The invasive crop pest *Drosophila suzukii*

纪小小、彭琼琳、梁子健

2024.5.30

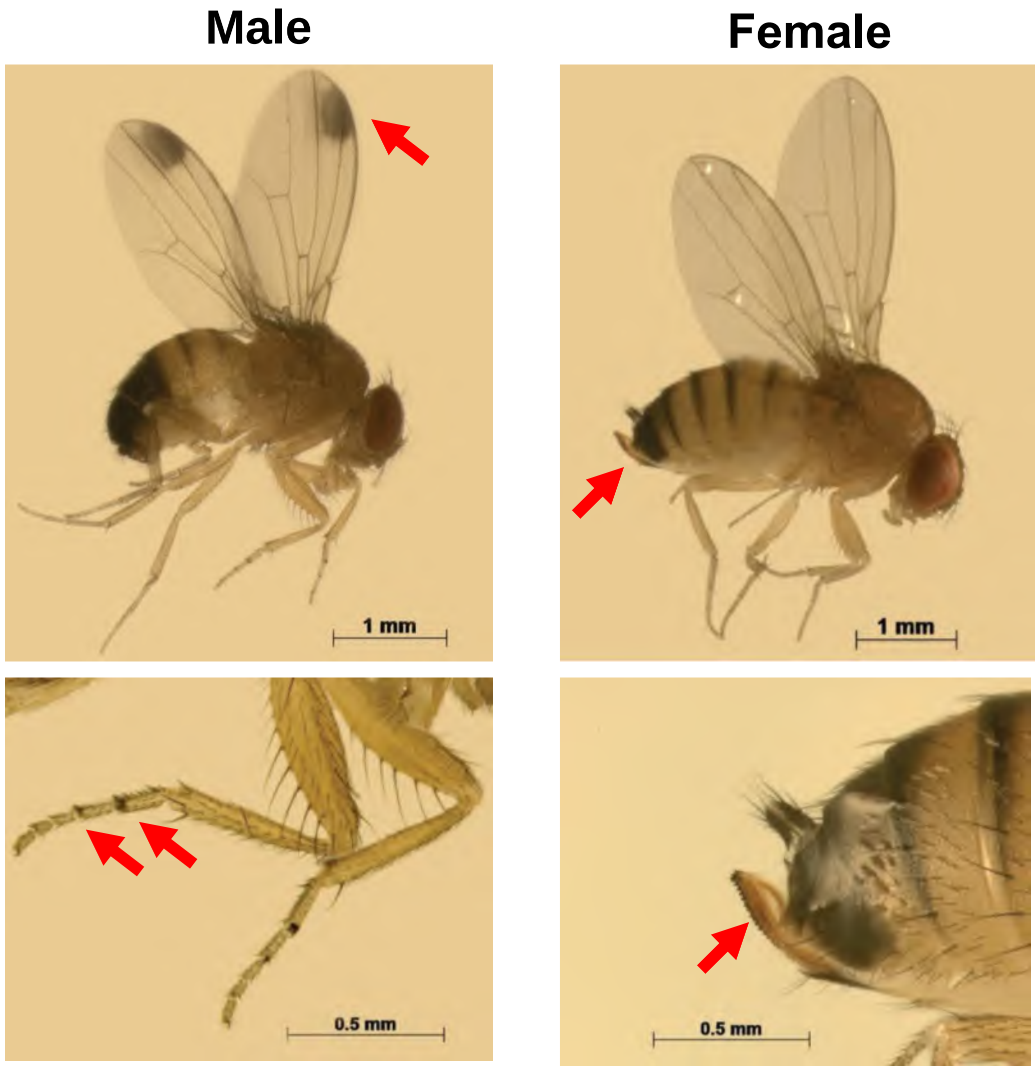
Content

- Overview of *Drosophila suzukii* —— 纪小小
- Chemical ecology of *Drosophila suzukii* —— 彭琼琳
- Strategies to control *Drosophila suzukii* —— 梁子健

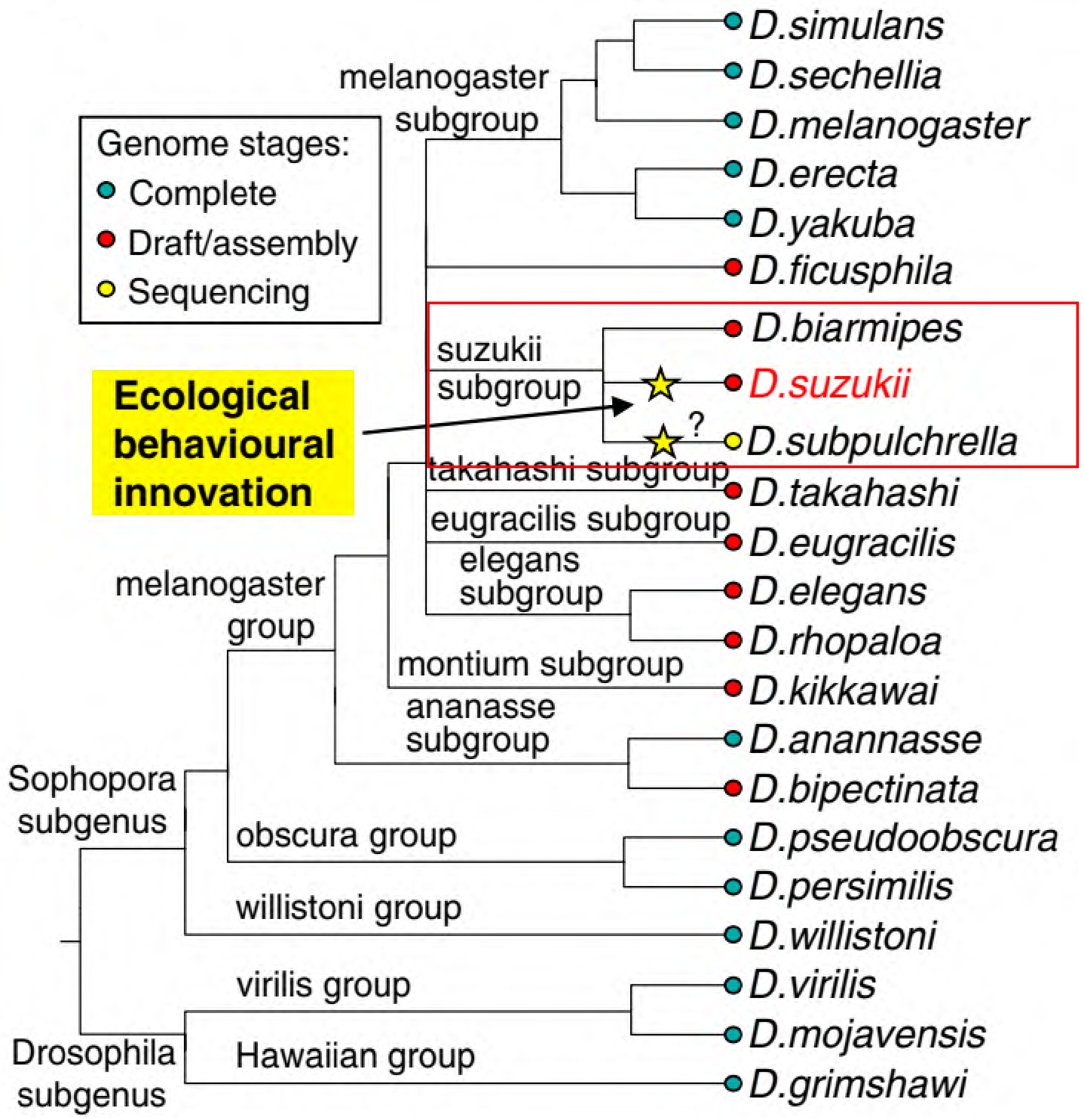
Overview of *Drosophila suzukii*

Ji Xiaoxiao
2024-05-30

Drosophila suzukii, the Spotted Wing *Drosophila* (SWD)

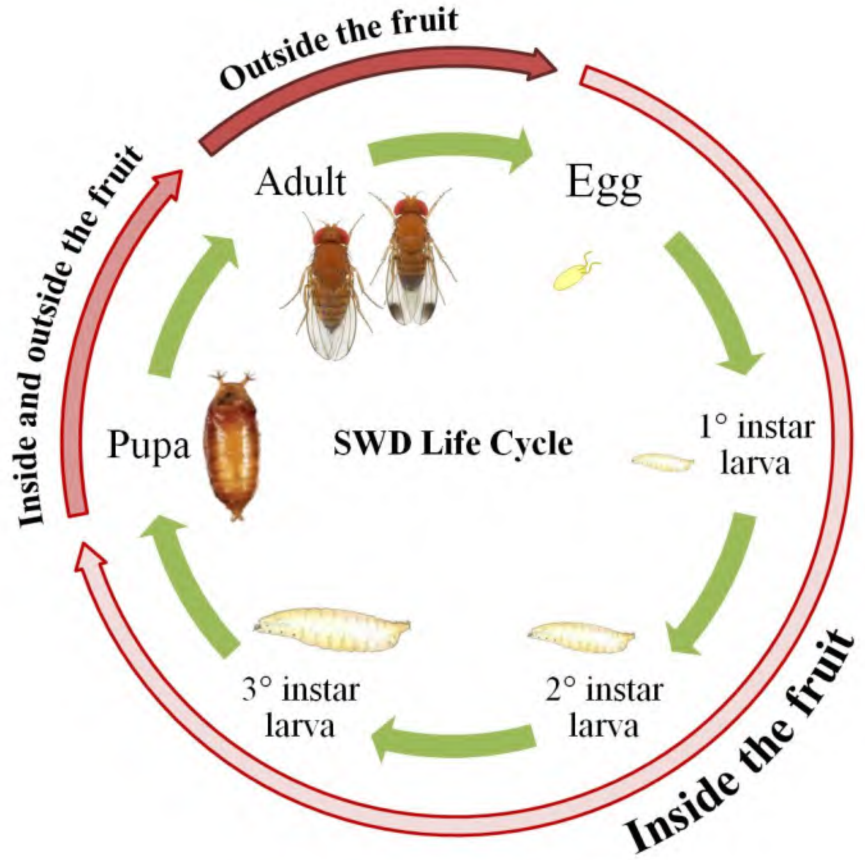


Garcia, *Drosophila suzukii management*, 2020



Rota-Stabelli et al., *Current biology*, 2013

Basic biology of *D. suzukii*



Developmental time is dependent on temperature and larval diet.

~10 days at 25℃, 21 to 25 days at 15 ℃

Females oviposit between 10 ℃ and 32 ℃.

The adult stage was noted to overwinter.

Lee et al., *Pest manag sci*, 2011

Why study *Drosophila suzukii*?

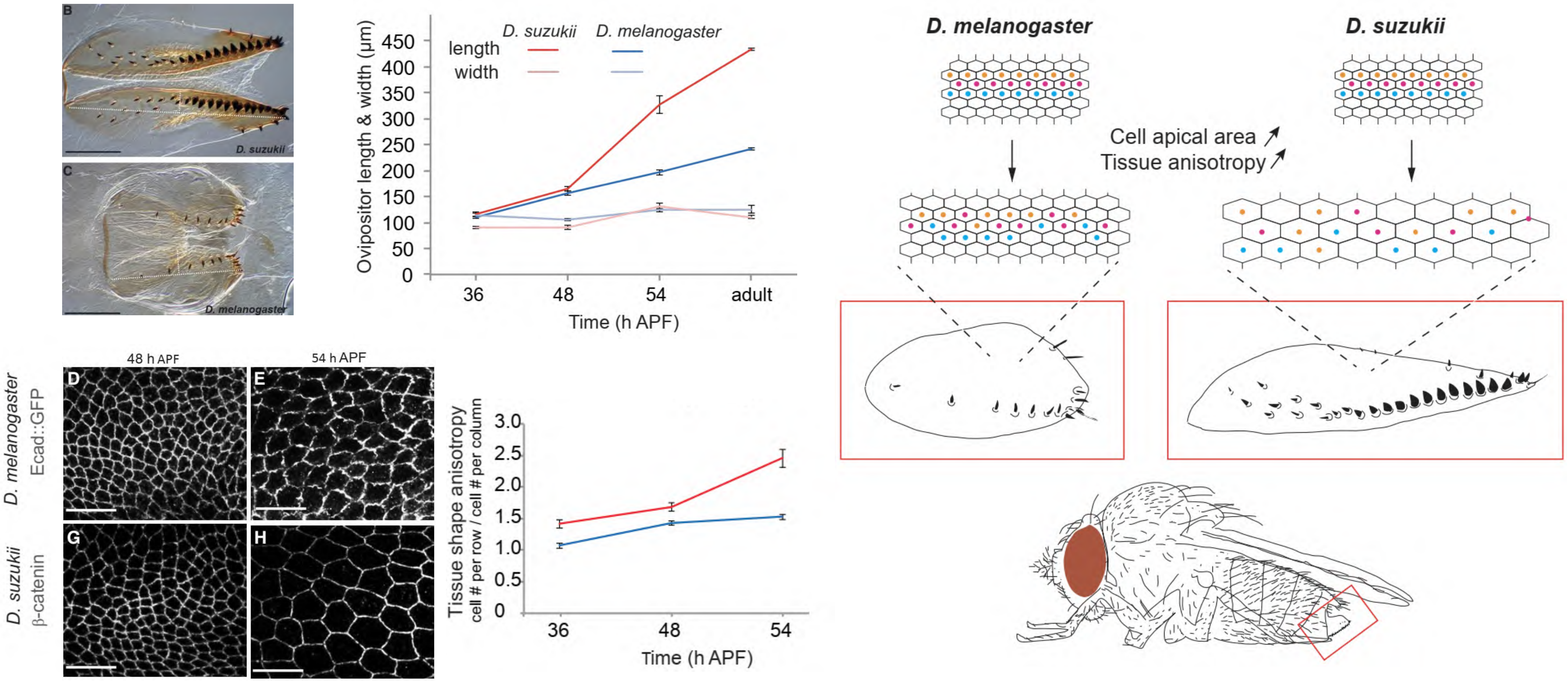
Drosophila suzukii:

- undamaged, ripening fruits.

Economic loss!!!

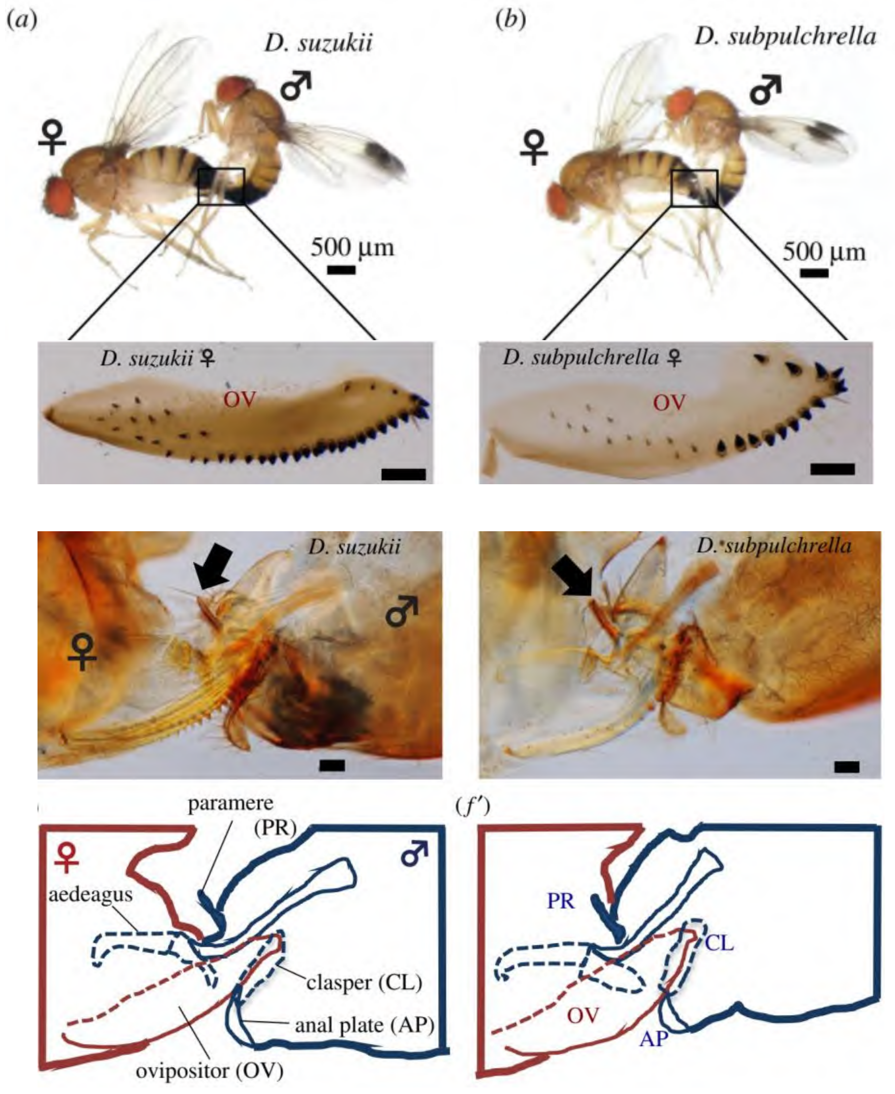
- wide host range: berries, cherries, grapes, pears, etc.
- fast invasion speed.
- **a model for invasion biology and pest management.**
- **a model for evolution.**

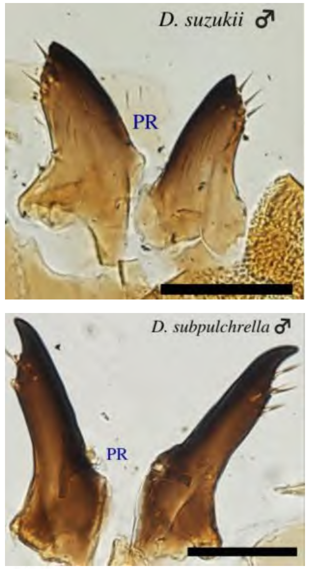
Evolution of ovipositor length in *Drosophila suzukii*

