaffected ones suitable for human consumption were collected. Additionally, the fruits were weighed to determine the quantity lost in each treatment. Delta 2.8 EC (Deltamethrin) showed the most effective insecticide used in the experiment, with (36.8%) of unaffected fruits, followed by Sumi- Alpha (Esfenvalerate) with (36.0%). Alert 2.8 EC (Lambda\_ cyhalothrin) and Actara (Thiamethoxam) gave the least effectiveness among the insecticides used. The percentage of affected fruits increased in the blocks treated with Actara, followed by Alert 2.8 EC (85.1%) (77.8%) respectively, while Delta 2.8 EC pesticide was the lowest of affected fruits with (63.2%).

**KEYWORDS:** Fruit Fly, Zucchini, Sumi- Alpha, Deltamethrin



## Developmental Biology And Demography Of Melon Fly, *Zeugodacus Cucurbitae* (Coquillett) (Diptera: Tephritidae)

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### ABSTRACT

The melon fly *Zeugodacus cucurbitae* is among the most frugivorous pests worldwide. The effects of pesticides on the biology and demography of this pest are not well known. We studied these parameters under spinosad and dimethoate treatments, with distilled water as a control. The experiment was conducted under  $75 \pm 10\%$  Relative Humidity,  $28 \pm 1^\circ\text{C}$  temperature, and 12:12 light duration. Results showed that biology, demography, and life table parameters were significantly affected by both treatments. The total developmental time, larval, and pupal duration were significantly lower in dimethoate. Egg viability, larval, and pupal survival rates were significantly higher in control than in the other treatments. Adults' longevity was also significantly longer in the control cohorts than those in spinosad and dimethoate. The lower survivorship rate, highest mortality rate, and higher probability of dying were recorded from cohorts exposed to dimethoate. A higher mean number of flies alive, net reproductive rate, and total fecundity were observed in the control. Moreover, a significantly longer doubling time, life expectancy, and cohort generation time were observed in the control. Meanwhile, a significant decrease for the intrinsic rate of natural increase, and the finite rate of increase, was observed in the control. Our results suggest that spinosad can be a better substitute for conventional pesticides. However, management will be more effective when spinosad is coupled with other agroecology-compatible practices. Future studies can be conducted on the effectiveness of spinosad in combination with other biopesticides.

**KEYWORDS:** *Zeugodacus cucurbitae*, developmental biology, demography, spinosad

## Entomopathogenic Fungi: Their Efficacy And Fatal Attraction Potential Against *Drosophila Suzukii* (Matsumura, 1931)

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### ABSTRACT

*Drosophila suzukii*, Spotted Wing *Drosophila* (SWD) is a devastating pest of soft and stone fruit crops. Originating in Asia, this pest has widely spread. Its detection in sub-Saharan Africa has sparked fears of amplified damage because of inadequate control tools and poor phytosanitary approaches. Current control strategies rely heavily on synthetic pesticides. An approach which is sustainable in addition to its massive health risk. Therefore, a nature-based alternative such as the use of entomopathogenic fungi is urgently needed. We determined whether fungal spore (0.05g) volatile (FV) trigger behavioral responses in SWD in addition to monitoring for mortality. Flies were infected using cylindrical-plastic chamber where they could walk and pick up spores for 2min and then monitored for mortality for 10 days in experimental cages. The flies' behavioral response to the FV was done by allowing them to choose between clean air or volatile released by fungal spores.

All isolates exhibited high mortality on SWD. The median lethal time (MLT) showed that isolate ICIP78 was the most potent ( $4.75 \pm 1.03$  days) post-treatment followed by ICIP07, ICIP18, ICIP30, ICIP20 with MLT of  $4.95 \pm 1.02$ ,  $6.08 \pm 1.03$ ,  $6.96 \pm 1.02$  and  $8.04 \pm 1.04$  days respectively.

Horizontal transmission using infected males showed that female survival and fecundity were influenced by the action of the fungi. The behavioral assay showed that ICIP78 induced significant attraction ( $60.63 \pm 5.82\%$ ) to SWD compared to other isolates.

The study identified promising virulent fungal isolates that could be used as biopesticide for SWD control and revealed the first case of attraction of the pest to fungal isolates.

**KEYWORDS:** Entomopathogenic fungi, *Metarhizium anisopliae*, attractant, SWD

## Impact Of Protection Practices On The Damages Of Fruit Flies (Diptera: Tephritidae) Infesting Cucurbit Crops In Morogoro, Tanzania

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### ABSTRACT

Fruit flies (Diptera: Tephritidae) substantially threaten global cucurbit crops, causing significant losses ranging from 30% to 100%. This study aimed to compare the effectiveness of agroecological, conventional protection, and untreated practices in mitigating fruit fly infestations in cucurbit crops in Morogoro, Tanzania. The study was conducted over four seasons from January 2021 to November 2022; the research utilized a Randomized Complete Block Design with five replications in two agroecological zones. Each plot measured 45 meters by 45 meters, and there was a 100-meter separation between plots within replications. The collected data, including blemished fruits, infestation rates, and yield (kg/ha) per cucurbit crop, were analyzed using R software. Results revealed significant interaction effects of season, agroecological zones, and management practices on blemished watermelon fruits. However, such effects were not observed in cucumber and squash. Furthermore, the study demonstrated that seasons and agroecological zones significantly influenced infestation rates of *Z.cucurbitae*, *Dacus ciliatus*, and *D.vertebratus* in all three cucurbit crops, with the lowest infestation recorded at higher altitudes during seasons three and four. Management practices and altitude significantly affected cucumber infestation, with the highest infestation occurring in agroecological plots at high altitudes. While the interaction effects of season, agroecological zones, and management practices on yield were significant for watermelon, no such effects were observed for cucumber and squash. Agroecology practices promote sustainable cucurbit crop production, reduce fruit fly populations, and positively impact yield; therefore, we recommend using agroecology practices for sustainable farming.