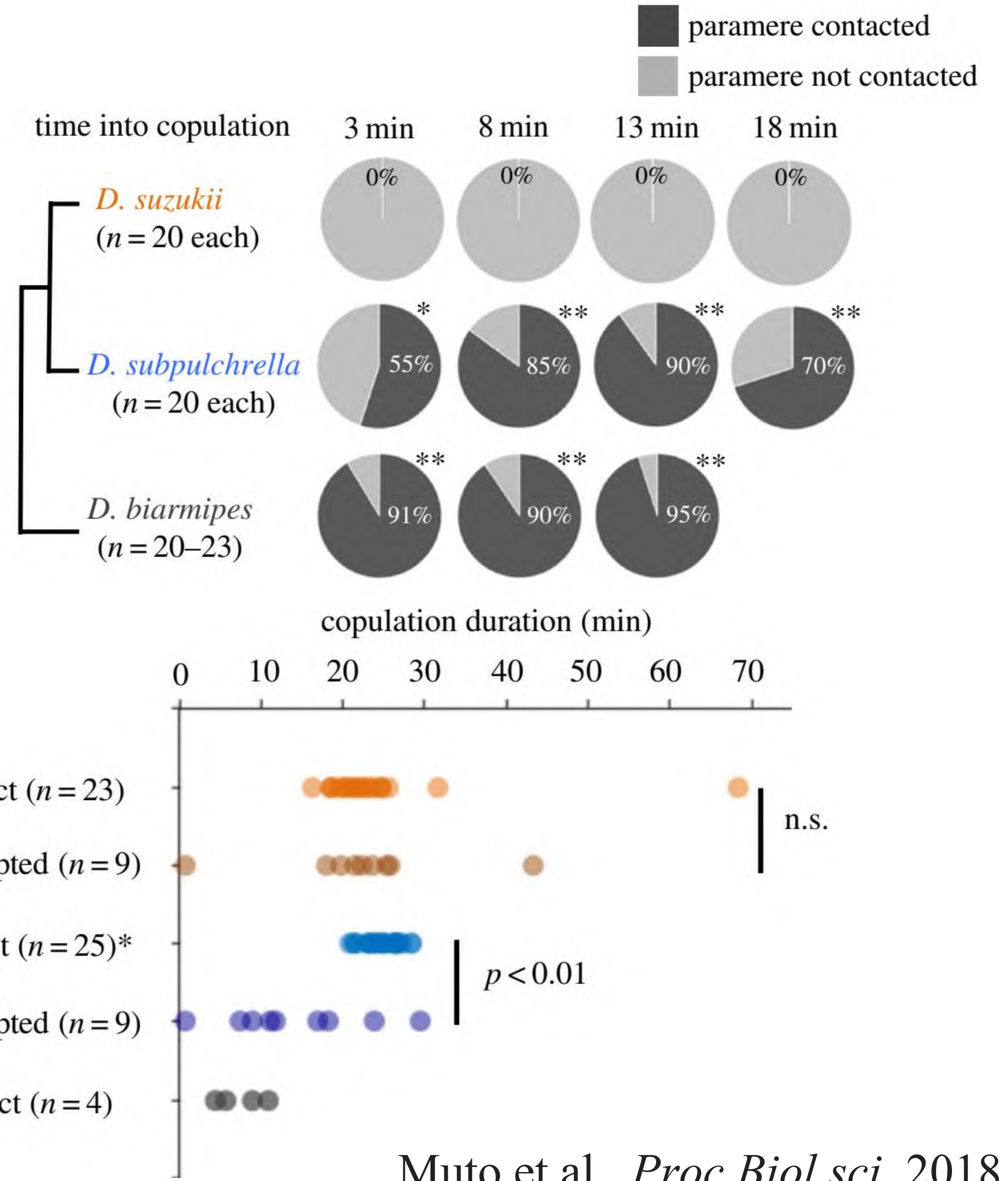


Green et al., *Current biology*, 2019

Genital coevolution between sexes in a fruit-damaging *Drosophila*





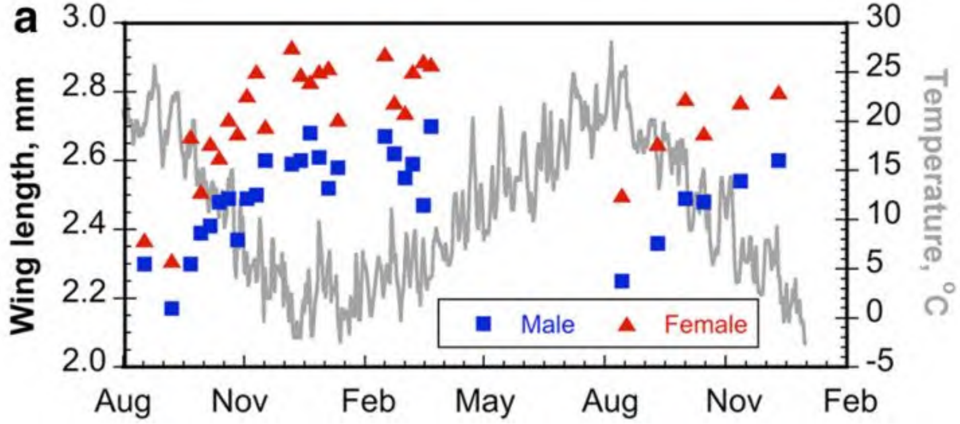


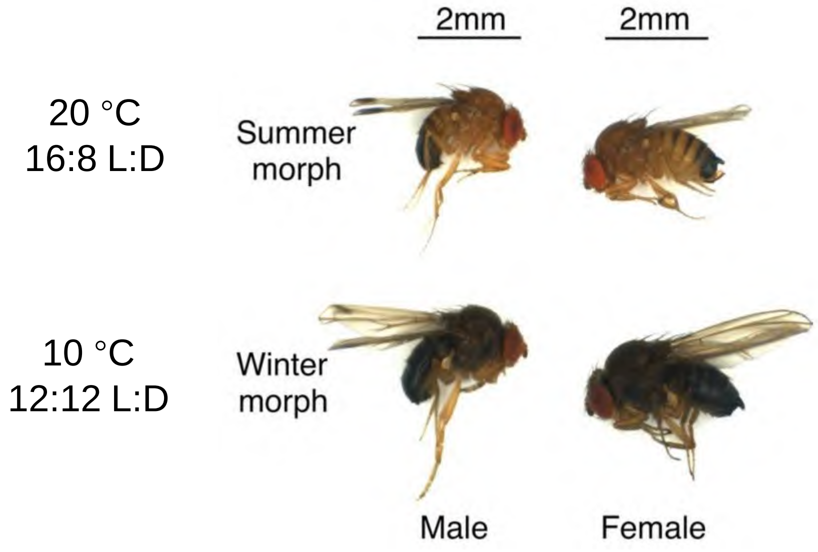
Muto et al., *Proc Biol sci*, 2018

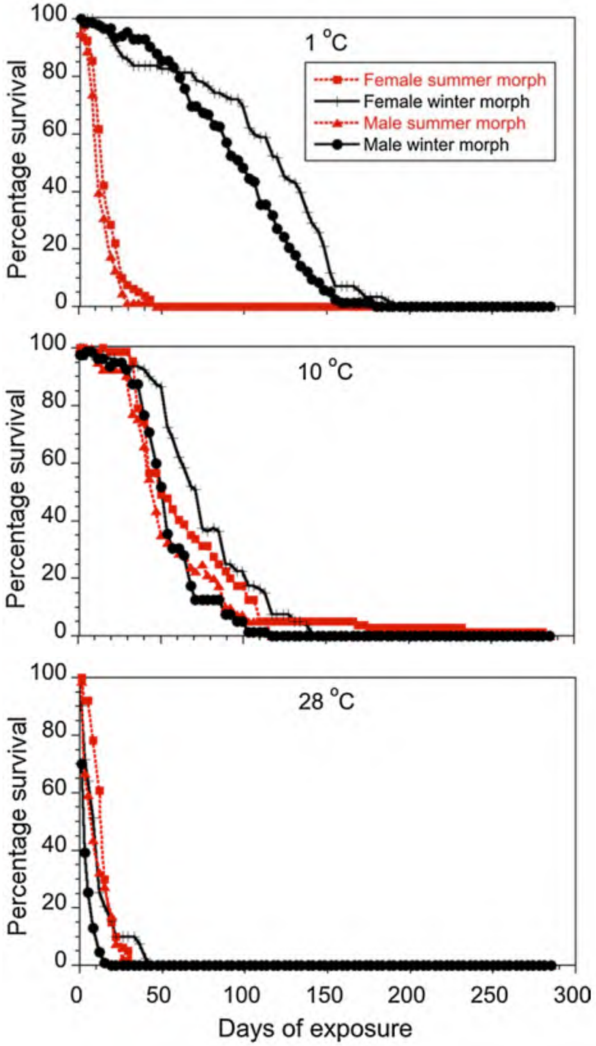
The geographic locations of 29 natural *Drosophila suzukii* populations

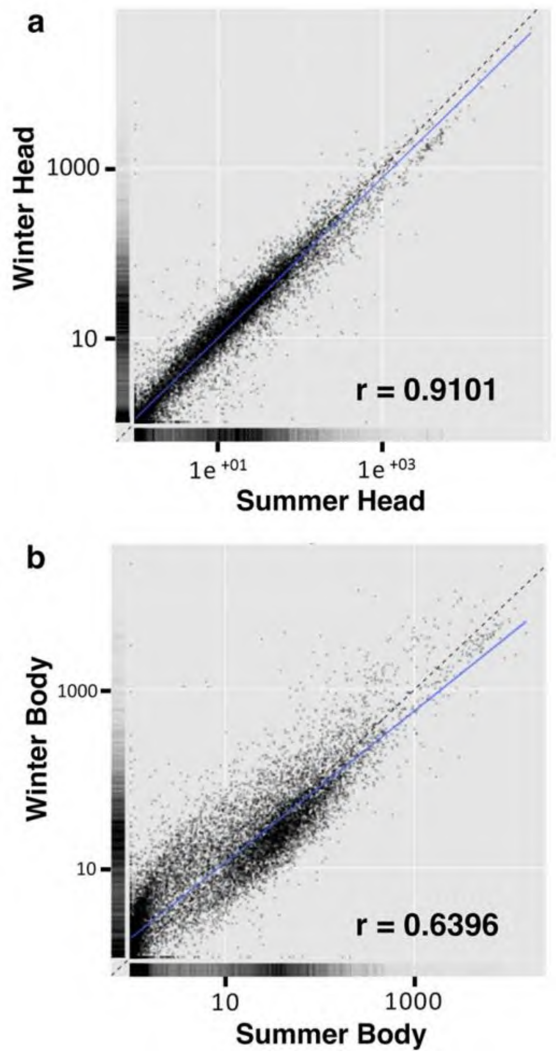
Feng et al., *bioRxiv*, 2023

Seasonal cues induce phenotypic plasticity of *Drosophila suzukii* to enhance winter survival



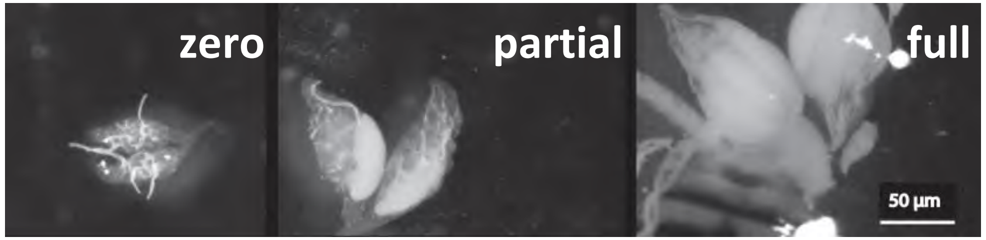




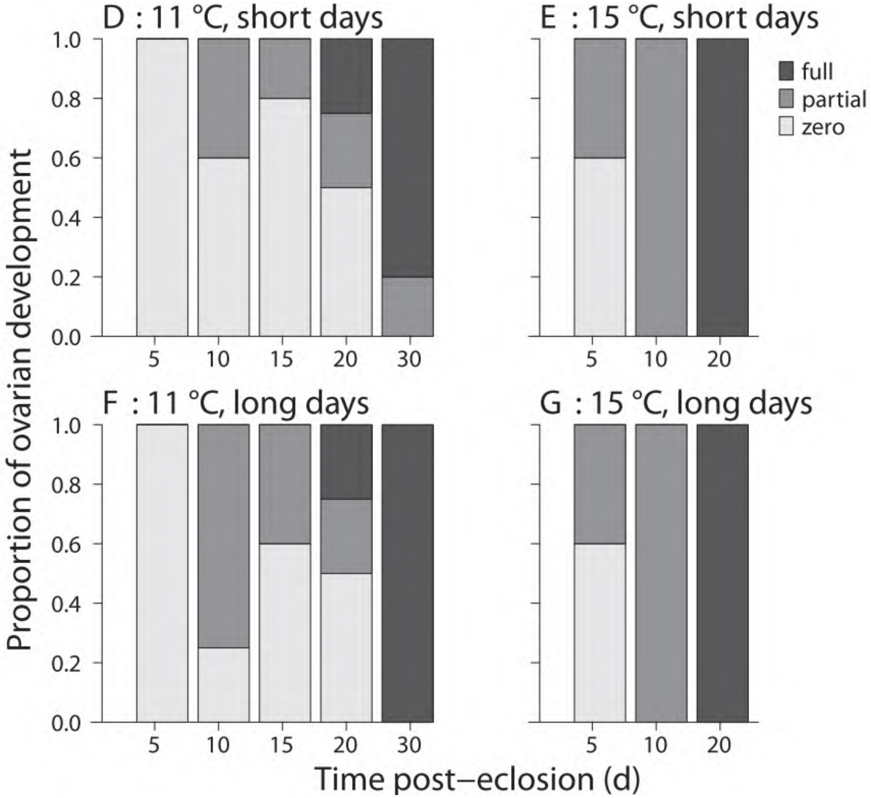


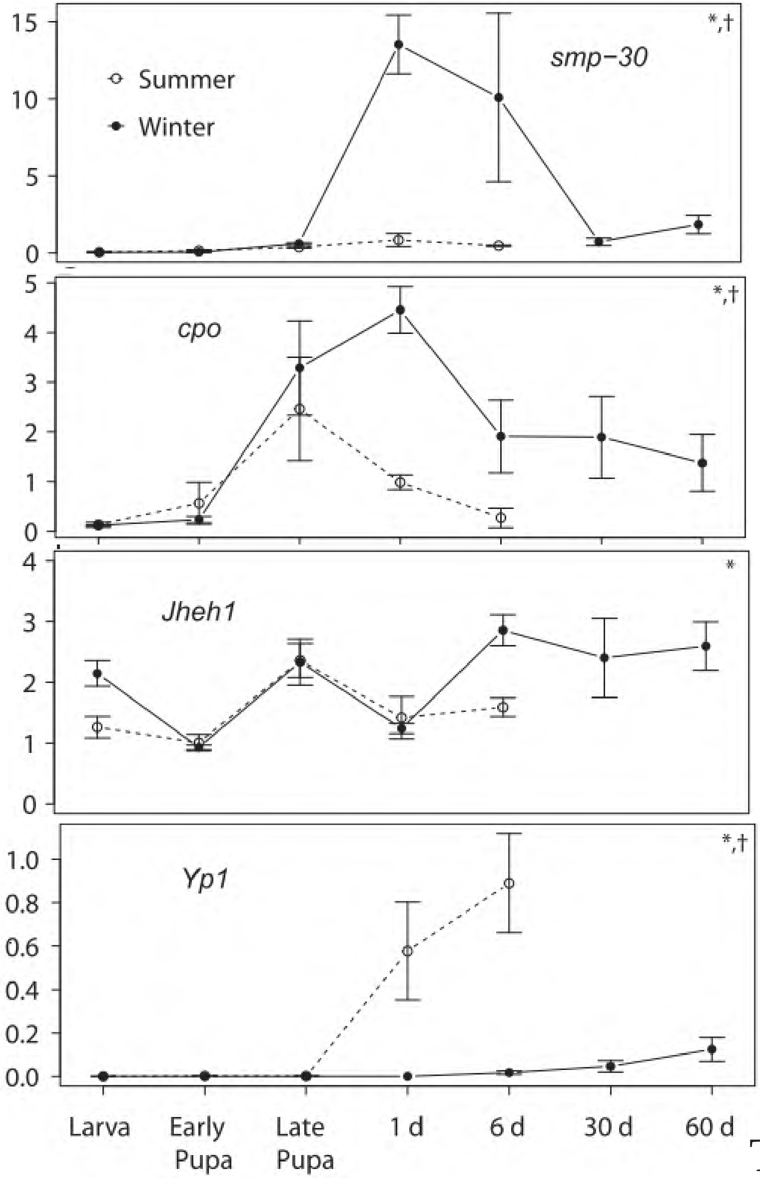
Shearer et al., *BMC ecology*, 2016

Reproductive arrest in winter-acclimated *Drosophila suzukii*

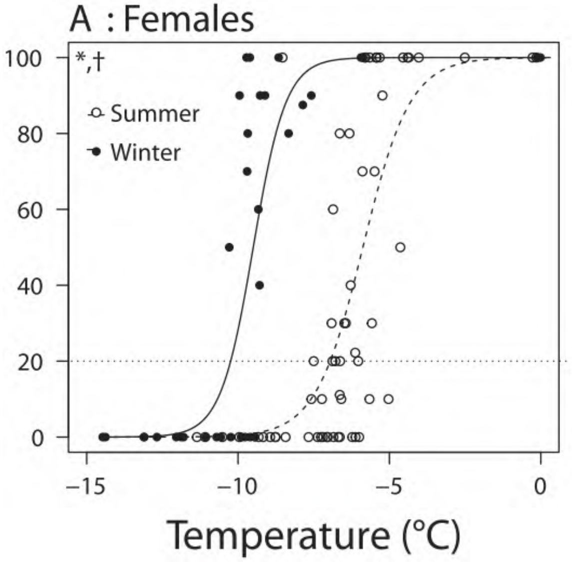


ovarian development



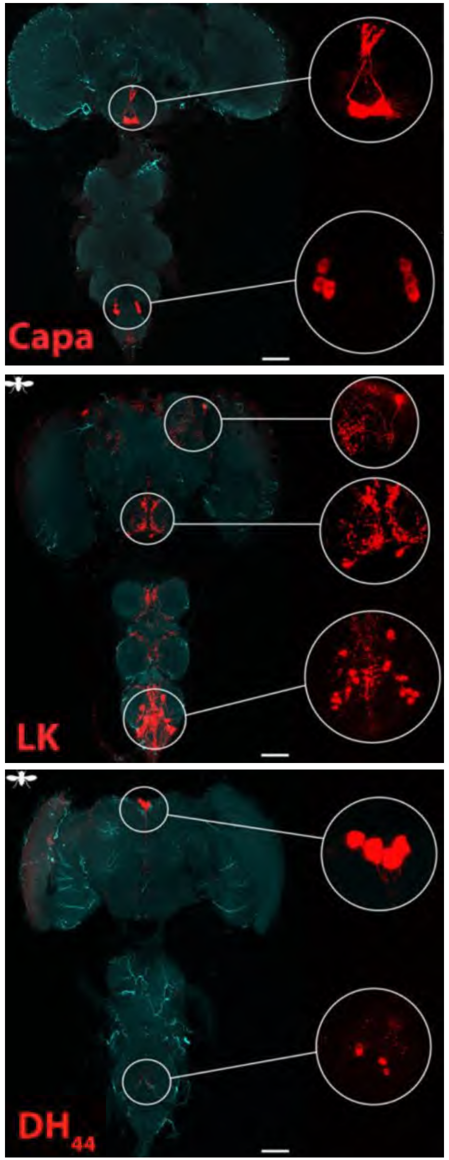


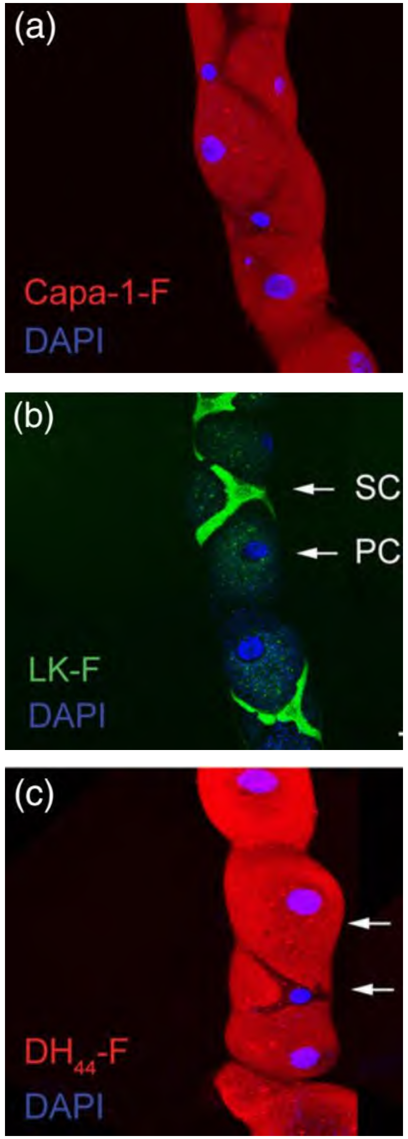
smp-30, cold acclimation;
cpo, diapause regulation;
Jheh1, juvenile hormone catabolism;
Yp1, vitellogenesis.

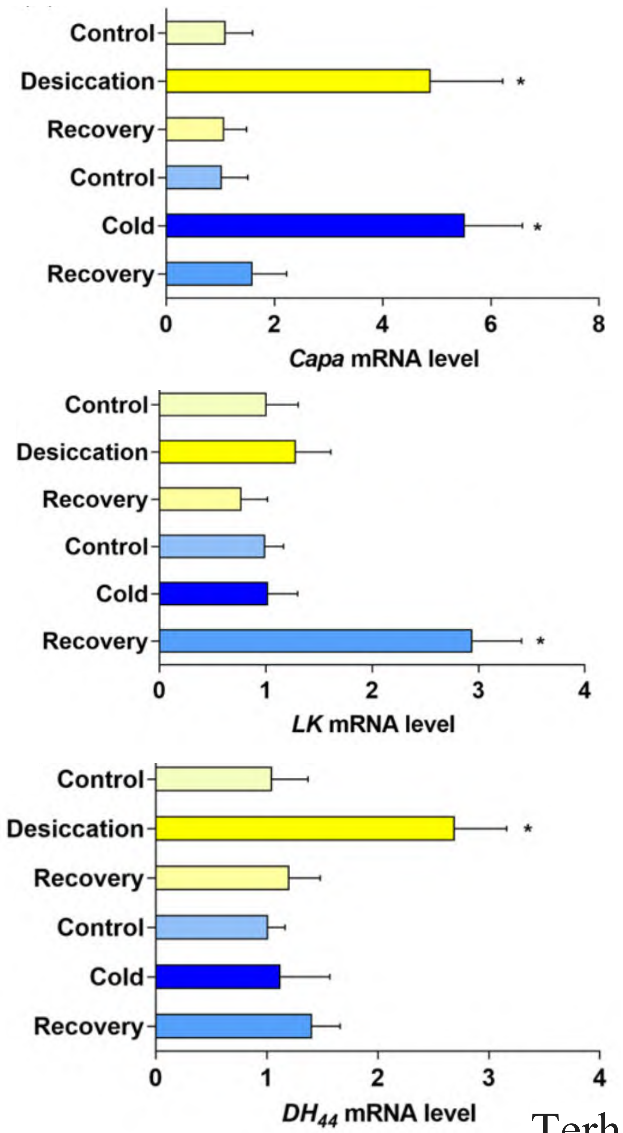


Toxopeus et al., *J insect physiol*, 2016

Renal neuroendocrine control of desiccation and cold tolerance in *Drosophila suzukii*



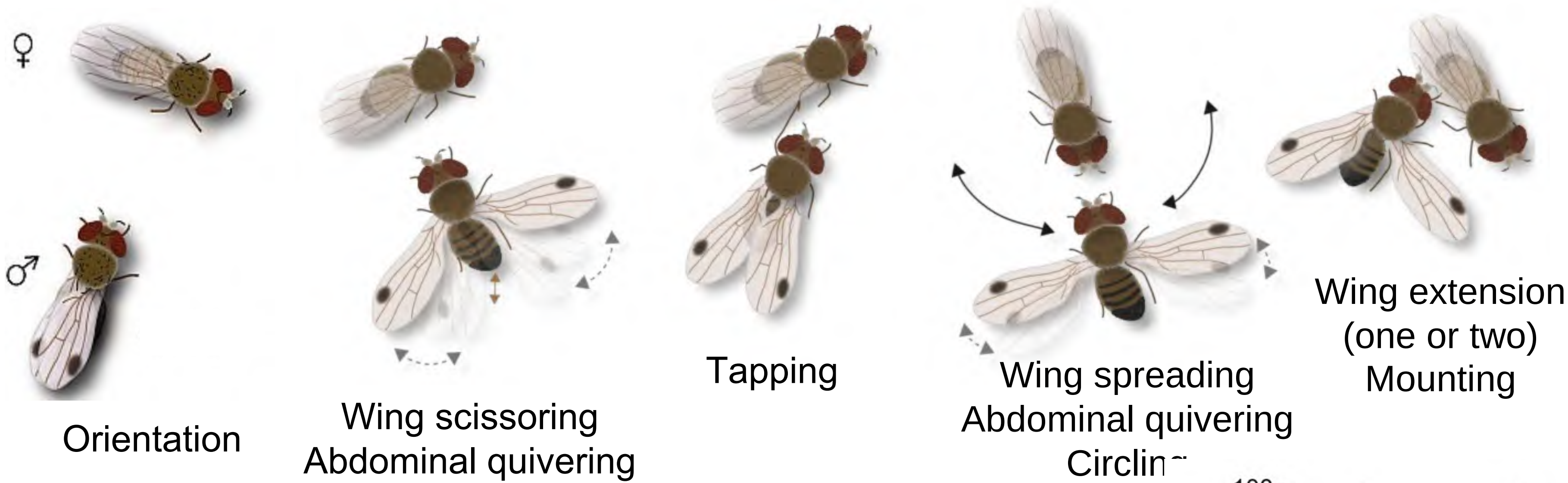


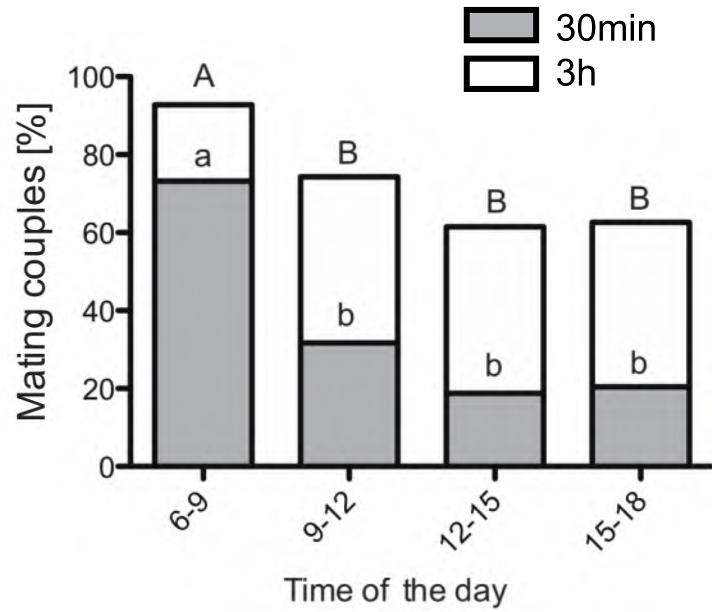


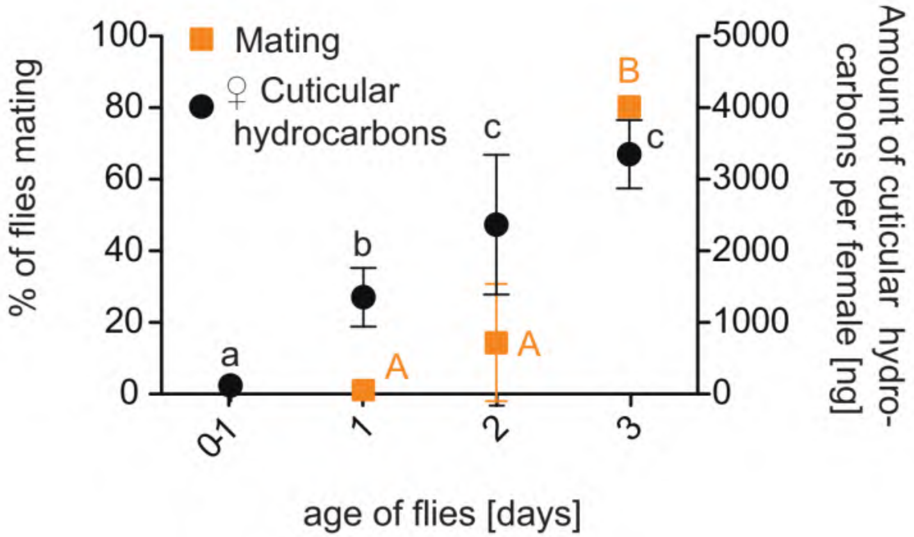
Terhzaz et al., *Pest manag sci*, 2018

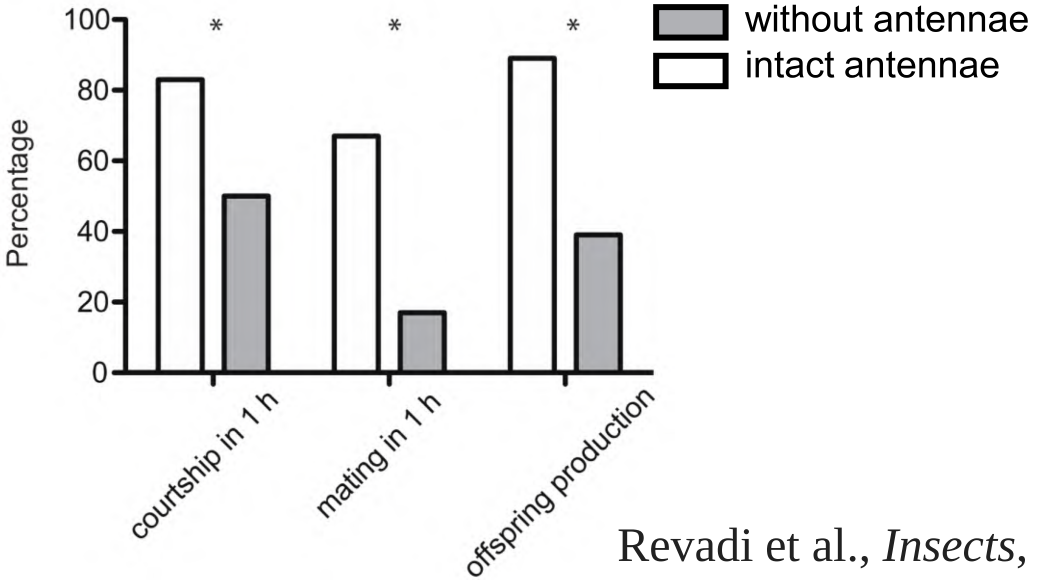
Sexual Behavior of *Drosophila suzukii*

Courtship behavior



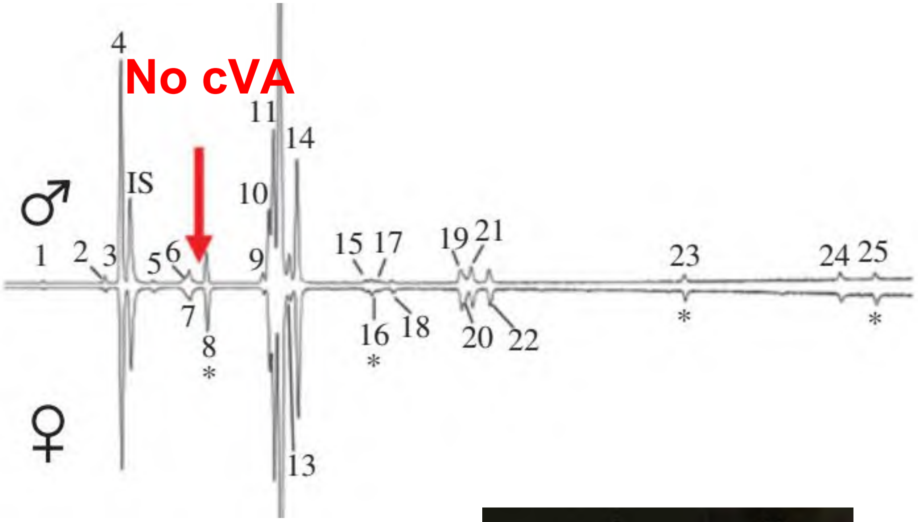


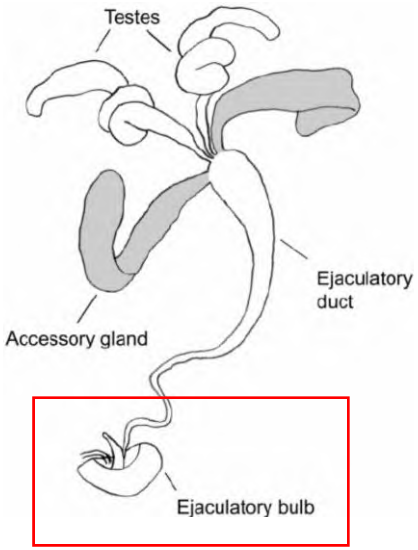


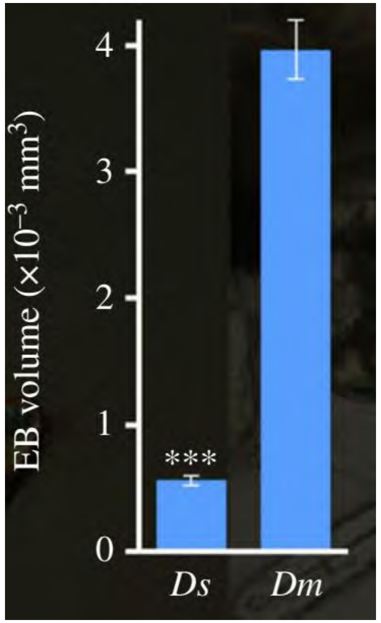


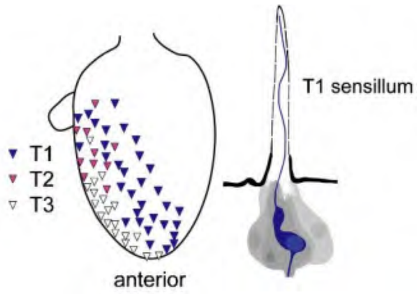
Revadi et al., *Insects*, 2015

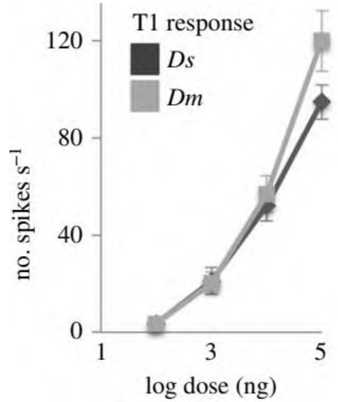
Loss of cVA reverses its role in sexual communication in *Drosophila suzukii*

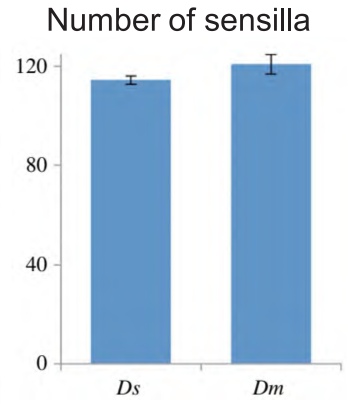


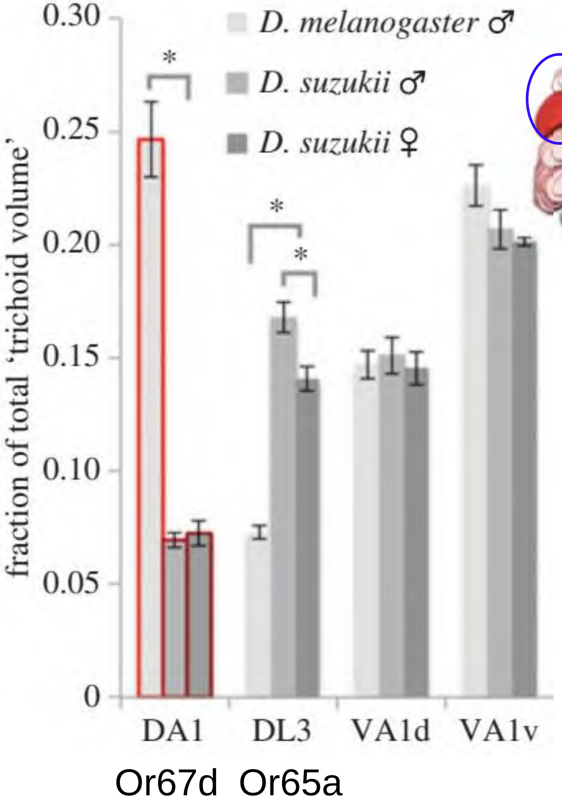


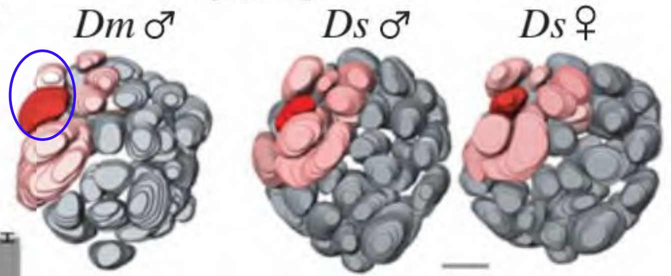


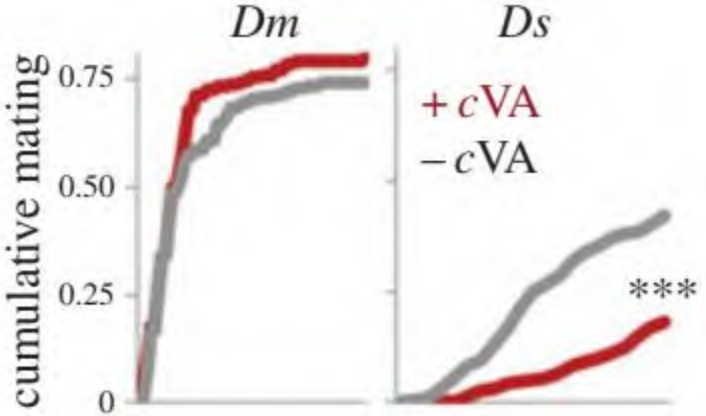












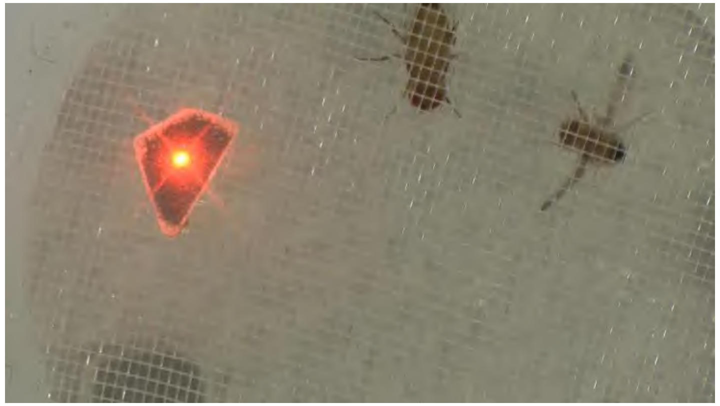
Dekker et al., *Proc Biol sci*, 2015

Substrate vibrations during courtship in *Drosophila suzukii*

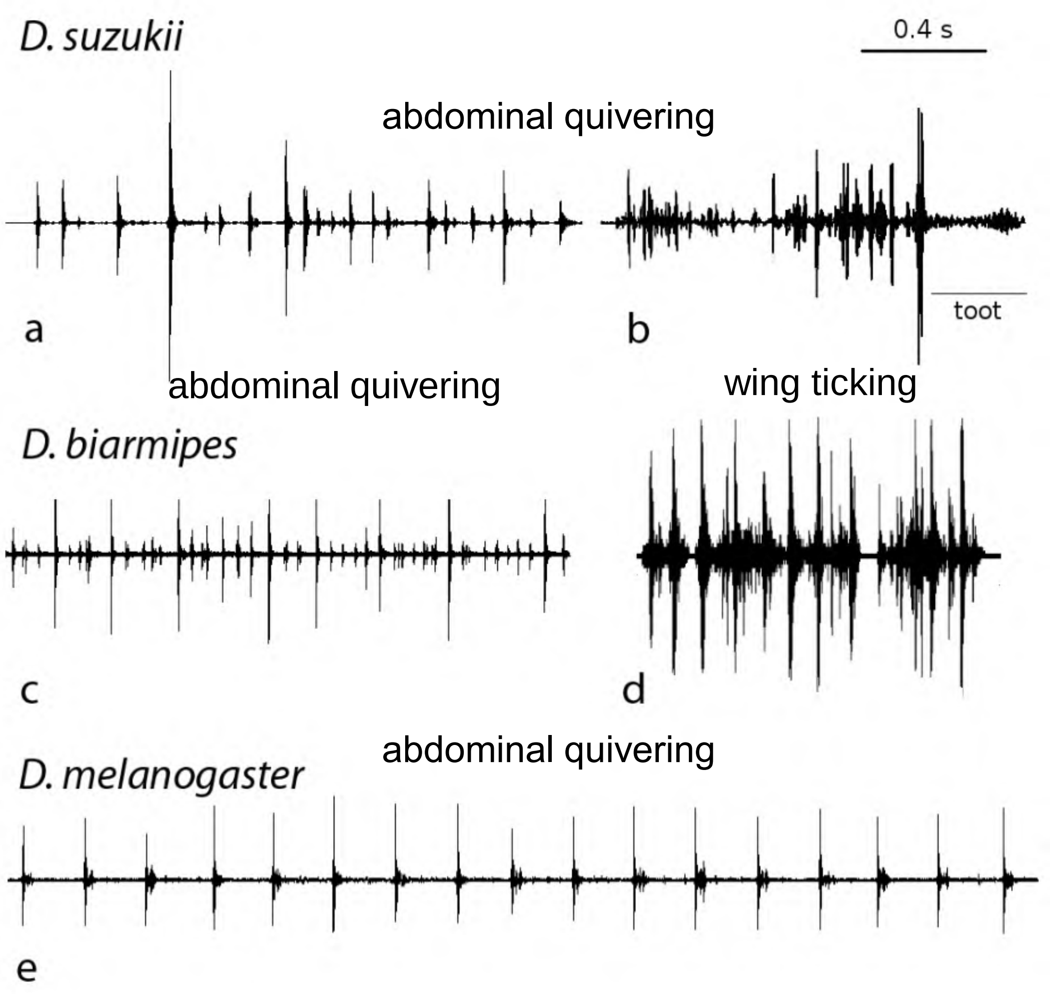
Substrate vibrations recording

	Abdominal quivering*	Wing ticking	Sine song	Pulse song	Toot
D. melanogaster	a ** 1	-	a, b *** 2	a, b *** 3	-
D. suzukii	a, d ****	-	-	-	d, e ****
D. biarmipes	a ** 1	e ****	e ****	-	a, b, c *** 4