**KEYWORDS:** Fruit flies, Cucurbit, Agroecology, Conventional, Sustainable.

## Rearing of *Diachasmimorpha longicaudata* (Hymenoptera: Braconidae) for biological control of *Ceratitis capitata* (Diptera: Tephritidae) in Morocco

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### ABSTRACT

The braconid *Diachasmimorpha longicaudata* (Ashmead) a larval-pupal endoparasitoid, originally from the Indo-Australian Region, has been used in several biological control programs of Tephritids, and considered as successfully established in most of the importing countries. The parasitoid was introduced from Spain in 2016, and reared on *Ceratitis capitata*, wild strain, collected from infested *Argania spinosa* (Sapotaceae) fruits, under restricted conditions, in the perspective of its probable release in the field. Medfly and parasitoid rearing were kept in a temperature-controlled insectary room ( $25 \pm 1^\circ\text{C}$ ,  $65 \pm 10\%$  RH; 12L:12D)

Reproductive and demographic parameters have been studied in order to optimize and improve rearing outcomes: 1) density and quality of host larvae, 2) host exposure time to the parasitoid, 3) sex ratio of parasitoid. Ratio of host/parasitoid, results indicated that the highest parasitism rate and parasitoid offspring production were obtained with ratios of 1:1 and 2:1 (larvae/female), along with the parasitoid lowest pupal mortality level, and the highest flight ability, at 24h exposure duration. A diet of pure honey and water for adult parasitoids gives a high longevity of almost 70 days. Other parameters did not differ significantly from one experimental to another. Our findings can be used to provide a suitable protocol for mass rearing of *D. longicaudata* for a biological control against *C. capitata*.

**KEYWORDS:** Biological control; *Ceratitis capitata*; *Diachasmimorpha longicaudata*; parasitoid; Morocco.

## Control Of Fruit Flies In Cucurbit Production In Mauritius- An Analysis Of Two Case Studies

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The fruit fly of the Tephritidae family causes substantial economic losses to cucurbits and other food crops in Mauritius. The larval stage, of this invasive pest, feeds on the fruit flesh, thus rendering agricultural produce inedible and unmarketable. During the Smart Agriculture project (2017-2023), led by the Mauritius Chamber of Agriculture, alternatives to the use of pesticides were tested to control the population of fruit flies. Of the thirteen growers who benefited from the Smart Agriculture project, two of them will be further analysed as case studies. Grower A has an open field cultivation of cucumber on 0.422 ha while Grower B, a sheltered butternut cultivation over the same area. Both are located in the South of Mauritius. For Grower A, two techniques were applied namely the Male Annihilation Technique (MAT) through the use of pheromones traps and the Bait Application Technique (BAT) using food attractants. Field sanitation was ensured using an augmentorium and Clerodendrum were planted around the field borders to lay the traps and attract the fruit flies. For Grower B, applied control and sanitation techniques included the MAT and augmentorium. Grower A achieved a remarkable 90% reduction in the Treatment Frequency Index (TFI) of insecticides, from 2.0 in 2020 to 0.2 in the year 2022. Conversely, Beneficiary B experienced a 26% increase in TFI, rising from 44.9 to 56.8 over the same period. The combination of tools and techniques used by Grower A provides a holistic approach for the successful control of fruit flies.

Keywords: Smart Agriculture; Fruit fly; Male Annihilation Technique (MAT); BAT (Bait Application Technique); Treatment Frequency Index (TFI)

## Introduction And Acclimatization Of The Parasitoid *Fopius Arisanus* (Hymenoptera: Braconidae) In Comoros

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### SUMMARY

The use of a parasitoid is one of the biological control methods to combat a targeted pest species. This is the case of the introduction of the parasitoid *Fopius arisanus* (Hymenoptera: Braconidae) in Comoros to fight against the fruit flies *Bactrocera dorsalis* and *Ceratitis capitata*. The parasitized pupae were shipped to Comoros from CIRAD La R  union and ICIPE Kenya. The rearing method was carried out at variable ambient temperature from 23 to 33  C and relative humidity from 59 to 77%. The individuals from the imported strains were placed in other cages within the laboratory. At the same time, breeding of *B. dorsalis* was carried out in order to have eggs which will serve as hosts for the parasitoids. For their releases, they were composed of individuals aged 7 to 10 days in order to have sexually mature and fertilized females, capable of laying eggs in the field. Between 2013 and 2015, six releases were carried out with strains from breeding in the INRAPE laboratory or directly from individuals from shipments of parasitized pupae. The results showed that six years after the first releases, the parasitoid is found on 7 host plants such as *Terminalia catappa*, *Annona senegalensis*, *Spondias dulcis*, *Psidium guajava*, *P. cattleinaum*, *Coffea arabica* and *Citrus reticulata*.

However, although its parasitism rate varies from one host fruit to another, the density of *F. arisanus* obtained still remains low. Hence the importance of a perspective of large-scale breeding and releases in order to make this biological control more effective.