abdominal quivering

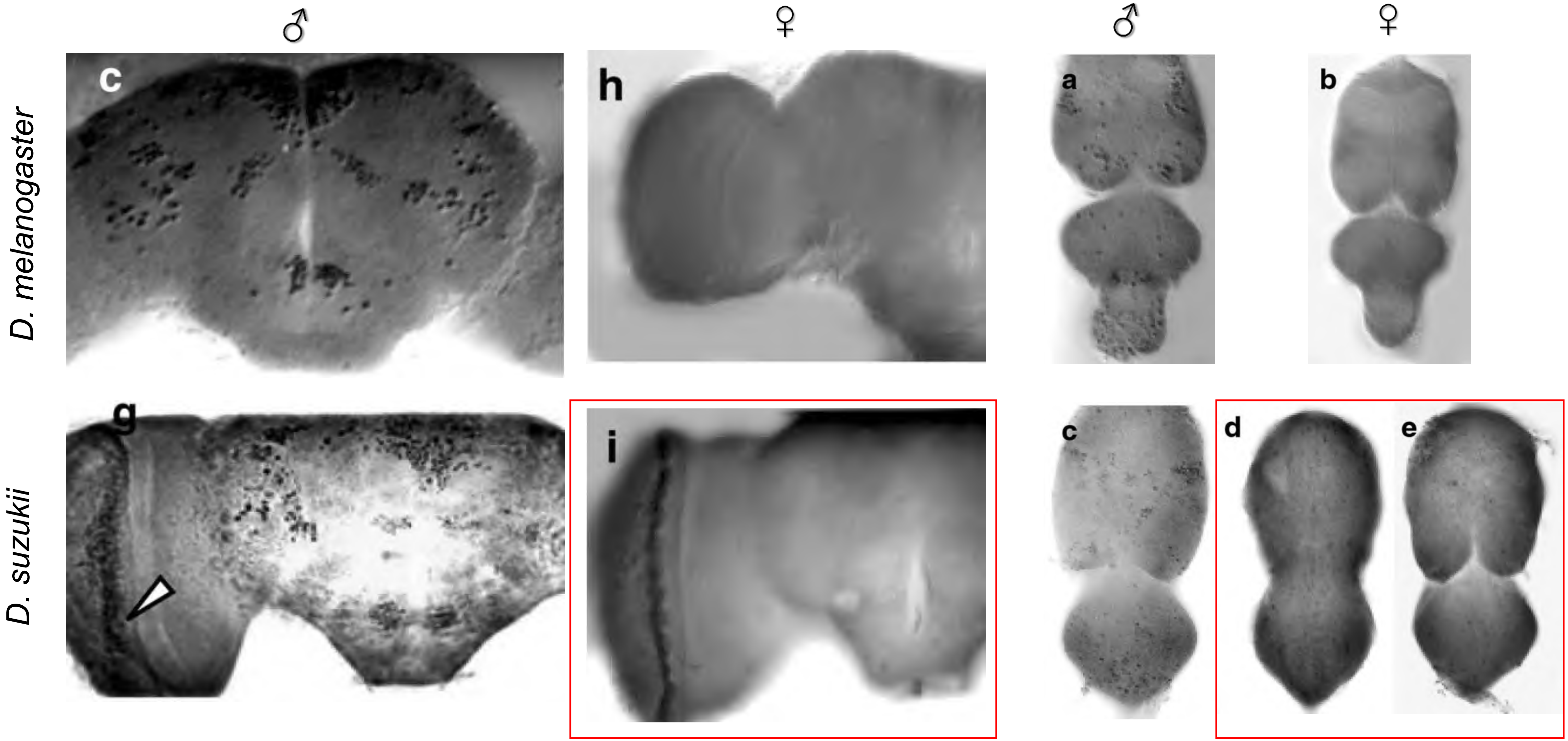


toot



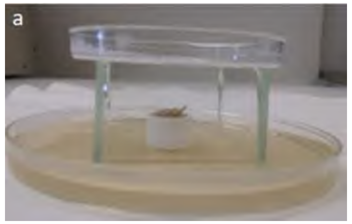
Mazzoni et al., *PloS one*, 2013

Fru^M is also expressed in female *Drosophila suzukii*



Usui-Aoki et al., *J neurogenet*, 2005

Aggressive Behavior of *Drosophila suzukii*



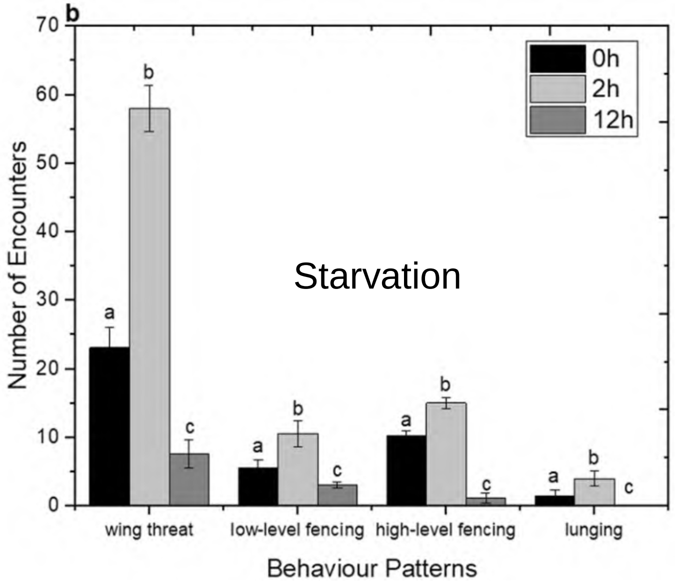
Set-up

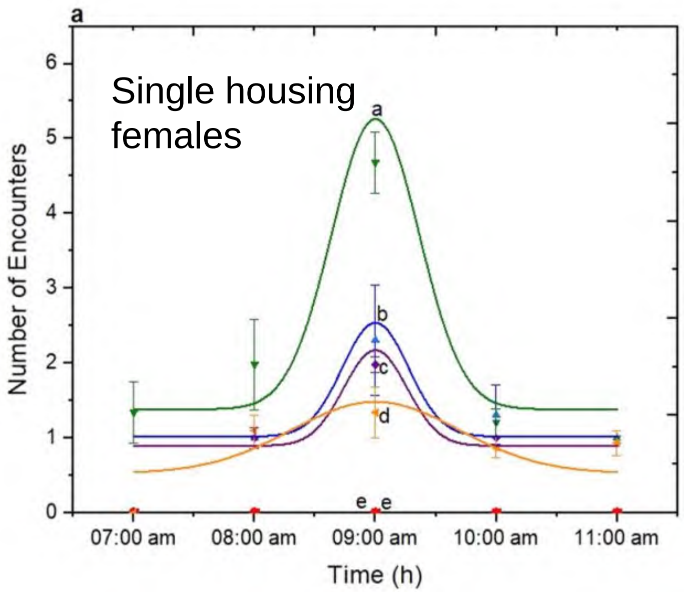
Wing threat

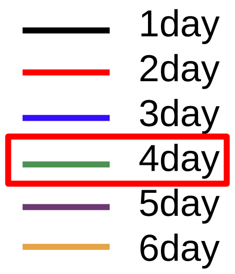
Fencing

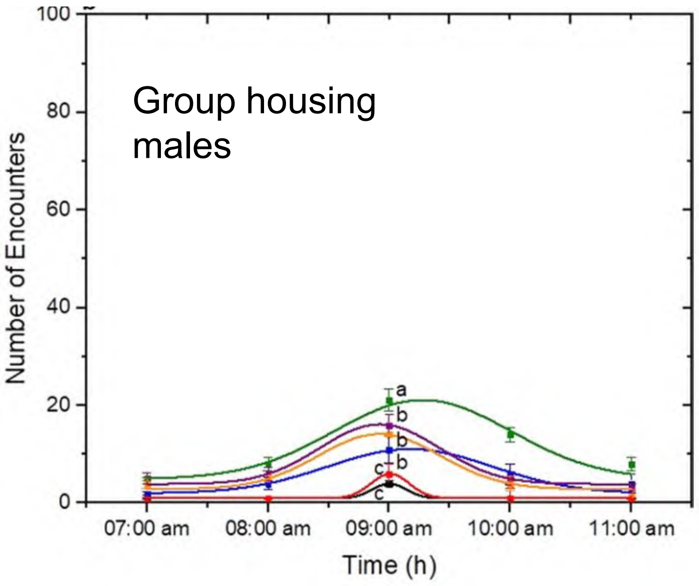
Lunging

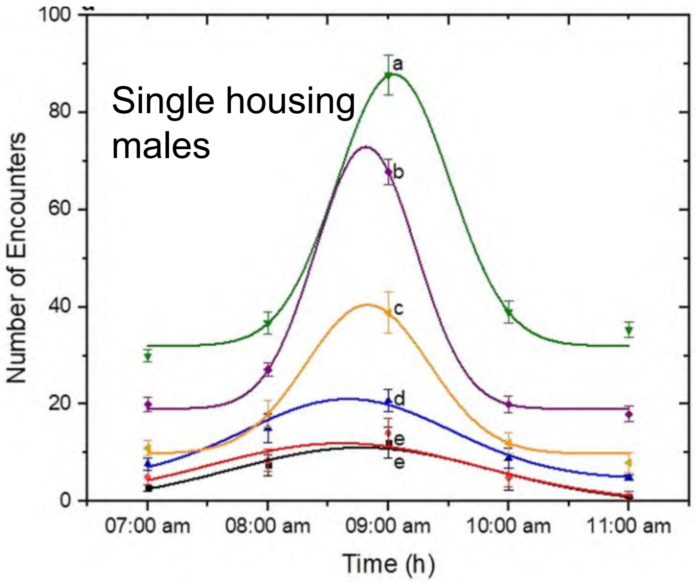
Flying attack









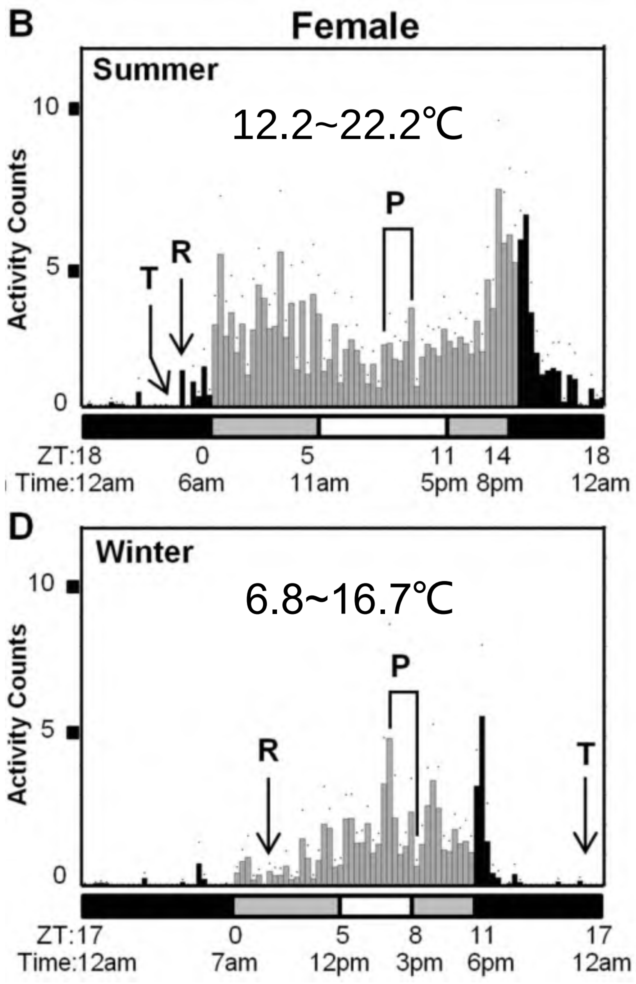


male only

D. suzukii only

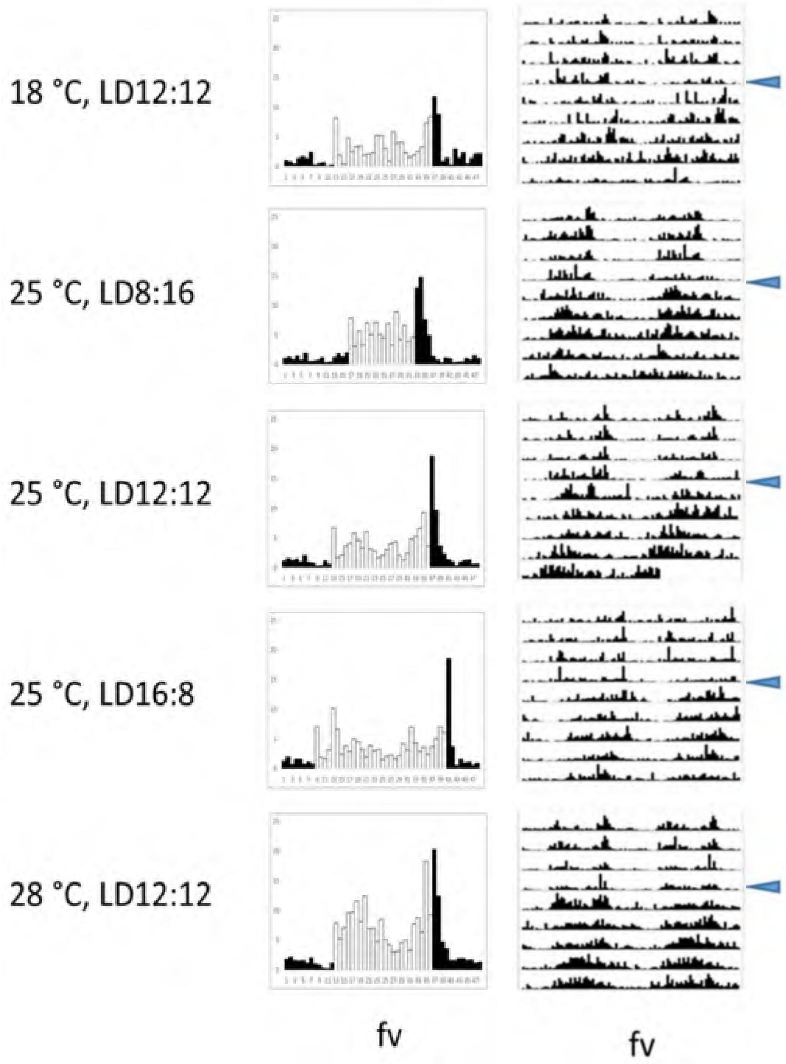
Belenioti and Nikolaos, *Sci rep*, 2020

Locomotor and circadian behavior in *Drosophila suzukii*

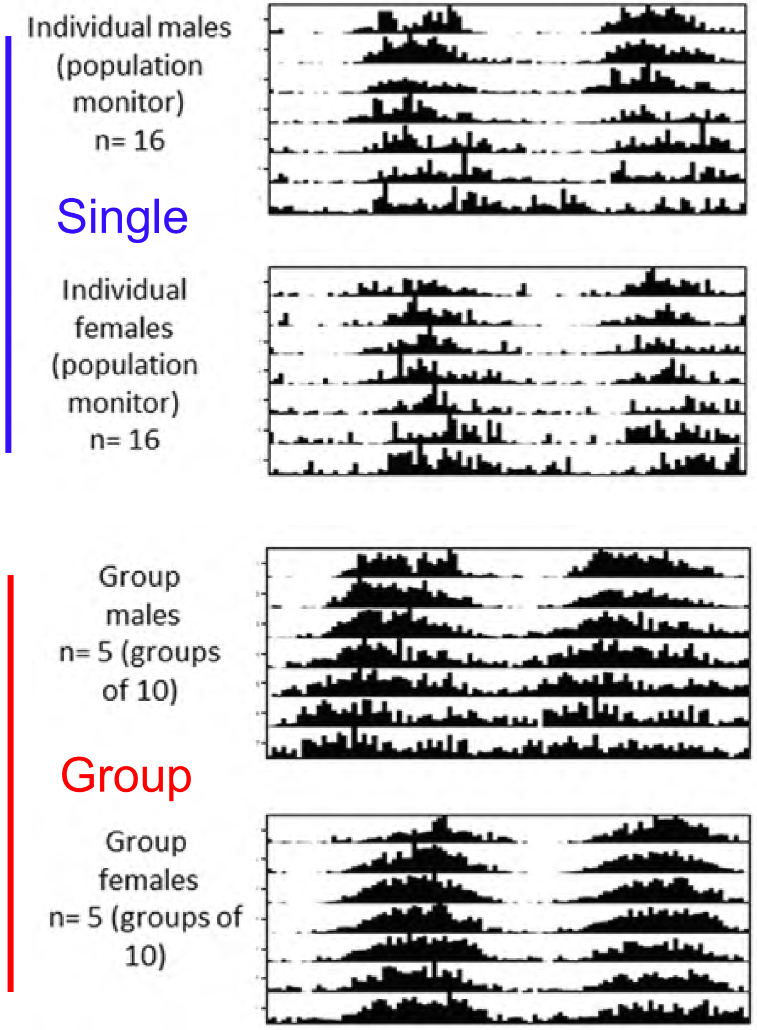


Activity: Male>Female

Hamby et al., *PloS one*, 2013



Hansen et al., *Front physiol*, 2019



Shaw et al., *J bio rhythms*, 2019

Genome of *Drosophila suzukii*, the Spotted Wing Drosophila

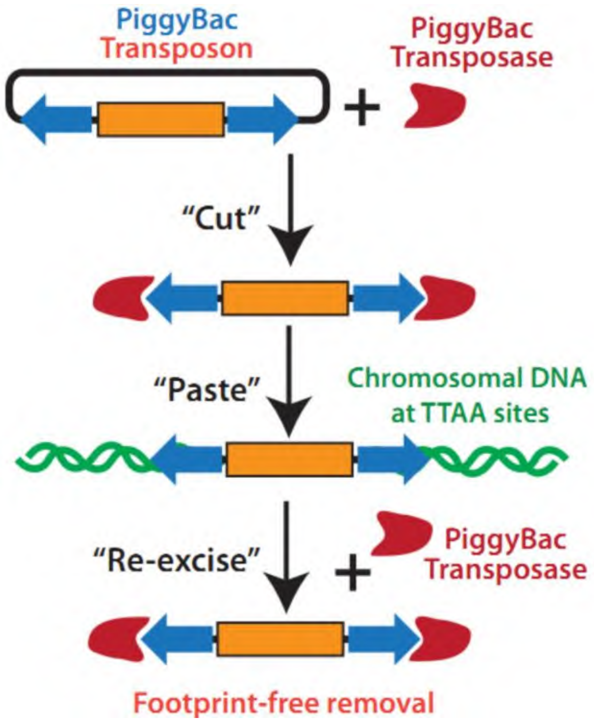
Joanna C. Chiu,*[,1] Xuanting Jiang,[†] Li Zhao,[‡] Christopher A. Hamm,[‡] Julie M. Cridland,[‡] Perot Saelao,[‡] Kelly A. Hamby,* Ernest K. Lee,[§] Rosanna S. Kwok,* Guojie Zhang,[†] Frank G. Zalom,* Vaughn M. Walton,** and David J. Begun[‡]

G3 · Genes | Genomes | Genetics
Volume 3 | December 2013

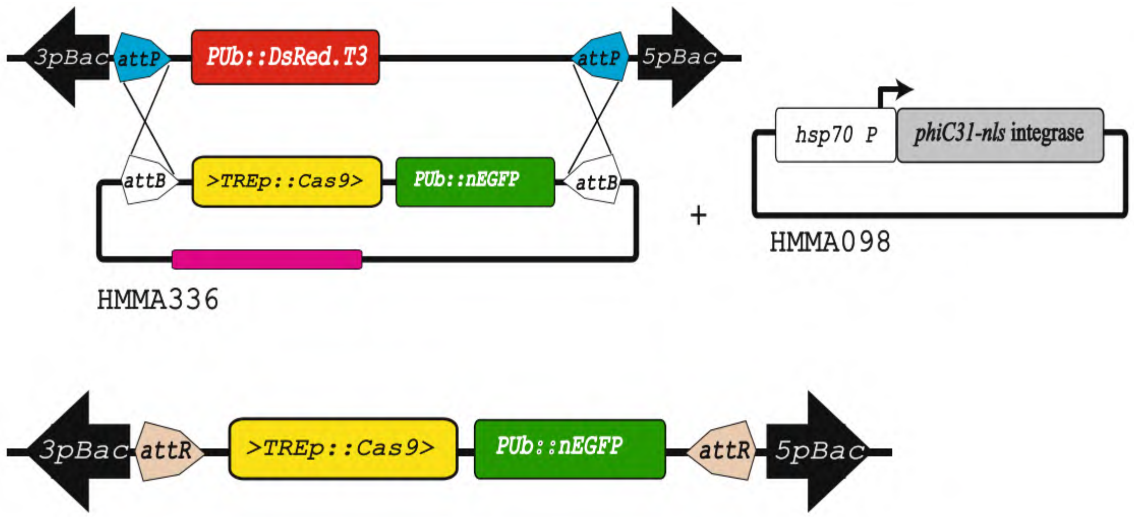
Near-chromosome level genome assembly of the fruit pest *Drosophila suzukii* using long-read sequencing

SCIENTIFIC REPORTS
natureresearch

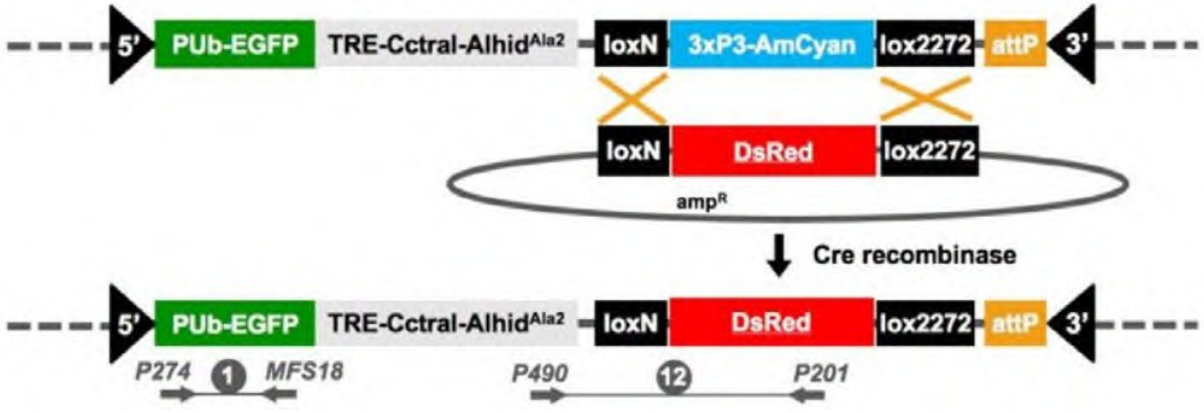
Mathilde Paris[1,6], Roxane Boyer[1,7], Rita Jaenichen[2], Jochen Wolf[2,3], Marianthi Karageorgi[1,8], Jack Green[1], Mathilde Cagnon[2], Hugues Parinello[4], Arnaud Estoup[5], Mathieu Gautier[5]✉, Nicolas Gompel[2]✉ & Benjamin Prud'homme[1]✉



Site-specific integration method in *Drosophila suzukii*



Ahmed et al., *BMC Genet*, 2020



Schetelig et al., *Insect Mol Biol*, 2018

Generation of an *attP* landing site in *D. suzukii* genomic region orthologous to the *D. melanogaster attP2* locus on chromosome 3.

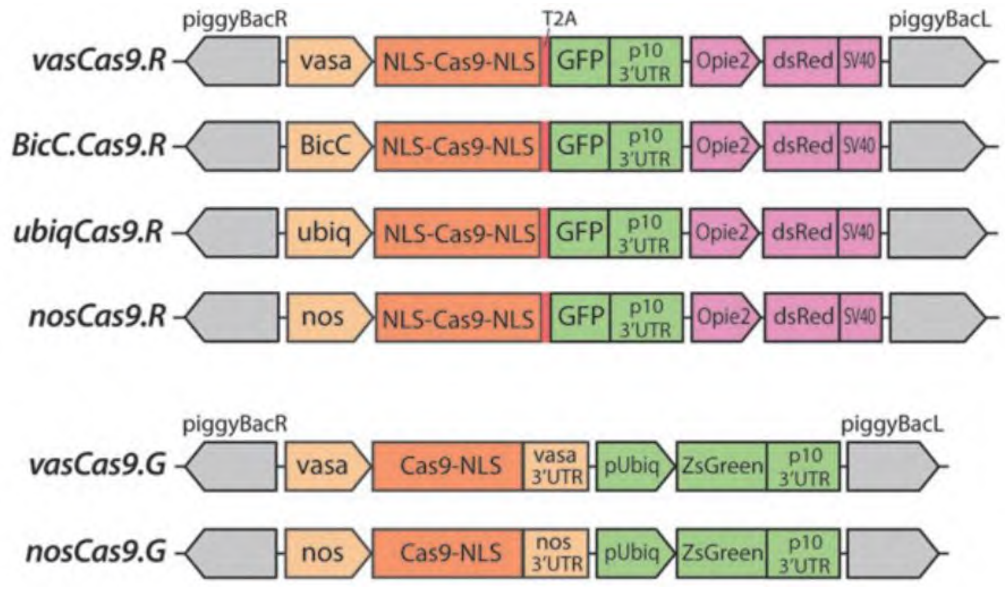
--*D. suzukii attP2* stock.

Cavey et al., *PLoS biology*, 2023

φC31 *attP*/*attB* system

Cre/*lox* system

Cas9 stocks



D. melanogaster promoters:

vasa (*vas*) and *nanos* (*nos*), early germ cells;

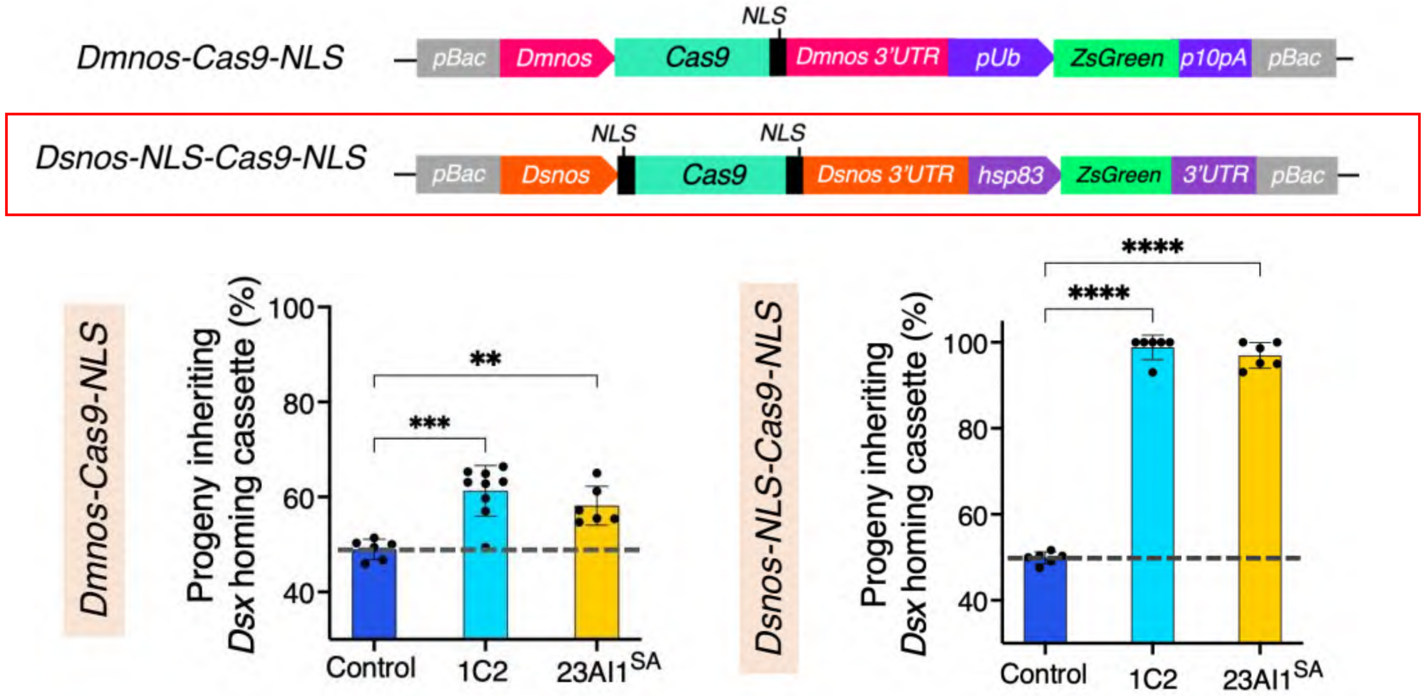
Bicaudal C (*BicC*), late germ cells;

polyubiquitin 63E (*ubiq*), both germ and somatic cells.

Efficacy: *Cas9.R* > *Cas9.G*

NLS-Cas9-NLS* > *Cas9-NLS

Kandul et al., *The CRISPR journal*, 2021



Yadav et al., *PNAS*, 2023

D. Melanogaster heat shock protein 70 gene promoter (*Dmhsp70*), expressed in both soma and germline.

Yan et al., *Int j mol sci*, 2021

NC STATE
UNIVERSITY

Max Scott

Drosophila suzukii
斑翅果蝇

Cochliomyia hominivorax
螺旋锥蝇（食人蝇）

Lucilia cuprina
铜绿蝇

Genetic Pest Management

Genetics and Genomics

Sex Determination

Epigenetics

Email: max_scott@ncsu.edu

Lab website: http://maxscottlab.wordpress.ncsu.edu/

Drosophila suzukii
斑翅果蝇

Ceratitis capitata
地中海实蝇

Aedes aegypti
埃及伊蚊

JUSTUS-LIEBIG-UNIVERSITÄT GIESSEN

Marc F. Schetelig

Molecular biocontrol and gene editing

His research aims to improve the sterile insect technique (SIT) through the development of environmentally friendly sex separation and male sterility technologies, as well as new genetic approaches.

Email: Marc.Schetelig@agrar.uni-giessen.de

Website: https://www.uni-giessen.de/de/fbz/fb09/institute/iib/ibp/team/schetelig

Take home message

- *Drosophila suzukii* is a pest because the females have a serrated ovipositor enabling them to infest ripening fruit. It is also known as Spotted Wing *Drosophila*, because males have one dark spot on each wing.
- Seasonal variations in morphology and physiology in *D. suzukii* facilitate its rapidly expanding range.
- Preliminary studies of courtship and aggression behaviors in *D. suzukii* reveal several species-specific features.
- Some strains have been developed to simplify gene editing in *D. suzukii.*
- A good model for morphological and behavioral evolution.

Chemical ecology of *Drosophila suzukii*

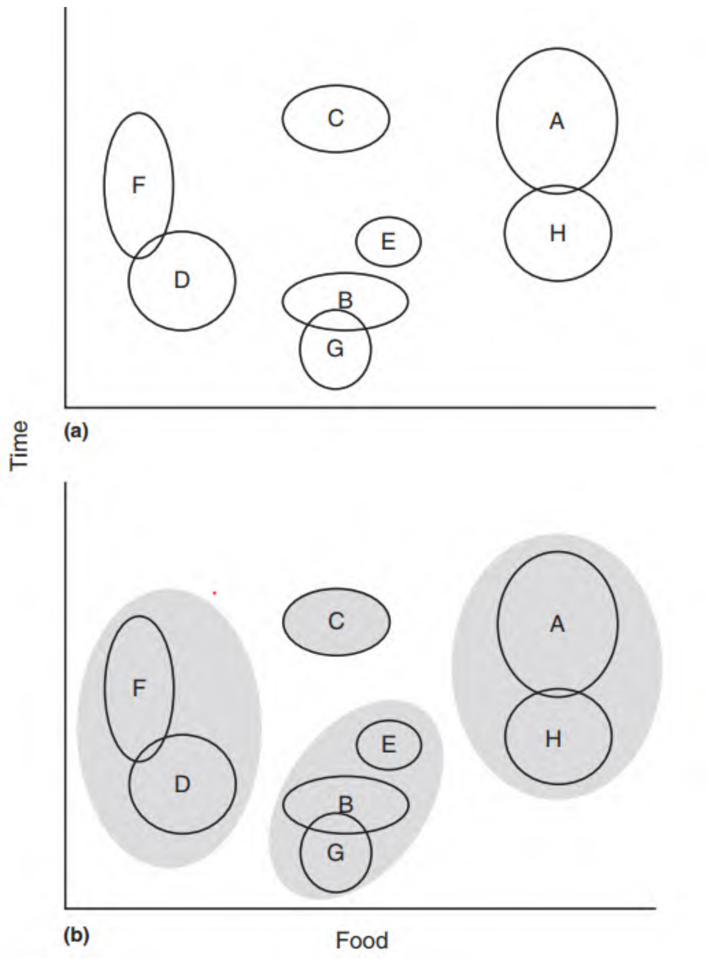
Peng Qionglin

2024-05-30

Ecological niche

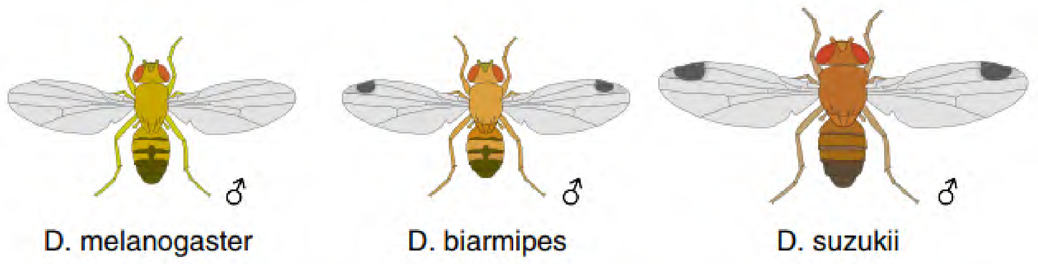
- **Ecological niche** is a term for the position of a species within an ecosystem, describing both the range of conditions necessary for persistence of the species, and its ecological role in the ecosystem.

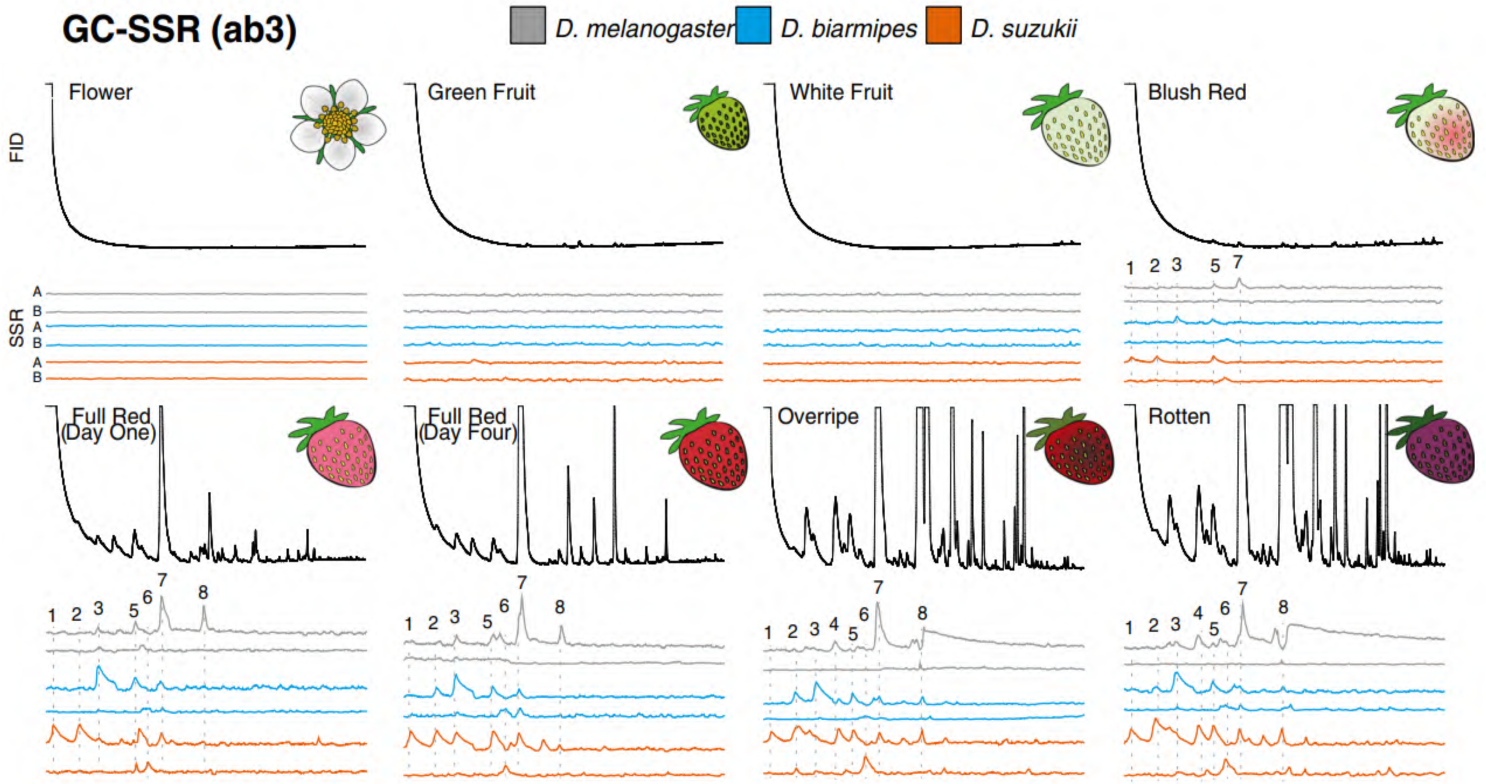
- **Niche shifts** are often the drivers of important evolutionary processes, such as ecological specialization or speciation.

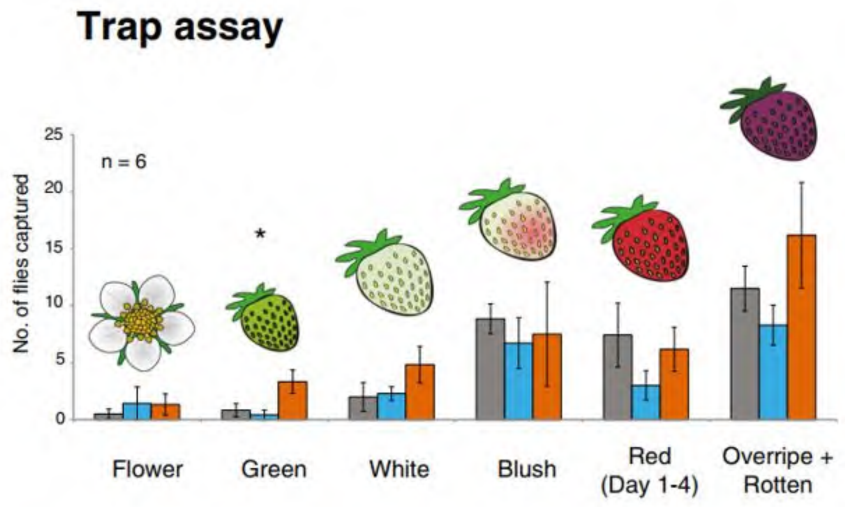


Projection of eight species onto two of the principal niche axes (food and time)

Similar to *D. melanogaster, D. suzukii* and *D. biarmipes* are more sensitive to ripen fruit

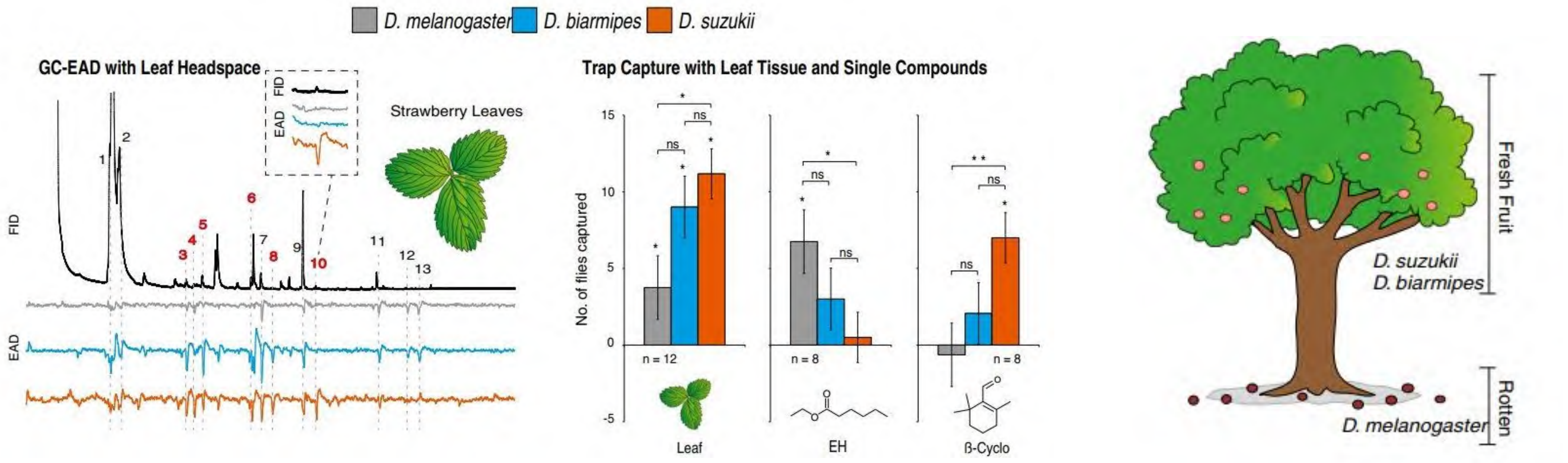


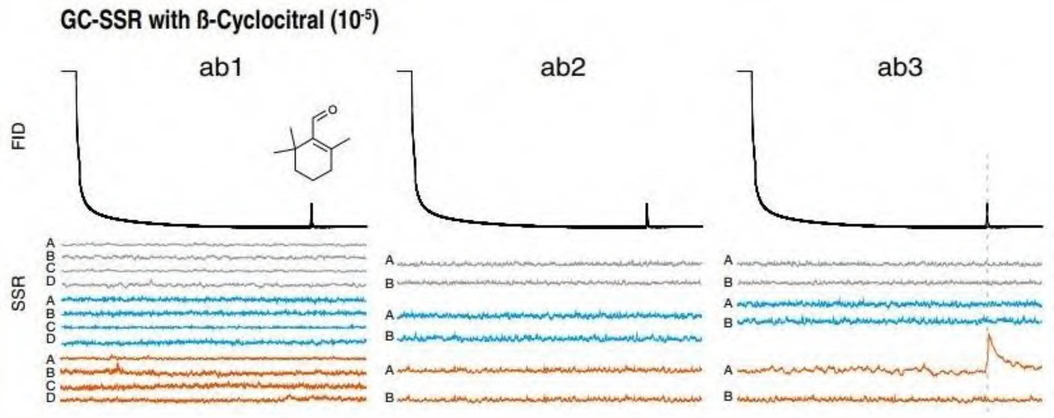




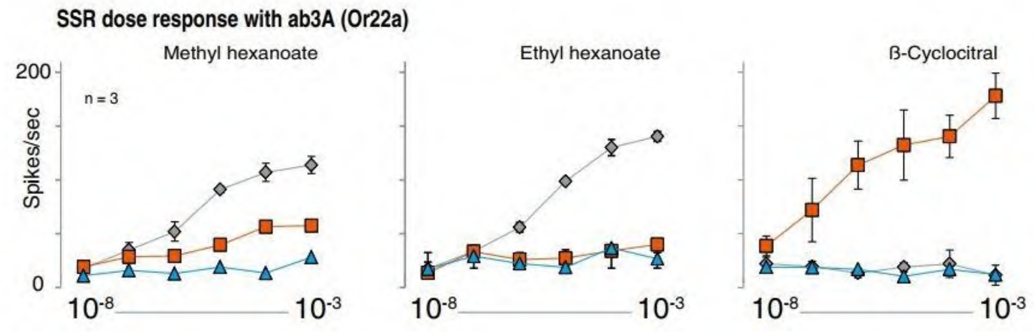
Keesey IW, et al., *J Chem Ecol*, 2015

D. suzukii and *D. biarmipes* are more attracted to leaf odors than *D. melanogaster*



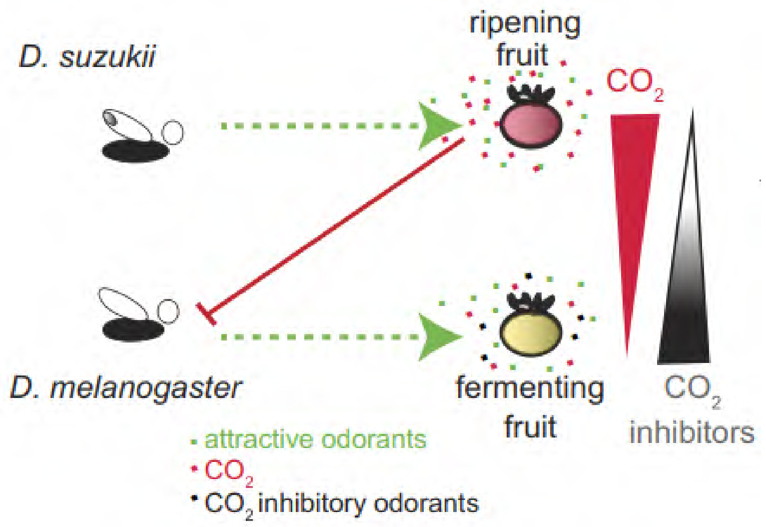


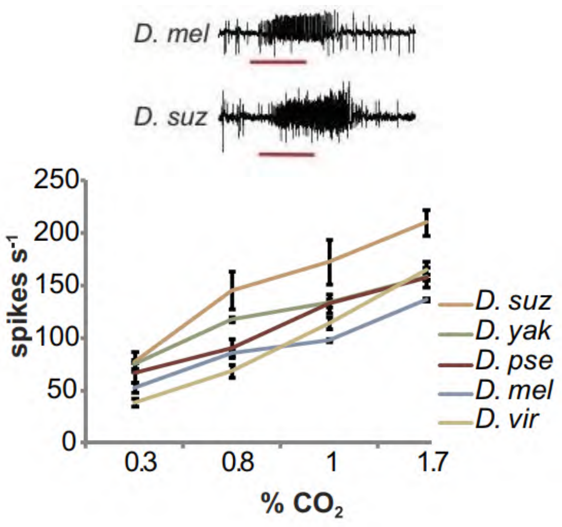
β-cyclocitral, a novel ligand for the ab3A neuron

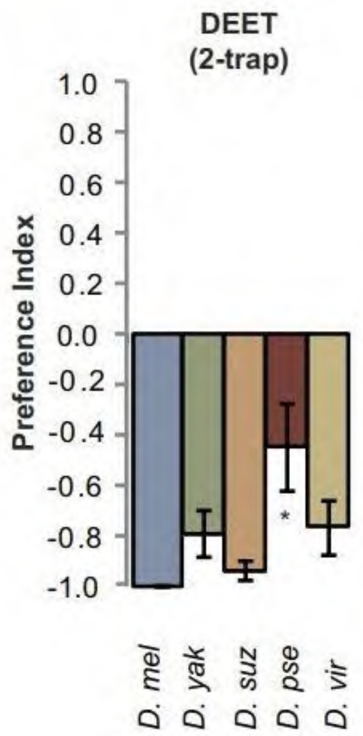


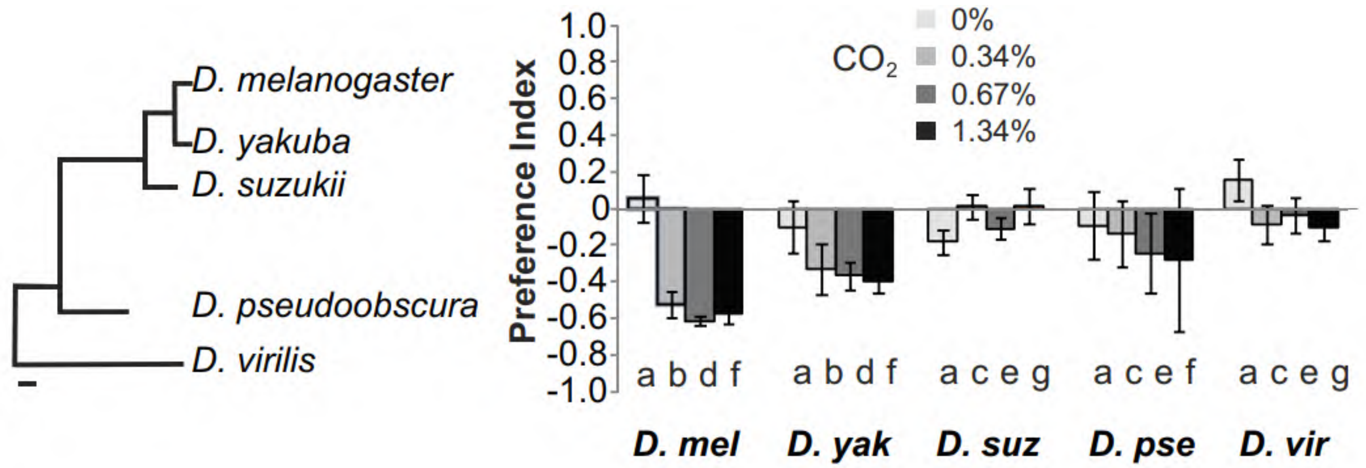
Keesey IW, et al., *J Chem Ecol*, 2015

D. suzukii do not avoid carbon dioxide like *D. melanogaster*









DEET (避蚊胺) shows strong repellency across five species

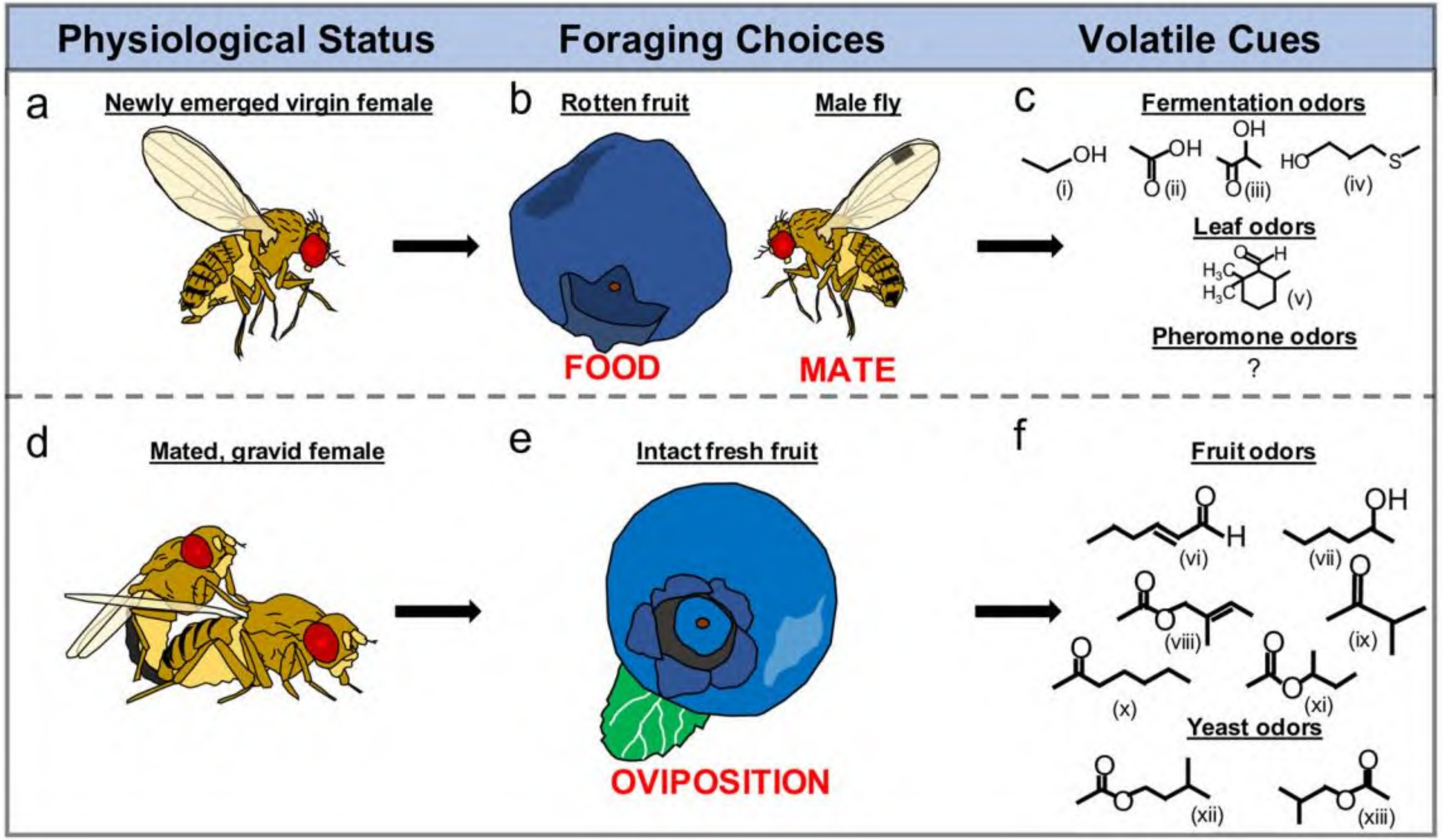
Krause Pham C and Ray A, *Sci Rep*, 2015

Altered sensory biology in shifting host preference

At least four distinct and potentially overlapping mechanisms:

1. A change in **the number of sensory sensilla** and associated receptor **neurons**, resulting in increased or decreased sensitivity to attractants or repellents.
2. A change in the sequence and tuning of a specific **receptor protein**, increasing or decreasing its receptive field and/or its sensitivity to specific host odors and tastants.
3. The **addition or deletion** of **specific receptor proteins** from the genome.
4. Changes in **how host chemosensory cues are integrated** to produce attraction or aversion.