**KEYWORDS:** Comoros, Introduction, Acclimatization, *Fopius arisanus*,

## Invasion, Spread And Pest Status Of The Melon Fly, *Zeugodacus Cucurbitae* (Diptera: Tephritidae) In Mozambique

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The melon fruit fly, *Zeugodacus cucurbitae* (Coquillett) (Diptera: Tephritidae) is among the most important pests of cucurbit fruits worldwide. Originating from Central Asia, it was first detected in Mozambique in 2013 in Mocimboa da Praia and Palma districts in the Northern Province of Cabo Delgado. The present study aimed to assess the current distribution and pest status of this species in the country. Trapping transects were established from 2019 to 2023, in all provinces, covering horticultural fields, villages, markets, sites along the highways and at borders with neighbouring countries. We used cue lure baited traps at each sampling site and inspected once per month. *Zeugodacus cucurbitae* was detected in northern and central provinces of Mozambique. In the detection points, the FTD (#flies per trap per day) ranged from 0.02 (in Vanduzi - Chitundo, Manica province) to 14.58 (Moatize-Condezi, Tete province). In general, Manica province was considered an area of *Z. cucurbitae* low pest prevalence as well as Cabo Delgado and Zambezia provinces, while Tete, Nampula and Sofala (at border with Tete province) were infested areas. There has been no detection of *Z. cucurbitae* in the southern provinces of the country. After the pest remained stationary in the northern region for several years, it is rapidly spreading throughout the Northern and Central regions. Although the southern region is considered a pest free area, the occurrence of *Z. cucurbitae*, will have severe impact on fruit and vegetables production and trade through direct fruit damage as well restrictions on the export to international trading partners.

**KEYWORDS:** fruit fly, *Zeugodacus cucurbitae*, detection, spread



### Project F<sup>3</sup>: Fruit Fly Free

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#### ABSTRACT

The Standards and Trade Development Facility is a global partnership facilitating safe trade. It funded the project F<sup>3</sup>: Fruit Fly Free, whose objective was to develop a framework for the establishment and maintenance of pest free areas (PFA) and areas of low pest prevalence (ALPPs) for fruit fly pests *Bactrocera dorsalis*, *Zeugodacus cucurbitae* and *Ceratitis capitata* in South Africa and Mozambique. *Zeugodacus cucurbitae* was detected in the northern part of Mozambique during 2013 and trapping was conducted from April 2021 to demarcate PFAs in both countries. *Bactrocera dorsalis* is well established in Mozambique but has a restricted distribution in South Africa and trapping was conducted from September 2020 to establish fruit production areas as PFAs and ALPP. In the southern part of South Africa, trapping was done from September 2020 to demarcate ALPPs for *C. capitata* in fruit production areas. The southern part of Mozambique and the whole of South Africa can be declared as PFAs for *Z. cucurbitae*. The National Plant Protection Organization of Mozambique reported on the status of *Z. cucurbitae* in February 2024. In Mozambique, *B. dorsalis* numbers never exceed 1 fly/trap/day in designated fruit production areas in Maputo, Inhambane and Manica. In South Africa, the Northern and Western Cape, and Free

State provinces are PFAs for *B. dorsalis*, while the status was changed from absent to present in one area in the Eastern Cape, the Sundays River Valley. The National Plant Protection Organization of South Africa reported on the change of *B. dorsalis* status in December 2021. ALPPs were established for *C. capitata* and *B. dorsalis* in South Africa. In addition, support for the establishment and maintenance of PFAs and ALPPs were provided through the development of mobile applications for fruit fly identification, training courses and financial models.

**KEYWORDS:** Pest Free Areas, Areas of Low Pest Prevalence, *Bactrocera dorsalis*, *Zeugodacus cucurbitae*, *Ceratitis capitata*

## Identification Of Pest-Free Areas And Areas Of Low Pest Prevalence For *Ceratitis Rosa* And *C. Quilicii* In Southern Africa

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*Ceratitis rosa* (Cr) and *C. quilicii* (Cq) are two closely related agricultural pests, occurring in parts of southern Africa. The DISPEST project, funded by the Belgian Development Cooperation, aims to provide recommendations for suitable Pest Free Areas (PFAs) and Areas of Low Pest Prevalence (ALPPs) for these two species in South Africa and Mozambique. In synergy with project F<sup>3</sup>, Fruit Fly Free (Standards and Trade Development Facility), and according to guidelines provided in the International Plant Protection Convention, our data contribute to the establishment of PFAs and ALPPs for the main tephritid pests impacting crop production in southern Africa. Suitable PFAs and ALPPs for Cr and Cq were determined via EGO lure trapping across South Africa and Mozambique between 2020 and 2021. In Mozambique, Cq was only trapped in the south of the country (Maputo province), whereas Cr was widely collected in all the other provinces (in higher numbers in the Inhambane and Maputo provinces). Across the eight provinces of South Africa, there were no records of Cr and Cq in Northern Cape Province. There were no records of Cr in the provinces of the Eastern Cape and Western Cape in South Africa. Three provinces in South Africa: Northern Cape, Eastern Cape and Western Cape can be delimited as PFAs for Cr. The Northern Cape Province can also be delimited as a PFA for Cq. ALPPs for Cr were identified in Limpopo and Kwa-Zulu Natal. ALPPs for Cq were identified in some fruit production areas of the Western Cape and Eastern Cape.