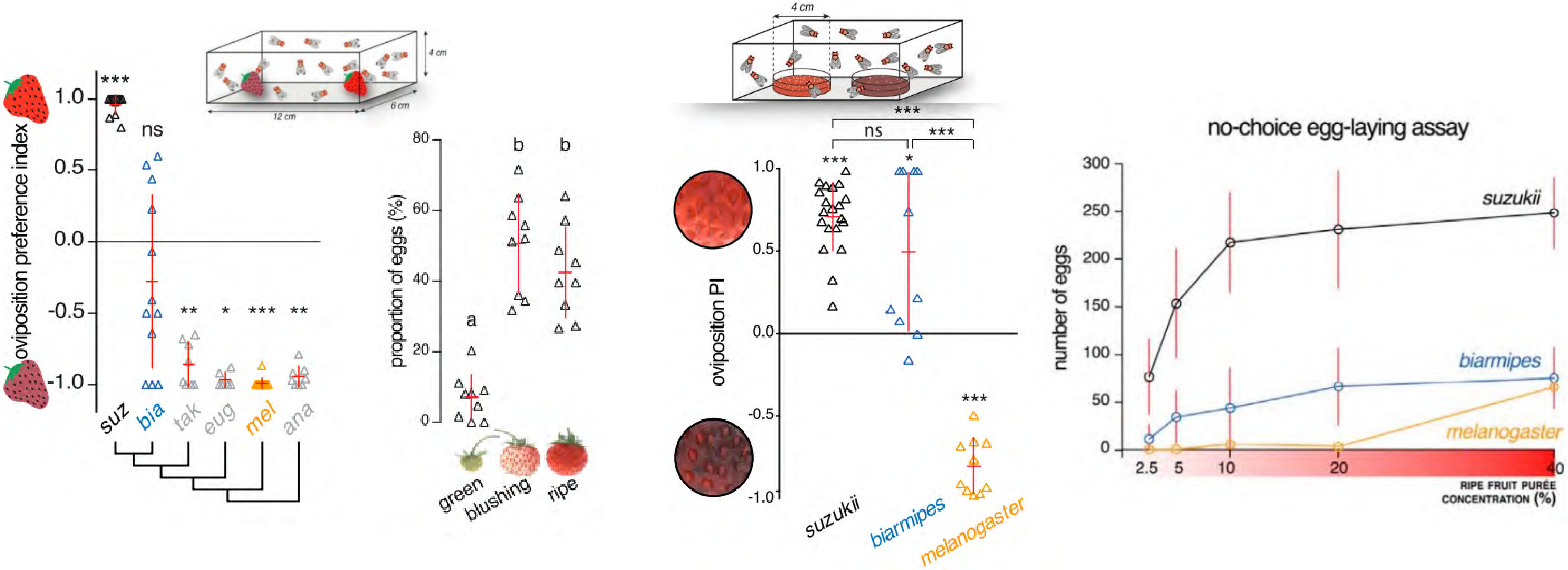
D. suzukii shifts its oviposition niche from fermented fruits to ripe, non-fermented fruits



- peripheral sensory systems?
  - olfaction
  - mechanosensation
  - gustation
- central nervous system?

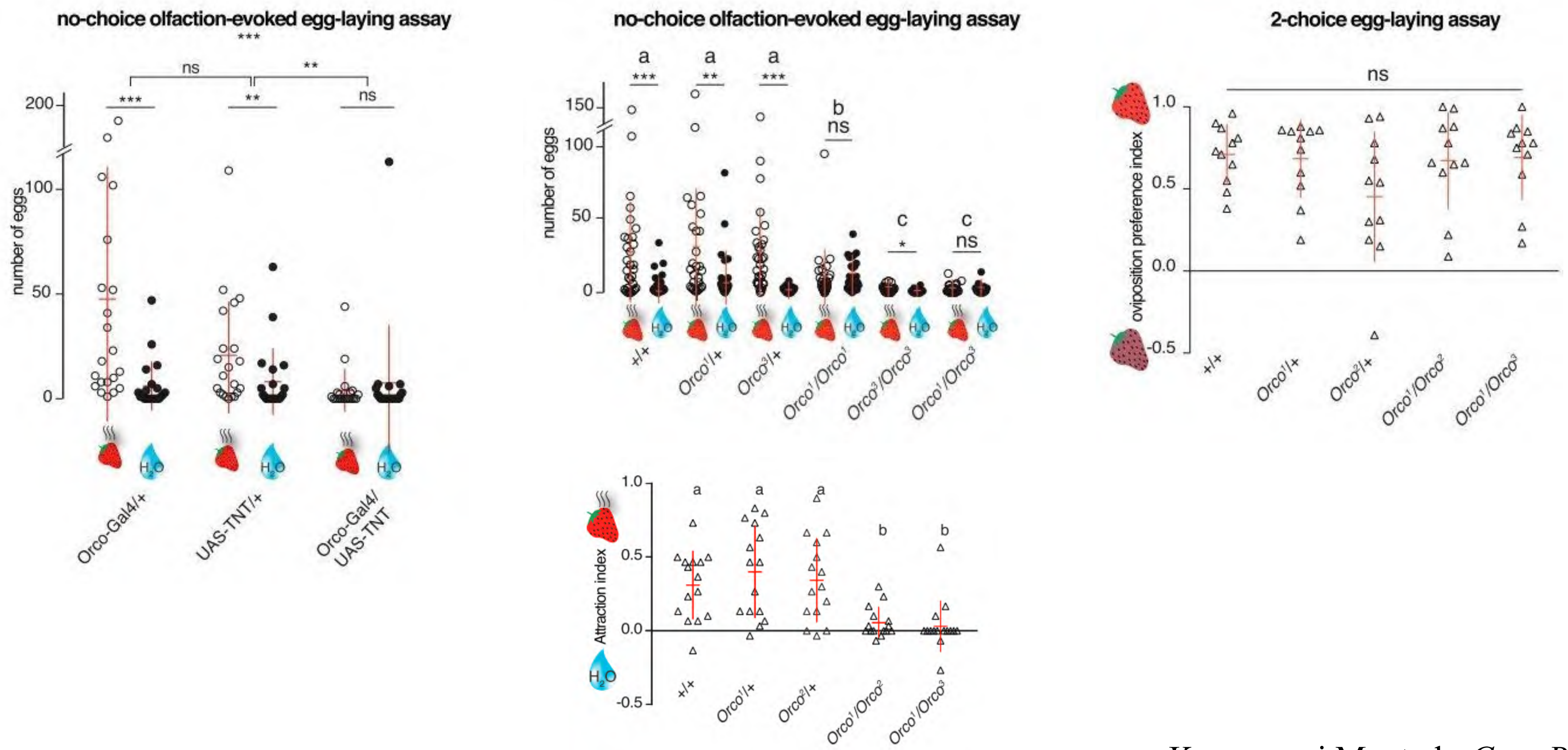
Cloonan KR, et al., *J Chem Ecol*, 2018

D. suzukii females have evolved a preference to lay eggs in ripe rather than rotten strawberries



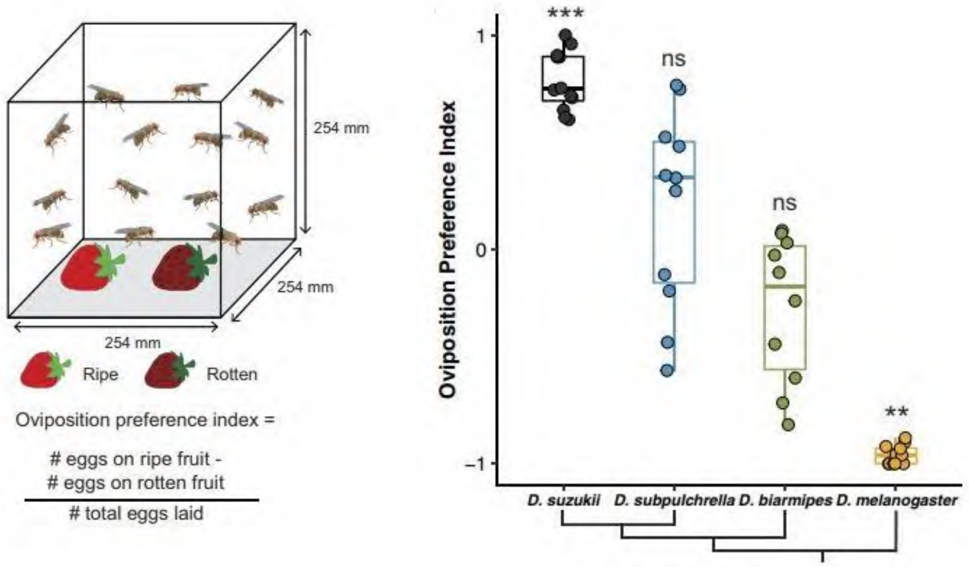
Karageorgi M, et al., *Curr Biol*, 2017

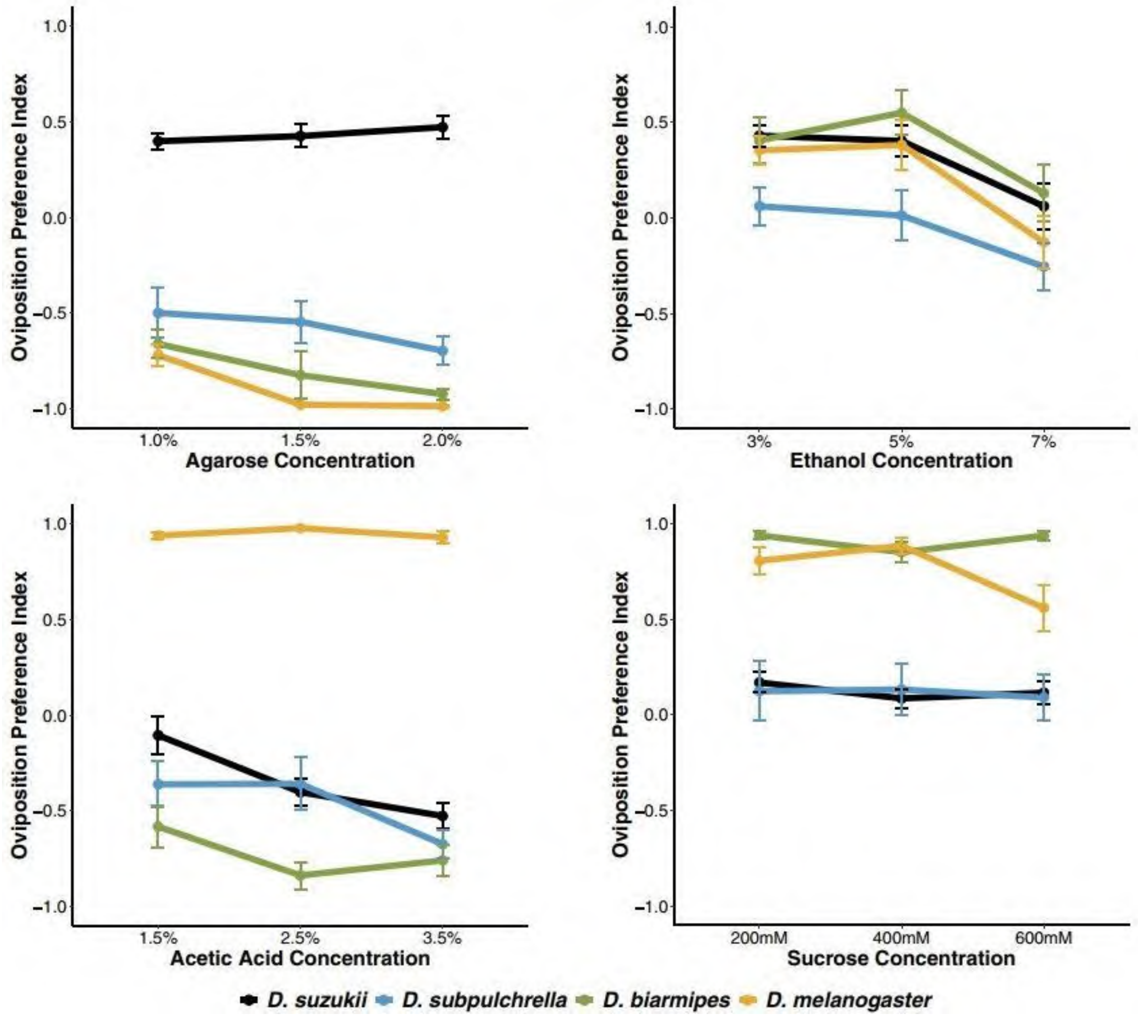
OR-mediated olfaction elicits oviposition in *D. suzukii*



Karageorgi M, et al., *Curr Biol*, 2017

Oviposition preference for substrates associated with fruit maturation differ among focal species

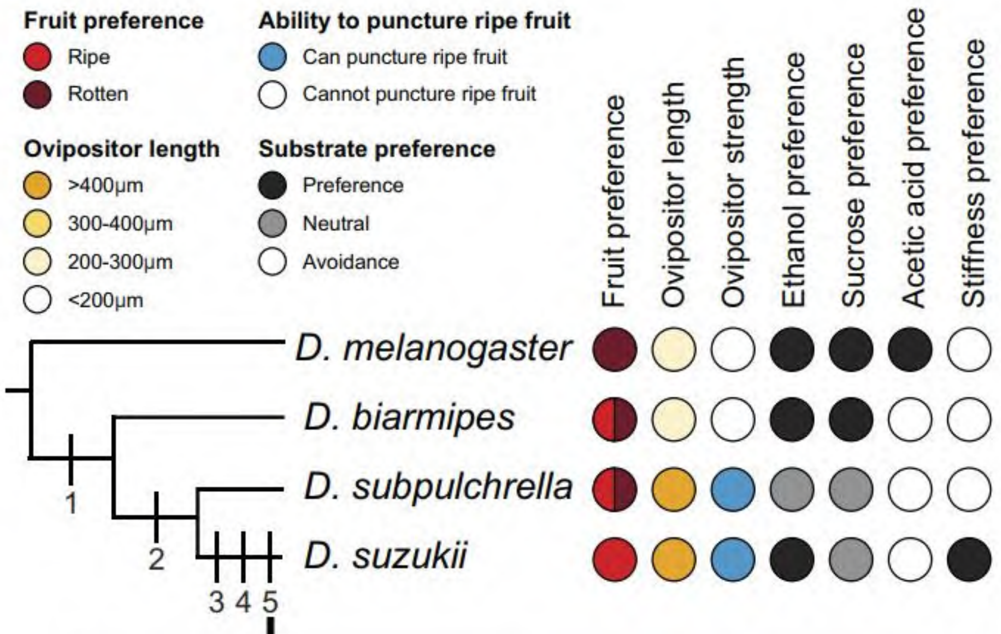




The evolution of ripe fruit preference in *D. suzukii* occurred gradually.

Durkin SM, et al., *Mol Biol Evol*, 2021

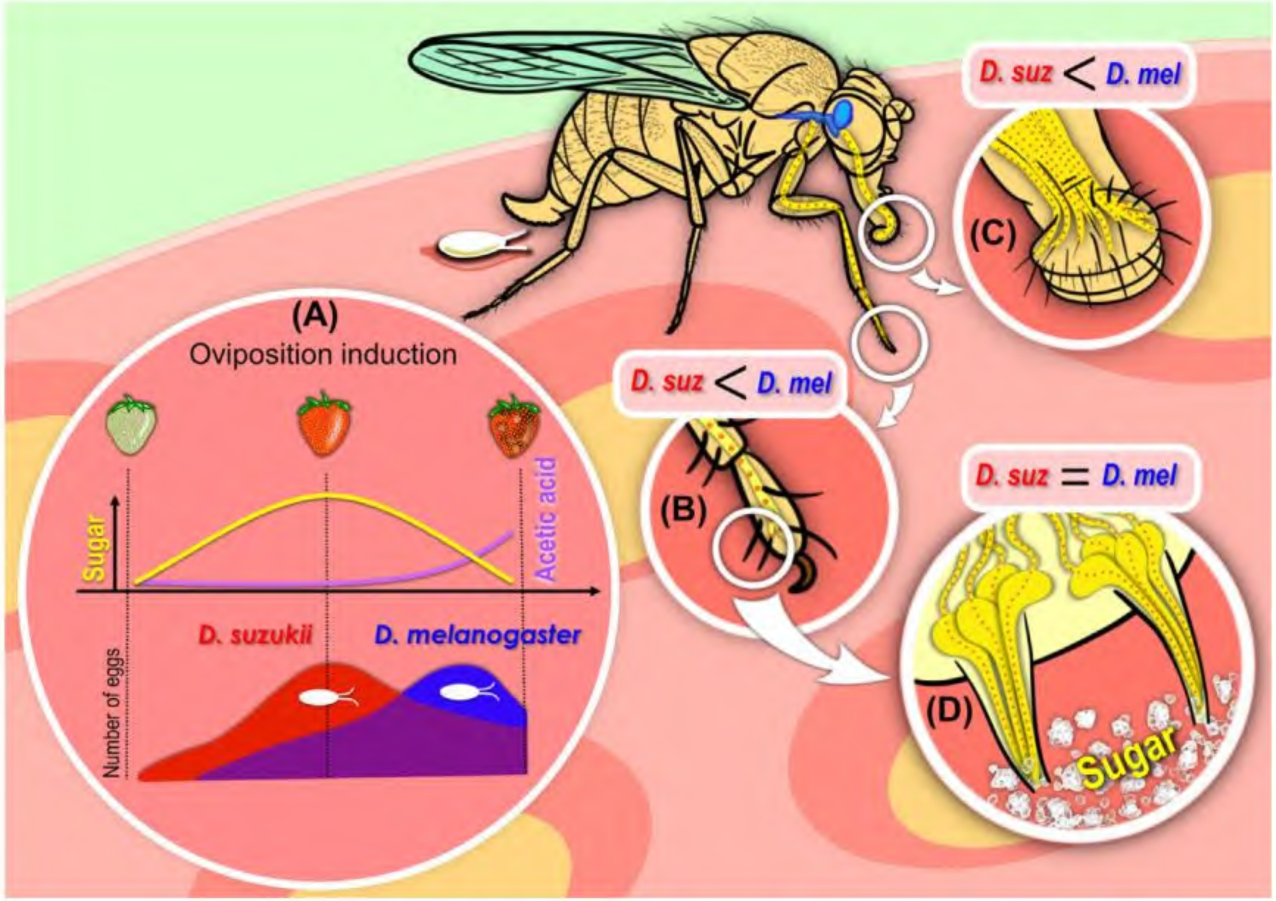
The niche shift in *D. suzukii* is associated with genetic changes in peripheral sensory systems, including olfaction, mechanosensation, and gustation



Sensory function	Genes of interest	Possible role in *D. suzukii*
Host choice specialization	*Or22a, Or85a*	Ripe fruit ovipostition specialization
Rotten fruit volatile sensing	*Or10a, Or85d, Or85f, Ir7a ppk*	Differential response to rotten fruit volatiles
CO_2 detection	*Gr63a, Ir56d, Trpγ*	Aversion to CO_2 produced during fermentation
Stiffness differentiation	*nan, Piezo*	Derived preference for stiff substrates

Durkin SM, et al., *Mol Biol Evol*, 2021

A sweet tooth makes a fly a pest



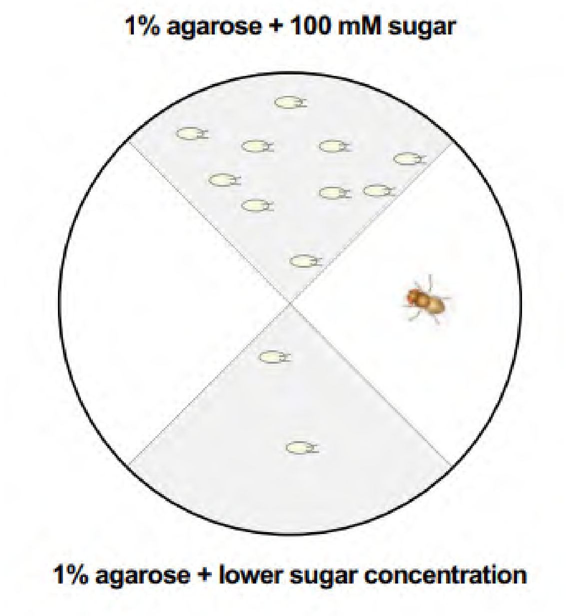
John R. Carlson

Benjamin Prud'homme

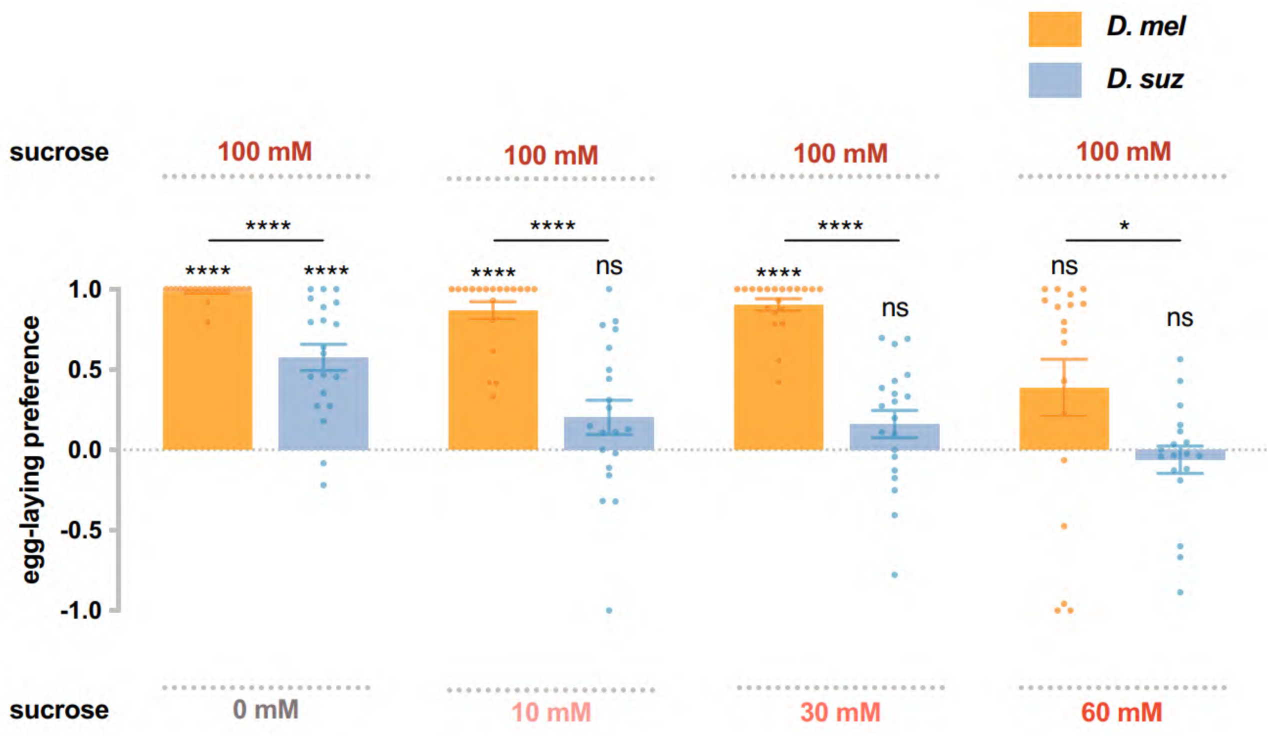
Changes in responsiveness to sugar-induced neuronal signals, but not in sugar perception drive the shift in the oviposition preference of *D. suzukii* from fermented to ripe fruits.

Rode NO and Meslin C, *Trends Ecol Evol*, 2024

D. suzukii shows a weaker egg-laying preference than *D. melanogaster* for sweeter substrates (sucrose, fructose and glucose)



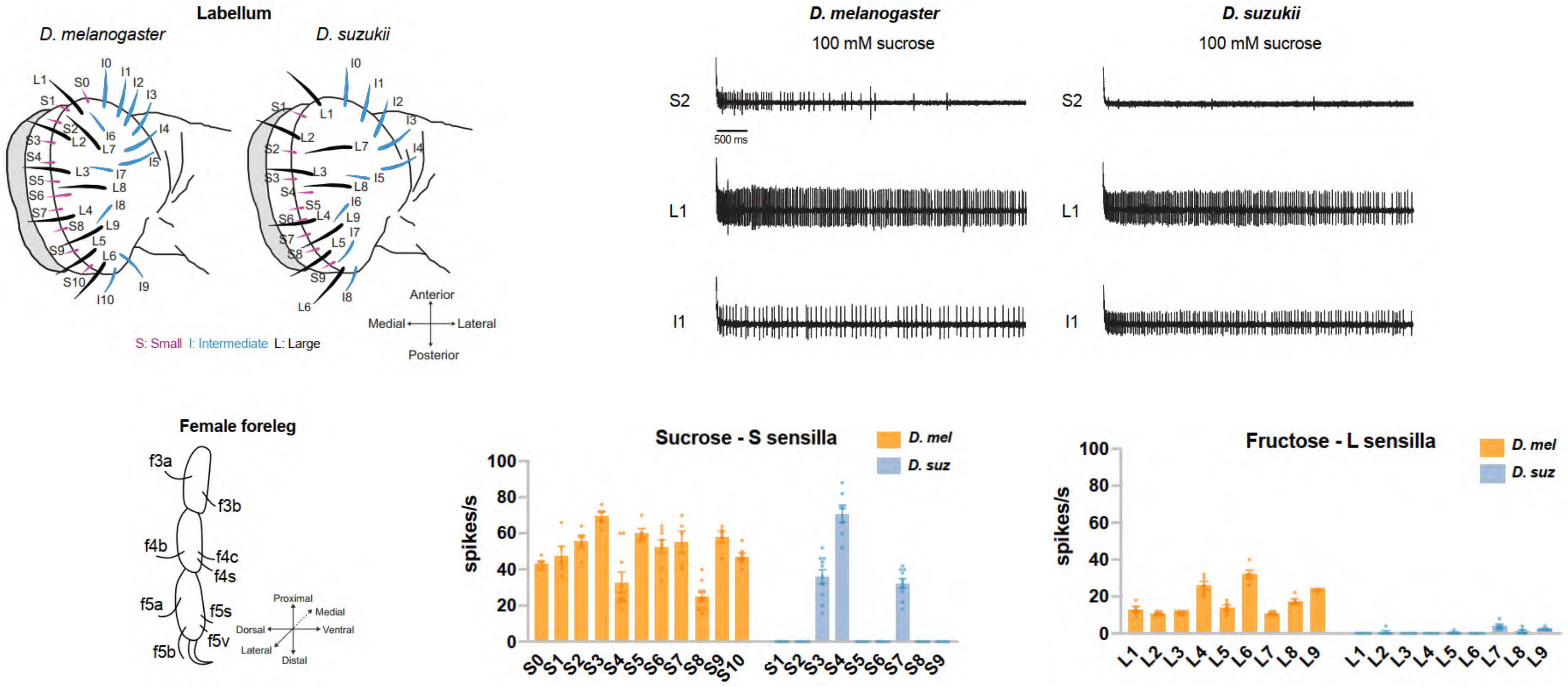
Oviposition choice assay



Sucrose, fructose and glucose show similar results.

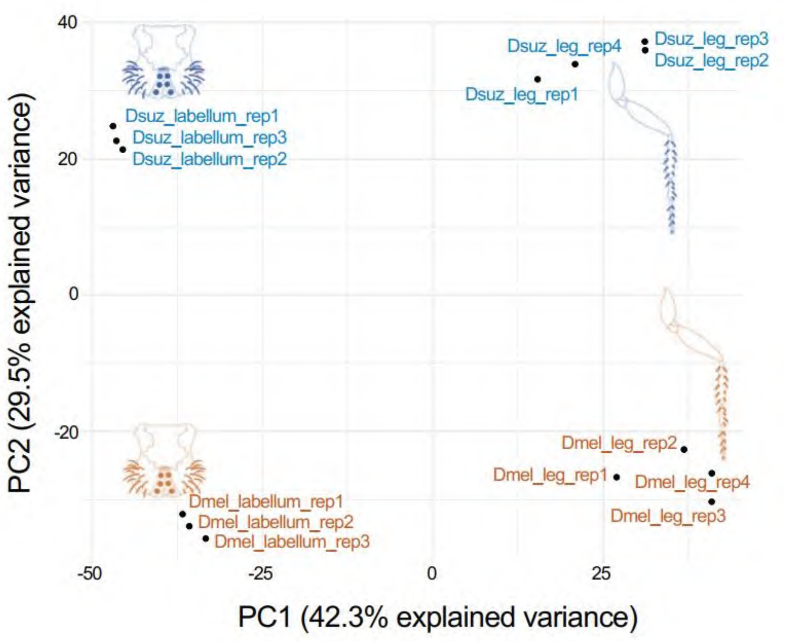
Wang W, et al., *eLife*, 2022

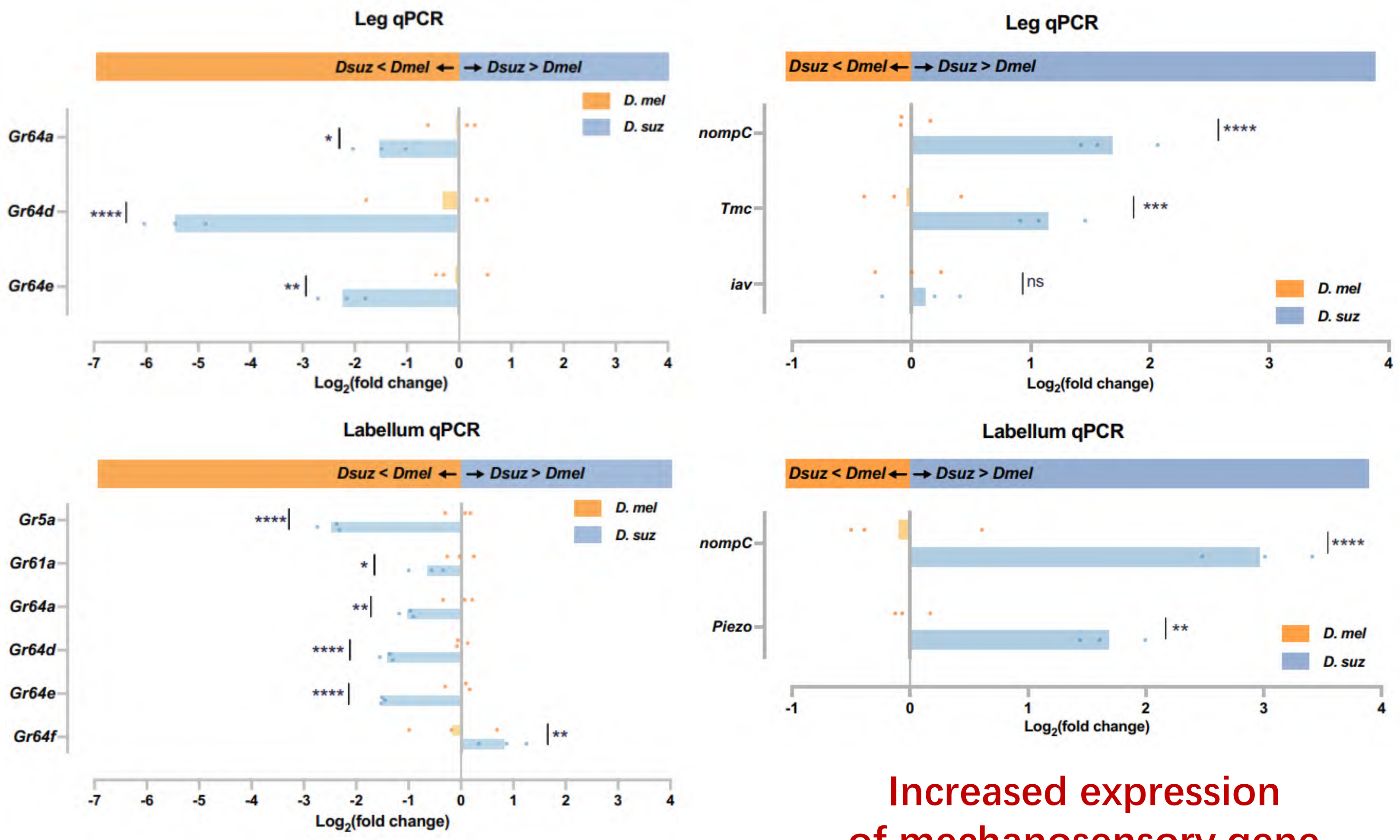
D. suzukii shows a reduced sensitivity of its GRNs to sucrose and fructose compared to *D. melanogaster*



Wang W, et al., *eLife*, 2022

Changes in the expression of sugar receptor genes and mechanosensory genes in the *D. suzukii* labellum and leg



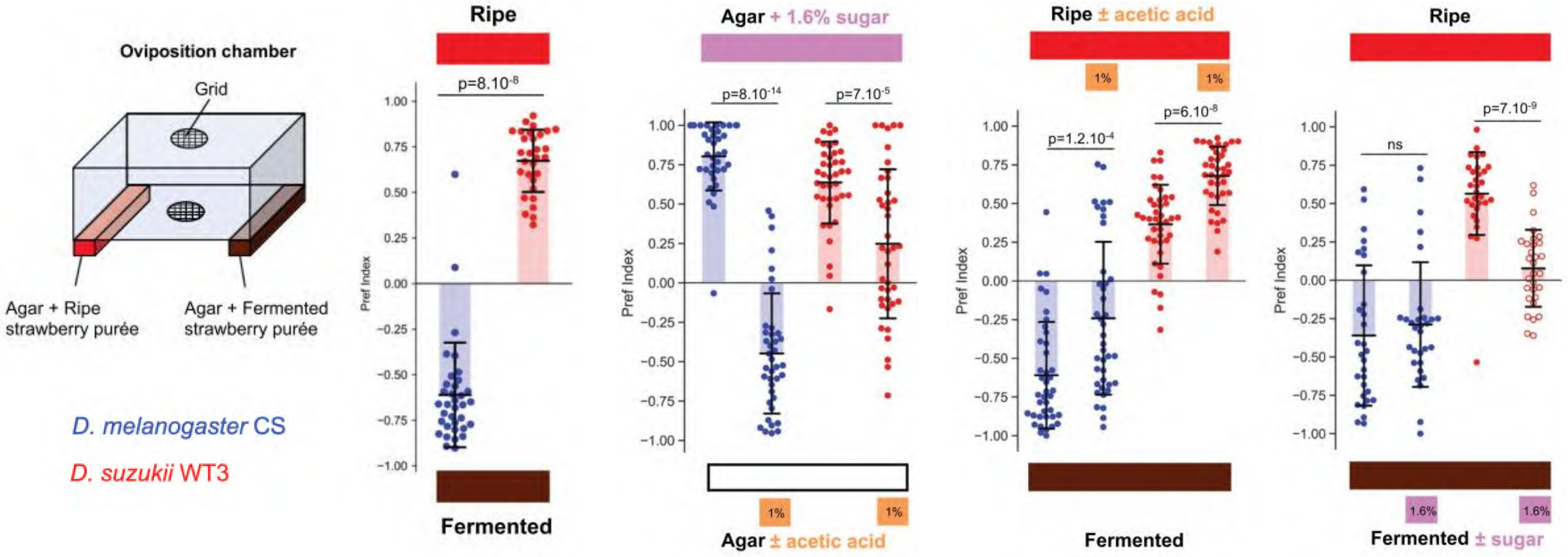


Reduced expression of sugar receptor gene

Increased expression of mechanosensory gene

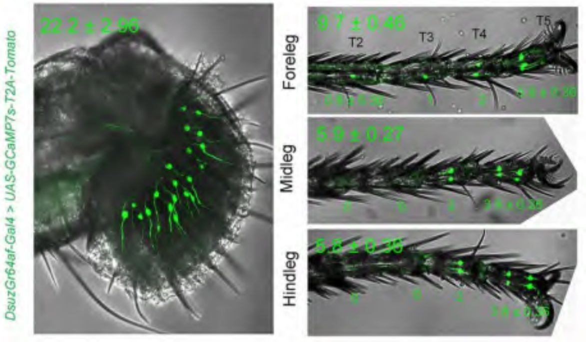
Wang W, et al., *eLife*, 2022

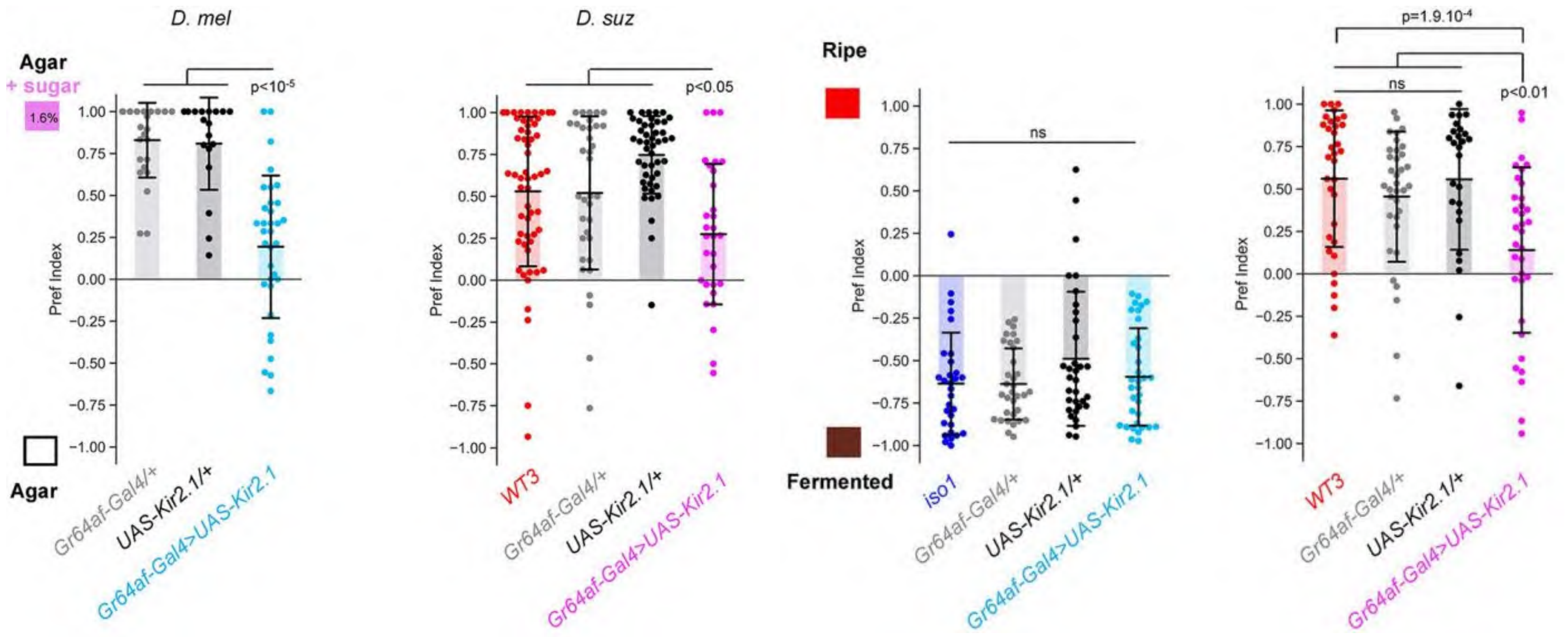
Sugar has a higher value for the oviposition preference of *D. suzukii*



Cavey M, et al., *PLoS Biol*, 2023

Sugar sensing is required for ripe substrate preference in *D. suzukii*





Sugar-GRN numbers

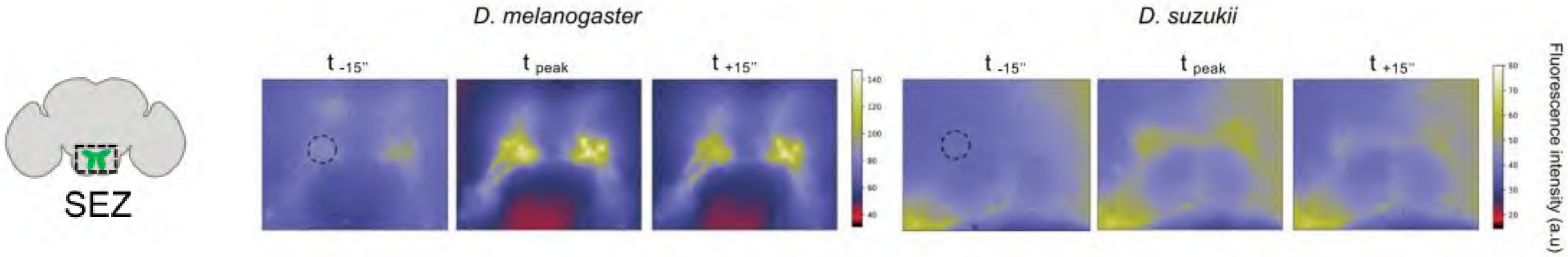
D. mel
D. suz

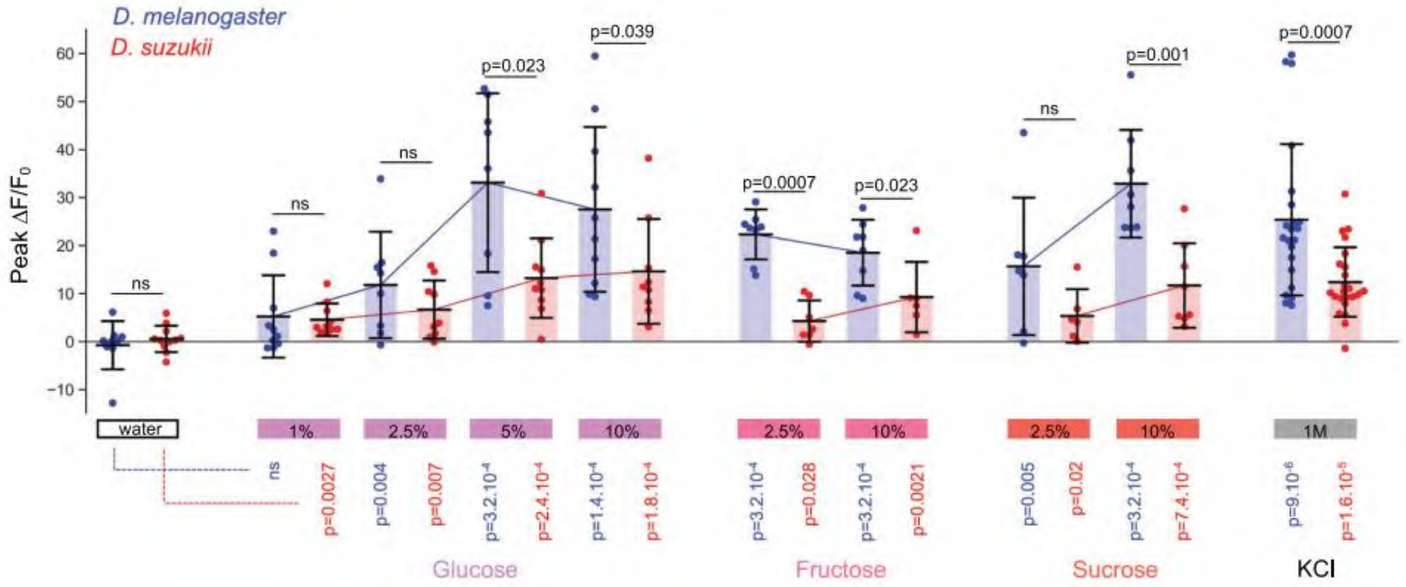
	Gr64af-Gal4	sensilla
proboscis	35-38 [d] 22.2 ± 2.96 [a]	31 [b] 21 [b]
foreleg	14 [c,e] 9.7 ± 0.46 [a]	14 [e] 10 [b]
midleg	6 [c,e] 5.9 ± 0.27 [a]	6 [e] *nd*
hindleg	6 [c,e] 5.8 ± 0.36 [a]	*nd* *nd*