**KEYWORDS:** Pest Free Areas, Areas of Low Pest Prevalence

## Management Of Area Wide Integrated Pest Management For Fruit Flies For Market Access In Namibia

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Namibia's fast-growing Horticultural Industry is threatened by the presence of fruit flies. The first report of fruit flies was reported in 2007. This was achieved through surveillance that resulted in detection and identification of fruit flies in the country. By then Namibia was a net exporter of Mangoes, Bananas, Watermelon, and Citrus to South Africa. Since the interception of fruit flies in Namibia, the Government deployed 230 traps in Northern, Central, North East and West including the Southern part known to be pest free area. Awareness and capacity training have been conducted where 80 personnel both from the Ministry and stakeholders including the producers were capacity in fruit fly identification and management. To date Namibia market access to South Africa citrus and mango and continuous surveillance and monitoring targeting population suppression is an ongoing activity Surveillance reports are shared with trading partners on a quarterly basis. However, due to the economic implications of fruit flies, measures such as delimiting and integrated control programme towards the pest are enforced in order to limit their spread. Namibia detected the following fruit flies; *Bactrocera dorsalis*, *Ceratitis Capitata*, *Ceratitis cosyra* and *Dacus* spp. Namibia have managed to review its fruit fly quarantine, host range, distribution and hot spots areas. Management of the fruit fly of Namibia's trade related capacity to market access strengthened and adoption of Area wide strategies and full implementation of Integrated Pest Management achieved.

**KEYWORDS:** *Bactrocera dorsalis*, Integrated Pest Management, Area Wild

## Innovative Strategies In *Ceratitis Capitata* Control: A Focus On Morocco's Sterile Insect Technique Initiative

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### ABSTRACT

The Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae), is a serious threat to Morocco's Citrus industry, which is a vital sector of the national agricultural economy. As a result, the fly has reduced citrus exports, increased production costs, and impacted environment. To overcome those problems, the Sterile Insect technique (SIT), which entails mass rearing, sterilizing, and releasing insects on the affected areas, has emerged as an economical and environmentally acceptable biological control tool to address this issue. With assistance from the International Atomic Energy Agency (IAEA), Morocco has set up a mass rearing facility near to Agadir in order to manage this fruit fly. The facility has been constructed by the Moroccan Ministry of Agriculture with a budget of more than six million US dollars then equipped by the National Office of Food Safety (ONSSA) with the support of the IAEA. The objective is to produce and release 100 million sterile males weekly, covering 180,000 hectares of citrus in Morocco. On the plan, pest infestation rates will be assessed from January to June 2024, which will be followed by the SIT implementation in the designated Souss Valley areas until an effective pest suppression is achieved. It is anticipated that these efforts will reduce significantly the pest damage and contribute to the resilience of the Moroccan citrus industry.

**KEYWORDS:** Biological control, Citrus industry, Integrated Pest Management, Medfly, Tephritidae

## Performance Of Two Food Substrates In The Mass Rearing Of *Bactrocera Dorsalis* Hendel (Diptera: Tephritidae)

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### ABSTRACT

The fruit fly *Bactrocera dorsalis* Hendel is a major constraint to mango production in Burkina Faso. The objective of this study was to identify a food substrate for mass rearing of *B. dorsalis* to implement sterile insect technique. For this purpose, two different food substrates were evaluated. For each diet, 200 eggs of *B. dorsalis* in four replicates were incubated in Petri dishes containing diet to evaluate some biological parameters. In addition, forty pairs of *B. dorsalis* in four replicates were fed with Enzymatic Yeast Hydrolysate and sugar to evaluate the fecundity of female flies and the survival of both sexes. The developmental cycle length in Diet 1 and Diet 2 was 23.03 days and 23.24 days, respectively. Fecundity duration ranged from  $57.75 \pm 2.29$  to  $109.81 \pm 3.81$  days for females from Diet 1 and Diet 2, respectively. The pupal hatching rate varied significantly ( $P < 0.0001$ ) from  $89.12\% \pm 1.47\%$  to  $97.93\% \pm 0.34\%$  depending on the type of food substrate. Males lived longer than females regardless of food substrate type ( $60.36 \pm 1.84$  to  $107.10 \pm 4.08$  days for Diet 1 versus  $42.02 \pm 1.65$  to  $87.79 \pm 2.27$  days for Diet 2). Both food substrates tested were favorable to the good development of *B. dorsalis*, but the spawning index was 4 times higher with Diet 1. Most of the components of Diet 1 are available on the local market and are cheaper. Thus, we recommend the use of Diet 1 for *B. dorsalis* larvae mass rearing.

**KEYWORDS:** Mass rearing, food substrates, fecundity, fruit fly, mango.

## Application Of Sterile Insect Technique (Sit) For Eradication And Suppression Of The Mediterranean Fruit Fly In Turkey

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### ABSTRACT

The Mediterranean fruit fly [*Ceratitis capitata* Wied. (Diptera:Tephritidae)] is the most important pest that causes problems in the fruit fields of our country. It is a polyphagous and quarantine species. Citrus, apricot, peach, nectarine, fig, persimmon, pomegranate, apple, pear and avocado are the most important hosts detected in our country. In case of export of fruits contaminated with pests, the tolerance is considered as zero due to the possibility of contamination to these countries. Sterile Insect Release studies is carried out Bornova Pest Control Research Institute. We produce 5 million pupae in our laboratory every week. We have 2000-hectare citrus field in Menderes district of Izmir province. To determine the population, change of the pest, pheromone traps were hung at a height of 1.5-2 meters from the ground, in the southeast and prevailing wind direction of the trees, and the Mediterranean fruit fly individuals in the traps were counted and recorded at two-week intervals. The pheromone capsule was replaced every 4-6 weeks and the adhesive trays were replaced as they became dirty. The traps were checked at two-week intervals and the captured Mediterranean fruit fly individuals were recorded. In addition, fruit samples were taken from citrus fruits suspected to be damaged by the Mediterranean fruit fly, as well as from other products that are hosts of the pest (figs, quince, pomegranates). It was observed that the population density of the pest started to increase in 2023 as of June with 3.5 average per week. The number of Mediterranean fruit flies caught in traps began to increase sharply in November and the highest density was reached at 346 adults per week on 21.11.2023. The numbers in the traps continue to be high as the harsh winter has not yet arrived in Izmir. Although the last count was made on January 8, the average number of fruit flies caught in traps is 278. Studies are continuing to determine the population changes of the pest in hanging traps and to catch them in mass traps. Producers and all relevant institutions and organizations were informed about SIT on October 5, 2023, in Seferihisar and Selçuk districts, regions where the Mediterranean fruit fly is densely seen. Project work will continue in the field and laboratory in 2024. Release studies of sterilized Mediterranean fruit flies will be carried out in a 2000-hectare study area in Menderes district. Technical staff engaged in the project at our Institute will receive SIT training through the IAEA scholarship program.

**KEYWORDS:** Mediterranean fruit fly, Sterile Insect Release

## Adaptation And Sexual Competitiveness Of *Bactrocera Zonata* Reared On Modified Gel Diet Over 7 Generations

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Larval diet formulation is one of the most crucial components in mass-rearing facilities. Therefore, it is imperative to choose a diet that is cost-effective, but there must not be any compromise on the quality of the released flies. A gel diet was developed to increase the efficiency of the SIT programs in Mauritius. However, the shift to the gel diet could only be implemented after sufficient scientific evidence has been collected as regards the fly's acceptance of and adaptability to the new larval medium. There should be a balance between adaptation to mass culture using an artificial diet and retaining important characteristics of the released flies. The ability of a species to settle in a new habitat, to survive, and to thrive under a different condition is dependent on their ability to produce different phenotypes, driven by genotypic interactions resulting during the adaptation process. *Bactrocera zonata* flies were bred for 7 generations under controlled laboratory conditions, using the novel larval gel diet. Flies were fed standard diet (sugar: enzymatic yeast powder in a 3: 1 ratio) and supplied with water ad libitum, as from emergence. Release-recapture exercise was carried out in the University Farm in Réduit, Mauritius, covering an area of 21 acres. Satisfactory quality parameters were achieved as regards to egg hatch, pupal weight (mg/100 pupae), emergence and flight ability for the F7 flies. Release-recapture analysis showed that more than 80 % of sterile males were recovered up to 5 days after release, while less than 10 % were recovered from day 7 onwards. Significantly more flies were caught over 125 m given by 93.4 % for flies bred on gel diet, and 92.0 % for flies bred on the conventional diet, while less than 10 % were detected at a distance greater than 150 m or more. A Fried Test was also carried out. The C value for the Fried Test was  $0.46 \pm 0.07$ , and thus suggest that the sterile males successfully competed with the wild flies. In summary the novel gel diet has the required quality to ensure the development of flies exhibiting desired characteristics for use in SIT programmes.

**KEYWORDS:** Mass culture, SIT, release-recapture, Fried test, cost effective diet



## Preliminary Analysis Of Quantum Dots As A Marking Technique For *Ceratitis Capitata*

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### ABSTRACT

This study investigated the efficacy of quantum dots as a marking technique for *Ceratitis capitata*, relative to fluorescent powders. *Ceratitis capitata* is a major agricultural pest, which is controlled using the Sterile Insect Technique (SIT) in many countries. One of the requirements for successful SIT is consistent monitoring of sterile vs wild flies. Sterile flies are marked prior to release, so that it is possible to determine the ratio of sterile to wild flies caught in traps, and therefore keep accurate records of released flies. Fluorescent powders are currently being used for this purpose, but some issues with this method include difficulty in distinguishing marked flies, marked flies can be negatively affected by powders at incorrect quantities, and powders can be transferred between flies. Quantum dots are a viable alternative to these powder marking techniques. This study evaluated the following when comparing the two marking methods: 1) retention rates using different preservation techniques, 2) stability and transference, 3) recapture rates, and 4) effects on survival, pupation and flight ability. Our results found that quantum dots showed variable retention rates, poor stability over time, while transference was equivalent to powder marked flies. In recapture experiments no flies with quantum dots were recaptured, while recapture rates for powder marked flies was poor (8-9%). Quantum dots did not affect mortality of flies nor pupation rate, but flight ability was poor compared to powder-marked flies. These preliminary results indicate that it would be worth exploring different application methods of quantum dots.

**KEYWORDS:** Fluorescent powders, Monitoring Techniques, Agricultural Pest Management

PO47

## Semiochemical Pre-Treatment Reduces The Response Of *Bactrocera Dorsalis* To Methyl Eugenol Under Semi-Field Conditions

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### ABSTRACT

Male flies in the genus *Bactrocera* (Diptera: Tephritidae) are attracted to phenylpropanoid semiochemicals. Due to its attractiveness to *Bactrocera* males, methyl eugenol is a highly effective lure that is used for male annihilation technique (MAT). MAT and sterile insect technique (SIT) are usually implemented sequentially to avoid SIT males being attracted to MAT baits. Prior semiochemical exposure may reduce subsequent lure responses of male *Bactrocera* and allow synchronous application of MAT and SIT. We determined how interactions between weather, physiology and prior semiochemical exposure affect the response of male *Bactrocera dorsalis* to methyl eugenol baited traps. Response of 20 males was determined in a semi-field setting in relation to time of day, temperature, relative humidity, semiochemical pre-treatment (methyl eugenol, eugenol, or none), diet (protein supplemented and protein deprived) and age (4, 10 and 20 days old) (n=5). Semiochemical pre-treatment involved supplementing the diet with either semiochemical at a concentration of 1.25% for 48 hours prior to testing. Exposure of mature males (10 and 20 days) to either semiochemical reduced their response to methyl eugenol by as much as 95.97%. Diet did not affect the response of semiochemical pre-treated flies. The number of flies that responded to methyl eugenol decreased with lower temperature, with poor response occurring below 23°C. These results highlight the potential of synchronous application of MAT and SIT by using semiochemical pre-treatment. We also show that eugenol can be a viable alternative to methyl eugenol, as it is as efficient, cheaper, and less toxic than methyl eugenol.

**KEYWORDS:** Attractants, IPM, methyl eugenol, semiochemical, SIT, trap response

## Effect Of Natural Zeolites On The Oviposition Of The Olive Fruit Fly And The Mediterranean Fruit Fly

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Over the recent years, there has been a growing urgency to find alternatives to chemical pesticides for effective pest control, prompting a closer look on natural zeolites. Our study focused on examining the impact of natural zeolite sourced from Evros, Greece (with a specific determination of the zeolite's synthesis) on the oviposition behavior of the olive fruit fly *Bactrocera oleae* (Diptera: Tephritidae) and the Mediterranean fruit fly *Ceratitis capitata* (Diptera: Tephritidae). The zeolite, whether applied alone or in combination with the emulsifier adjuvant NU-FILM-P® in water, was administered as an aqueous suspension on the surface of olive fruits. The results revealed a significant decrease in the number of eggs laid in treated olive fruits compared to the control group (without zeolite application). This deterrent effect is likely attributed to the formation of a thin zeolite layer (hymen) on the fruit surface. Conversely, when Mediterranean fruit fly females were exposed to peaches and vanilla plums treated with natural zeolites, no notable oviposition deterrent effect was observed. Consequently, ongoing experiments involving various zeolite types and different host plants of the Mediterranean fruit fly are underway. In summary, Greek zeolites demonstrate a notable oviposition deterrent effect on the olive fruit fly but not on the Mediterranean fruit fly.

**KEYWORDS:** *Bactrocera oleae*, *Ceratitis capitata*, Tephritidae, Diptera, alternative pesticide

## Influence Of Crop Protection Strategies And Landscape Composition On *B. Dorsalis* Infestation Rate In Mango Orchards In La Réunion

Laura, Moquet<sup>1\*</sup>, Jean-Marc Barbier<sup>2</sup>, Frederic Chiroleu<sup>1</sup>, Emma Dieudonné<sup>1</sup>, Marie-Ludders Moutoussamy<sup>1</sup> and Hélène, Delatte<sup>1</sup>

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### ABSTRACT

Since its first detection in 2017, in La Réunion, *Bactrocera dorsalis* has caused considerable damage to crops of economic importance, such as mango. However, there is variability among orchards in the damage caused by these pests, probably due to farmer practices, mango varieties, and/or landscape. Farmers can use different management strategies: prophylaxis with the removal of fallen fruit, male trapping with methyleugenol (but with regulatory restrictions in the EU), attract and kill (Syneis bait), chemical treatments among others. In La Réunion, around fifty varieties of mango are grown, but the main ones are Cogshall, José and Nam Doc Mai. The composition of the landscape could influence the presence of fruit fly pests by providing alternative hosts to thrive. In this study, we analysed how farmer practices, landscape composition and mango varieties were related to *B. dorsalis* infestation rate. We regularly collected fruits between June 2020 and February 2022 and calculated the number of emerging individuals of each fruit fly species for the different fruit species, site and date. Agricultural practices were determined from semi-structured interviews and categorised according to the farm structure and practices for *B. dorsalis* management. Landscape composition was determined from high-resolution satellite imagery, and the area of the landscape cover was calculated in a 500m buffer around each sampled orchard plot. We observed that the influence of practices and landscape composition on the infestation rate depended on the mango variety. Our results provide important clues for managing this pest in mango orchards.

**KEYWORDS:** Oriental fruit fly, Agro-ecology, Pest management

## Socioeconomic Impact Of Fruit Flies (Diptera, Tephritidae) On Small-Scale Agroecological Cucurbit Production In Eastern Central Tanzania

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Environmental safety and productive agriculture are two sides of the same coin in the fight against poverty and food insecurity in Africa. For sustainable agriculture against fruit fly pests, agroecological farming practices are becoming more popular although their socio-economic benefits have been rarely quantified. In this study, we quantify the socioeconomic impact of Tephritidae on cucurbit crop production in the Morogoro area (Central Eastern Tanzania) by conducting a baseline survey among farmers and field experiments. The perceived impact of fruit flies includes; the inability to sell infested fruits, the loss of fruit quality and market value, increased production costs and discouragement of farming investment. The perceived benefits of agroecological farming included enhanced weed, pest and disease control, moisture preservation, low crop production costs, local availability of the inputs, enhanced plant vigor, improved soil fertility, and higher crop yield. The field experiment results showed how agroecological crop management significantly reduced the number of damaged cucumber, squash and watermelon fruits. Improvement in yield on agroecological plots was observed mainly during the second year of production for cucumber and squash. The cost-benefit ratio (per hectare) under agroecology management was 2.0:1.9:0.9 and under conventional management was 1.8:2.2:0.3, for respectively squash, watermelon and cucumber. The production cost was significantly lower in agroecological farming in all cucurbit crops than in conventional. Agroecological farming can generate positive economic benefits in terms of production and management costs.

**KEYWORDS:** Agroecology, cucurbits, fruit flies, socio-economics, yield

## Agroecological Farming Practices Against Fruit Flies In Central Eastern Tanzania

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Management of tephritid fruit flies via agroecological farming is becoming a preferred option because it has no adverse negative effect on the environment and human health. However, awareness on the use of agroecology as a fruit fly pest control strategy is relatively low in most parts of Tanzania. Our objective was to quantify awareness and promote the use of agroecological practices for the management of fruit flies among small-holder cucurbit farmers. Surveys were conducted in Central Eastern Tanzania, using a semi-structured questionnaire. A total of 138 cucurbit growers, including 94 males, 44 females, participated in the survey. We found that 63% of farmers applied mainly synthetic insecticides, 27.5% employed exclusively agroecological farming methods and 9.4% did not control pests. Agroecological farming methods used against fruit flies were spot application of baits (26.3%), weeding (26.3%), orchard sanitation (23.7%), bio fencing (13.2%), application of biopesticides (5.3%), early harvesting (2.6%) and mulching (2.6%). Contingency chi-square tests and a Generalized Linear Model were used to analyze the data. Experience in cucurbit production significantly determined awareness and choice of the agroecological farming method. Awareness on fruit flies' infestation significantly varied with experience, education and the type of cucurbit crop grown. Up to 82.6% of farmers who were using synthetic insecticides and those who did not apply any method were willing to switch to agroecological farming methods if they were trained. Raising awareness and providing training is likely to increase the adoption of agroecological farming methods.

**KEYWORDS:** Awareness, Agroecology, fruit flies, Infestation, fruits, management

## Contribution To Fruit Flies (*Bactrocera Dorsalis*) Ipm Strategy In Humid Forest With Bimodal Rainfall Agroecological Zone In Cameroon

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### ABSTRACT

*Bactrocera dorsalis* and several native Tephritid species in Africa continent are responsible for serious constraints to mango and other fruit production in sub-Saharan countries. A one year trapping (twelve months) was conducted in 2023 in Humid Forest with Bimodal Rainfall Agro-ecological zone in Cameroon. This was done to determine this species seasonality in the 3 localities (Mfoundi, Mfou and Esseka) where farms specialized for the production of mango fruits for export were abandoned by farmers because of difficulties to control the pest with their practices. Methyl Eugenol was used as para-pheromone, and data were collected every week from each trap. The patterns of male lure trap count also revealed the presence of *B. dorsalis* throughout the year in these 3 localities. *Bactrocera dorsalis* exhibited peaks during the rainy season in May in two localities (Mfoundi and Mfou), which coincided with the mango season, while it peaked in June in Esseka. This preliminary result indicates that the control period of *B. dorsalis* must be well considered in the farmer package of Integrated Pest Management tactics and planned from mid-February to June when the pest is more abundant. This study is the first yearly assessment to address this particular problem to control this fruit fly species in these three localities.

**KEYWORDS:** *Bactrocera dorsalis*, Methyl Eugenol, trap



## A Challenge In Neretva Valley Area Wide Control Program: New Insight On Medfly Overwintering Capacity

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### ABSTRACT

Background: Medfly area-wide suppression program in the Neretva valley integrates release of sterile medfly males from the late April till mid-November. This release strategy is implemented from since 2010 when an area-wide control program supported by FAO/IAEA was initiated. Methods: Medfly overwintering capacity in the Neretva valley was assessed during 2019-2021 as a part of the EU-funded project FF-IPM (<http://fruitflies-ipm.eu>). We analysed: i) adult, pupae and larvae overwintering capacity ii) detection of adults at hot spots from April to June and iii) available and suitable host plants fruits in late winter. Results: Experiments on the OFF -season survival potential of adults and pupae show that significant percentage of adults can survive through April and May. Significant pupal survival and long adult lifespan reach summer period and egg laying from April through July in both open field and urban conditions. Annual reports for 2014-2017 note several adult detections during early April in open fields, as well as detections of larvae in *Fortunella japonica* and *Citrus paradisi*. Conclusion: Medfly overwintering capacity in Neretva valley increased significantly in favor of the pest. Beside population that overwinters as larvae in fruit, significant percentage of adults are able to overwinter in both open field conditions as well in urban areas and reproduce through spring and summer. Findings from this research suggest that current national suppression strategy for *C. capitata* need to be adjusted. The release strategy should be optimized concentrating on hotspots supported with implementation of the off- season strategies and suppression methods with goal to control the low adult populations during winter and early spring period.

**KEYWORDS:** Medfly, Sterile Insect Technique, overwintering adults

# 5<sup>TH</sup> TEAM MEETING

15 - 18 April 2024

Maritim Crystals Beach Hotel, Belle Mare,  
Republic of Mauritius

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*The AgriSafe Hub Research and Development Centre*

RFD is a well-established agricultural solutions provider with a strong commitment towards food security. Market leader in the Crop Protection, Soil Health, Plant and Public Health Sectors, the company nurtures a strong innovative culture and provides quality agricultural inputs sourced from renowned suppliers. Customised consultancy services are provided locally and across the African continent with the aim of encouraging a more sustainable food production model.



#### **Soil Analysis & Fertility Management**

RFD, with the support of Brookside Laboratories in the USA, provides precise soil analysis services to the industry. Customised soil fertility management strategies by RFD's soil expert accompanies the test results.

#### **Sustainable Crop Protection**

RFD has developed the AgriSafe® concept which recognises the importance of crop protection to ensure a sustainable agricultural production. The judicious use of chemical inputs is encouraged to preserve biodiversity and protect beneficial organisms such as pollinators, predators, and parasitoids.

#### **Introduction of new varieties**

RFD's Research and Development Centre (The AgriSafe Hub) situated in the western part of the island focuses on identifying new vegetable varieties which are more adapted to our local conditions.

#### **Technical support**

With the expertise of an entomologist, a plant pathologist, a weed scientist, and a soil scientist, RFD, provides growers with professional agronomic support for accurate diagnosis and the efficient management of pests, diseases, and weeds.

#### **Traceability**

AgriSafe® emphasises on the importance of traceability through the systematic recording of agronomic interventions ensuring compliance with recommended pre-harvest intervals as per food safety regulations,



**Discover Excellence with Blychem: Your Trusted Partner in Agriculture and Irrigation**

At Blychem, we are dedicated to transforming the landscape of agriculture and irrigation, one innovative solution at a time. With a rich history of expertise and a commitment to excellence, we stand as a beacon of reliability and ingenuity in these critical sectors.

**Transforming Agriculture:** As leaders in agricultural solutions, Blychem brings cutting-edge technologies and sustainable practices to empower farmers around the island. Our comprehensive range of crop protection products, tailored nutrition solutions, and world-class seeds ensure optimal yields while promoting environmental stewardship.

**Re-inventing Irrigation:** With a focus on efficiency and sustainability, Blychem revolutionises irrigation practices to meet the evolving needs of modern agriculture. Partnering with global leaders like Valley Irrigation and Netafim, we offer state-of-the-art solutions that maximize water usage, minimize resource waste, and enhance crop productivity.

**Your Trusted Partner:** Our mission goes beyond providing products – we are your trusted partner in agricultural success. Our team of experts is committed to delivering personalized solutions, expert advice, and unparalleled support to help you achieve your goals.

**Join Us in Cultivating Excellence:** Whether you are a small-scale farmer or a large-scale agribusiness, Blychem is here to support your journey towards agricultural excellence. Together, let's cultivate a future where innovation thrives, and yields flourish. Discover the difference with Blychem – where agriculture meets innovation, and success grows.





## Company profile Russell IPM and Russell Bio Solutions

Russell IPM is a leading manufacturer of biorational crop protection products in the UK. We provide tailored solutions to address the challenges faced by farmers and growers worldwide. Specializing in pheromone lures, traps, and bio-rational pesticides, we are committed to staying at the forefront of innovation, development, and customer support for integrated pest management on a global scale.

“Our mission is to develop and promote technologies that tackle the crucial task of feeding the world's population while safeguarding both people and the environment. We aim to expand our successful partnerships globally, sharing knowledge and benefits with communities worldwide.”

Over the past three decades, our dedicated research and development team has focused on pioneering high-potential new products. We cater to the needs of the agriculture sector, stored product industries, and home and garden markets. Our research facilities boast a pheromone dispenser formulation laboratory, trap adhesive research unit, advanced pressure-sensitive adhesive coating equipment, and cutting-edge technology to incorporate pheromones and attractants into adhesive layers. Additionally, we house an advanced in-house printing facility for customizable products.

Russell Bio Solutions, a sister company of Russell IPM, is one of the leading UK manufacturers of natural product-based biopesticides, bio-fertilizers, and biostimulants. Our core expertise lies in sustainable biorational crop protection and plant nutrition solutions, harnessing the power of beneficial soil microbes and natural products. Operating from our factory in Flint, North Wales, UK, we are pioneers in microbial pesticides. We boast expertise in large-scale solid and liquid fermentation of microbes, as well as pheromone-based attract-and-kill systems and slow-release microbial tablet formulations. With our products marketed in over 80 countries worldwide, we strive to provide effective solutions that address the needs of smallholder farmers in Asia and Africa, empowering them to participate in the global agricultural market.

Russell IPM and Russell Bio Solutions have developed numerous biorational solutions for various insect species, including several fruit fly species of economic importance, Fall Armyworm, Tuta absoluta, and other invasive pests found in Europe, Asia, and Africa.

Our ultimate aim is to develop sustainable crop protection solutions and foster an agro-ecological climate where minimal intervention is required to achieve optimum harvest levels. Through our biological solutions, we aim to help farmers mitigate the impact of climate change and significantly reduce their reliance on chemical fertilizers and pesticides.

With a legacy spanning over 37 years, Russell IPM has been recognized for its outstanding performance, receiving the Queen's Award for Enterprise three times in 2011, 2012, and 2018.

The Government Online Centre (GOC) (<https://mitci.govmu.org/Pages/GOCNew1.aspx>), a pivotal department under the Ministry of Information Technology, Communication, and Innovation (<https://mitci.govmu.org>), stands as a cornerstone of the Government's digital infrastructure. Since its inception in May 2005, the GOC has evolved into a state-of-the-art centralized data centre, dedicated to delivering essential government services to citizens, businesses, government officials, and overseas non-citizens.

From its modest beginnings with just five server racks, the GOC has expanded exponentially, now boasting an impressive 80-rack capacity for servers and equipment. The GOC is one of the few data centres on the island with a robust infrastructure with wide range of network complexities serving its stakeholders on a 24/7 basis.

The GOC is steadfast in its mission to elevate digital accessibility, thereby enhancing service delivery. Committed to optimizing costs associated with Government IT Infrastructure, its priority is to ensure stringent security and privacy measures while championing the digital transformation of government services and fostering transparency, while upholding accountability

In its quest to solidify its position as a reference in Government Data Centres for the African Region, the GOC ensures strict adherence to International Data Centre Standards. Additionally, the GOC's dedicated team of professionals consistently innovates by spearheading centrally hosted e-Government projects. Notable projects include the Government Portal (<https://govmu.org>), the Government Email Infrastructure, and the Government Cloud Infrastructure which provides Infrastructure as a Service as well as Platform as a Service.

The GOC as a service provider also provides the following key facilities:-

- Internet access through the Government Intranet System (GINS)
- Web publishing and hosting facilities for Ministries / Departments and Parastatal Bodies
- Hosting of common and back-office applications
- Hosting of e-Services applications
- Server Hosting facilities (Co-location)

For any other information regarding the GOC and its services, please send an email on [contact@goc.govmu.org](mailto:contact@goc.govmu.org)