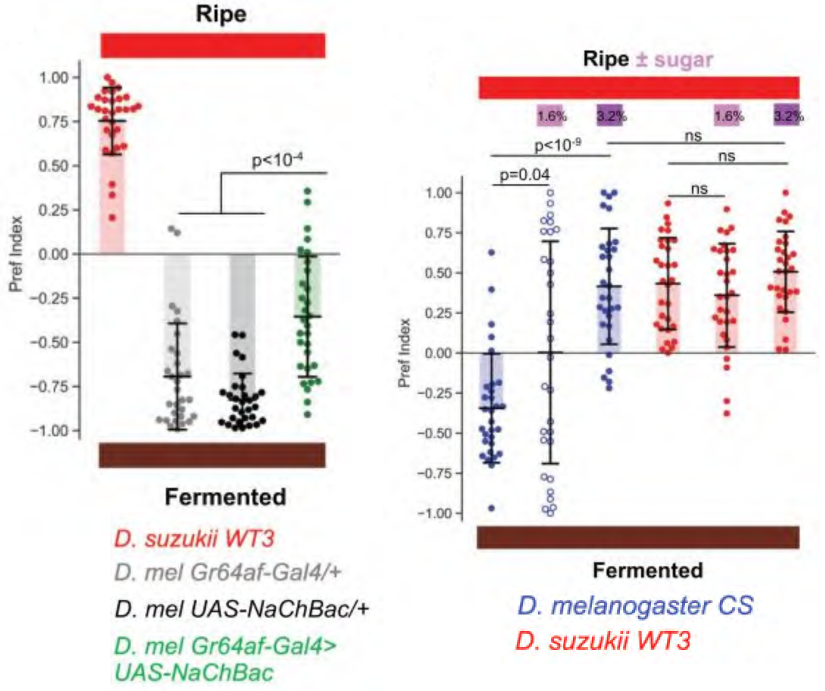
Cavey M, et al., *PLoS Biol*, 2023

Egg-laying preference for ripe substrates results from changes in signal interpretation, not in sugar perception

Synaptic terminals of labellar GRNs







Cavey M, et al., *PLoS Biol*, 2023

Nicolas Gompel's lab

Genetics of phenotype evolution

Research Di

Research

Our group focuses on the genetic origin of trait diversification. For many animal groups, closely r
Some sort of variation on a theme. The theme can be colors, simple forms, textures, fancy choreo
shaped over evolutionary times through the interplay of two forces, arising genetic variation a
understand how changes in the DNA sequence translate at the levels of gene function, gene expre

We use fruit fly species (Drosophila ssp.) that differ in their morphologies and their behaviors
differences. This currently results in two large projects in the lab.

One project analyzes color patterns on fly wings. The evolutionary gain of such wing paintings, as
genes controlling pigment formation. Therefore, a large part of our work focuses on the control c
quantitative outputs produced by these changes.

The other project studies how an innate reproductive behavior has diversified among Drosophi
decaying fruits, one of them, *Drosophila suzukii*, has gained the ability to target earlier stages of fr
the Western world, by the damages it causes to the cultures of our favorite fruits (strawberries, r
genetic and neuronal determinants of egg-laying behavior between *D. suzukii* and other species th

In general, our work combines genetics, genomics, and quantitative phenotype analysis, alway
situation and compare them to species representing a derived situation.

University of Bonn
Zoology and Evolutionary Developmental Biology
Meckenheimer Allee 169, 53115 Bonn, Germany
ngompel@uni-bonn.de

cnrs

VOTRE PROFIL LE CNRS SUR LE WEB

Nos recherches Nos innovations Nos défis

Benjamin Prud'homme

Chercheur en génétique évolutive du développement

Médaille de bronze du CNRS 2014

Les travaux de Benjamin Prud'homme tentent de faire le lien entre l'évolution des caractères morphologiques et comportementaux chez les animaux et les changements génétiques qui leur donnent naissance, en étudiant la diversité des mouches drosophiles.

Après une thèse obtenue en 2003, il réalise un post-doctorat à l'université du Wisconsin (États-Unis). Là, il commence à s'intéresser à des motifs pigmentaires des ailes des drosophiles associés à divers comportements, élucidant les mécanismes génétiques à l'origine de l'évolution de ces caractères. Recruté par le CNRS en 2007, il monte avec un autre chercheur une équipe à l'Institut de biologie du développement de Marseille. Tout en y poursuivant ses études sur les motifs

Summary

- The niche shift in *D. suzukii* is associated with genetic changes in peripheral sensory systems, including olfaction, mechanosensation, and gustation.
- Sugar sensing is required for ripe substrate preference, but the interpretation of sugar perception within the CNS drives the niche shift in *D. suzukii*.
- *D. suzukii* are more attracted to ripening fruit and leaf. The preference towards leaves is linked to β-cyclocitral, a novel ligand for the “ab3A” neuron.
- *D. suzukii* do not avoid carbon dioxide like *D. melanogaster,* but avoid DEET. A DEET substitute could be used to control *D. suzukii*.

Reference

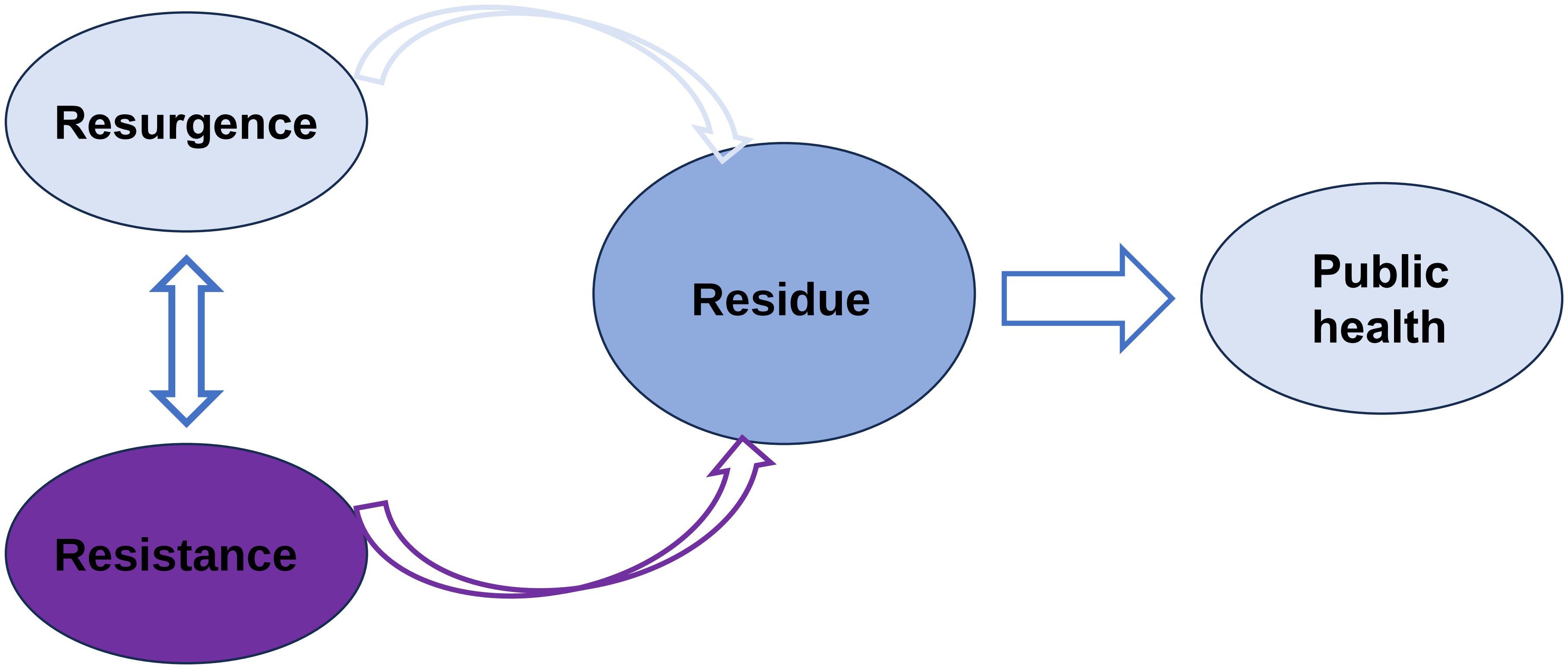
1. Keesey IW, Knaden M, Hansson BS. Olfactory specialization in Drosophila suzukii supports an ecological shift in host preference from rotten to fresh fruit. *J Chem Ecol*. 2015;41(2):121-128. doi:10.1007/s10886-015-0544-3
2. Krause Pham C, Ray A. Conservation of Olfactory Avoidance in Drosophila Species and Identification of Repellents for Drosophila suzukii. *Sci Rep*. 2015;5:11527. doi:10.1038/srep11527
3. Karageorgi M, Bräcker LB, Lebreton S, et al. Evolution of Multiple Sensory Systems Drives Novel Egg-Laying Behavior in the Fruit Pest Drosophila suzukii. *Curr Biol*. 2017;27(6):847-853. doi:10.1016/j.cub.2017.01.055
4. Cloonan KR, Abraham J, Angeli S, Syed Z, Rodriguez-Saona C. Advances in the Chemical Ecology of the Spotted Wing Drosophila (Drosophila suzukii) and its Applications. *J Chem Ecol*. 2018;44(10):922-939. doi:10.1007/s10886-018-1000-y
5. Durkin SM, Chakraborty M, Abrieux A, et al. Behavioral and Genomic Sensory Adaptations Underlying the Pest Activity of Drosophila suzukii. *Mol Biol Evol*. 2021;38(6):2532-2546. doi:10.1093/molbev/msab048
6. Wang W, Dweck HKM, Talross GJS, Zaidi A, Gendron JM, Carlson JR. Sugar sensation and mechanosensation in the egg-laying preference shift of Drosophila suzukii. *Elife*. 2022;11:e81703. doi:10.7554/eLife.81703
7. Cavey M, Charroux B, Travaillard S, et al. Increased sugar valuation contributes to the evolutionary shift in egg-laying behavior of the fruit pest Drosophila suzukii. *PLoS Biol*. 2023;21(12):e3002432. doi:10.1371/journal.pbio.3002432
8. Rode NO, Meslin C. A sweet tooth makes a fly a pest. *Trends Ecol Evol*. 2024;39(4):315-317. doi:10.1016/j.tree.2024.03.002

Strategies to control *Drosophila suzukii*

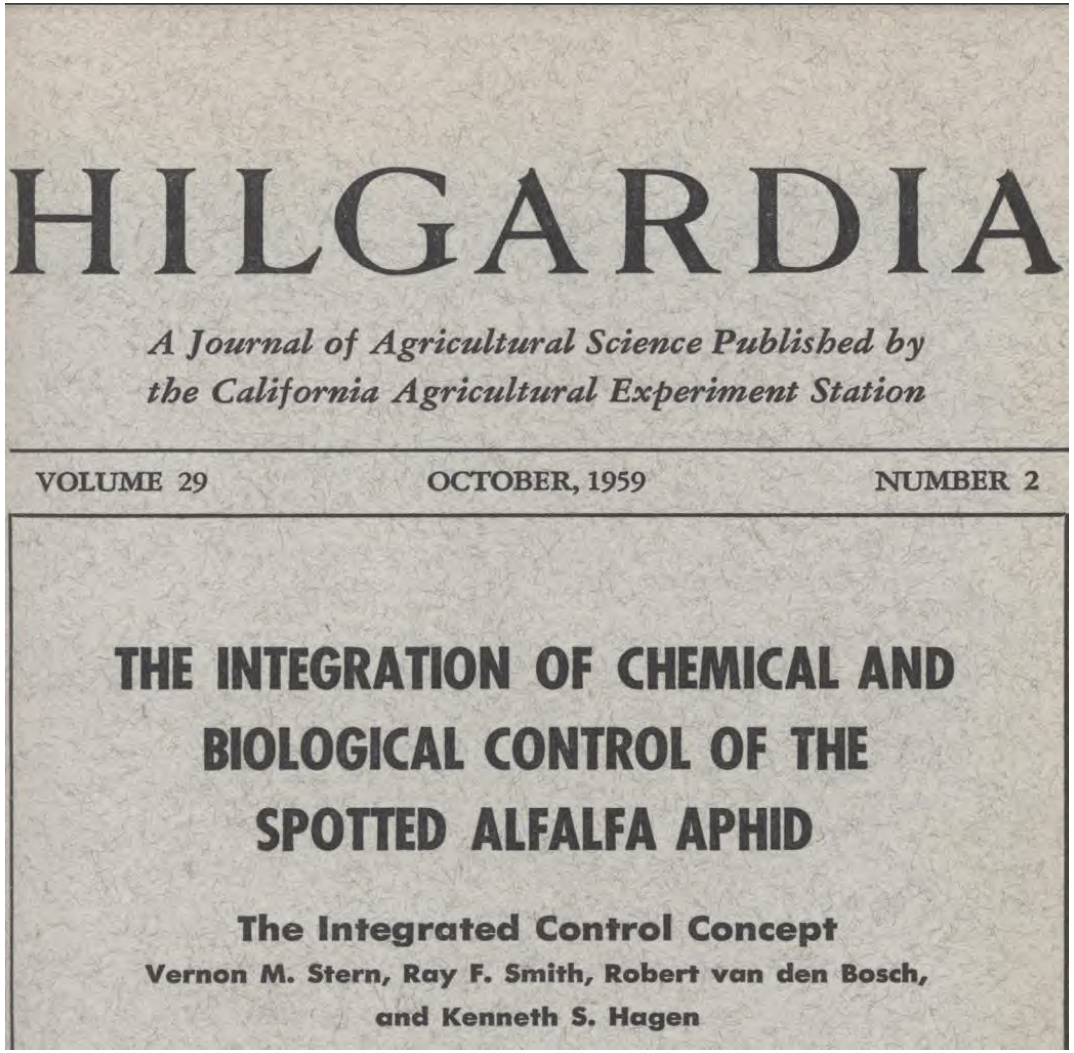
Joshua Liang

2024-05-30

The "3R" problem of synthetic chemical pesticide



What is Integrated Pest Management (IPM) ?



HILGARDIA

A Journal of Agricultural Science Published by the California Agricultural Experiment Station

VOLUME 29 | OCTOBER, 1959 | NUMBER 2

THE INTEGRATION OF CHEMICAL AND BIOLOGICAL CONTROL OF THE SPOTTED ALFALFA APHID

The Integrated Control Concept

Vernon M. Stern, Ray F. Smith, Robert van den Bosch, and Kenneth S. Hagen

Applied pest control which combines and integrates biological and chemical control.

Drosophila suzukii Management

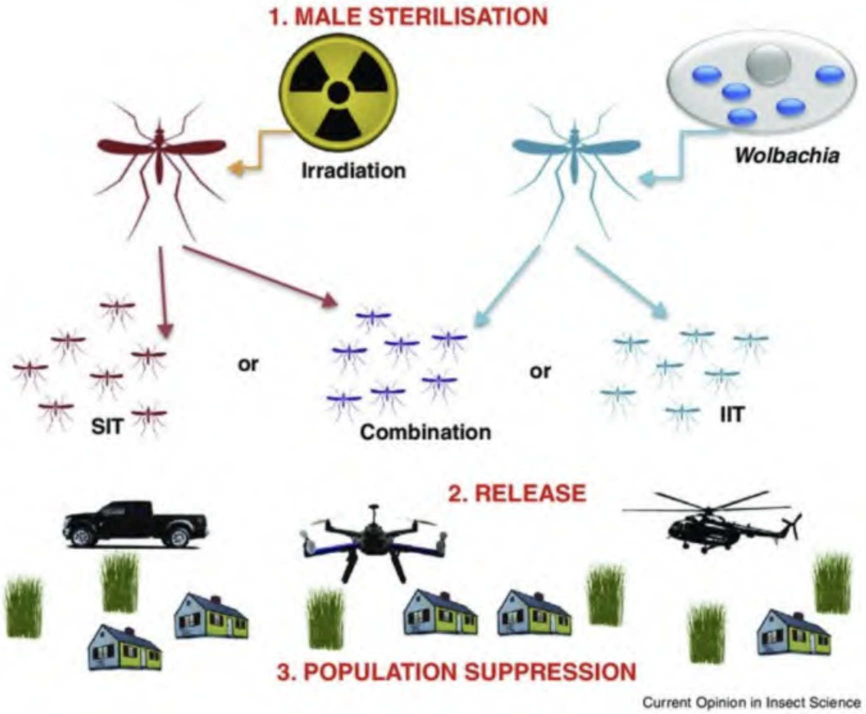
Chemical control

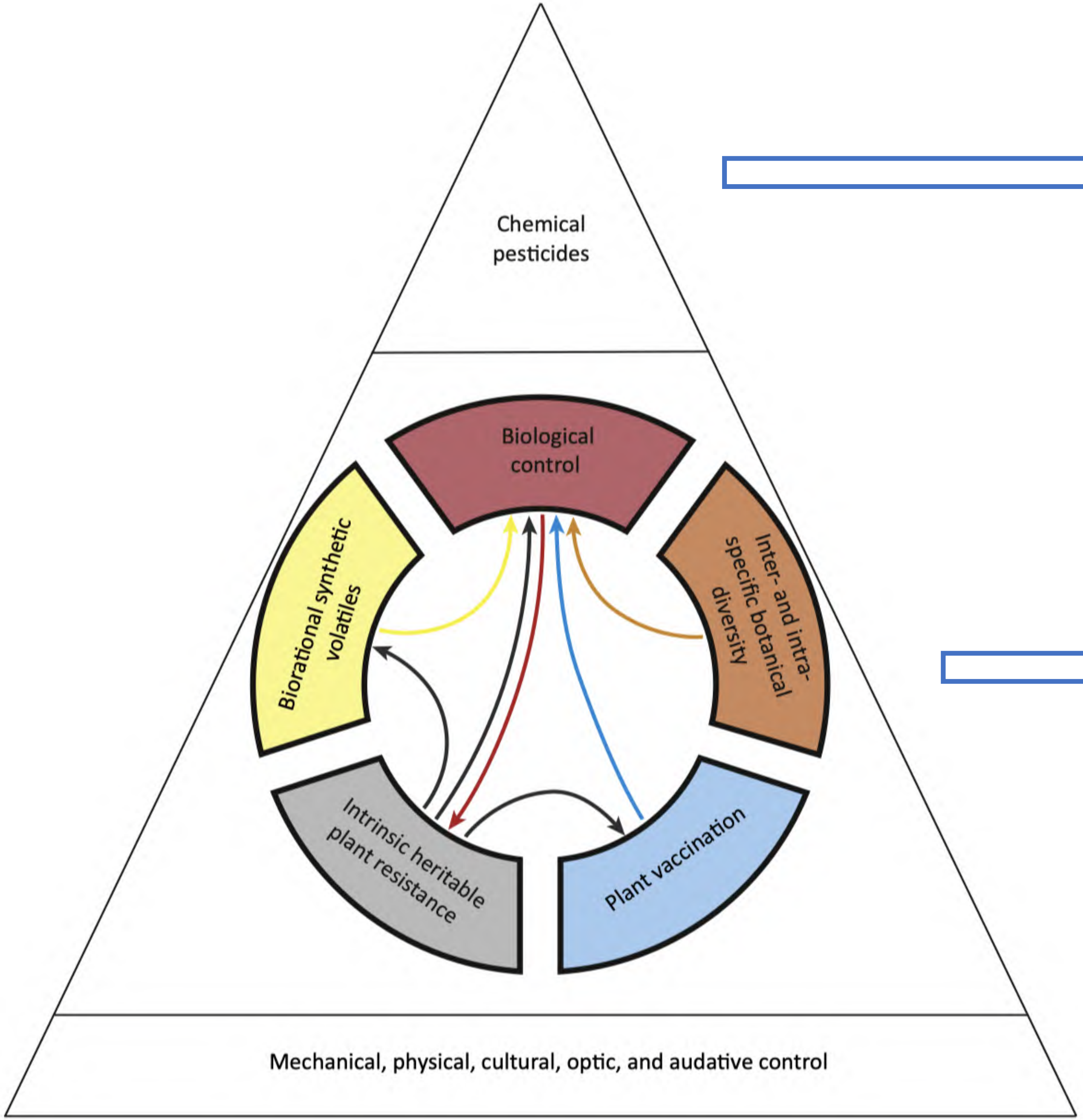
Biological control

Cultural control

Sterile Insect Technique(SIT)

百里香酚





Chemical control

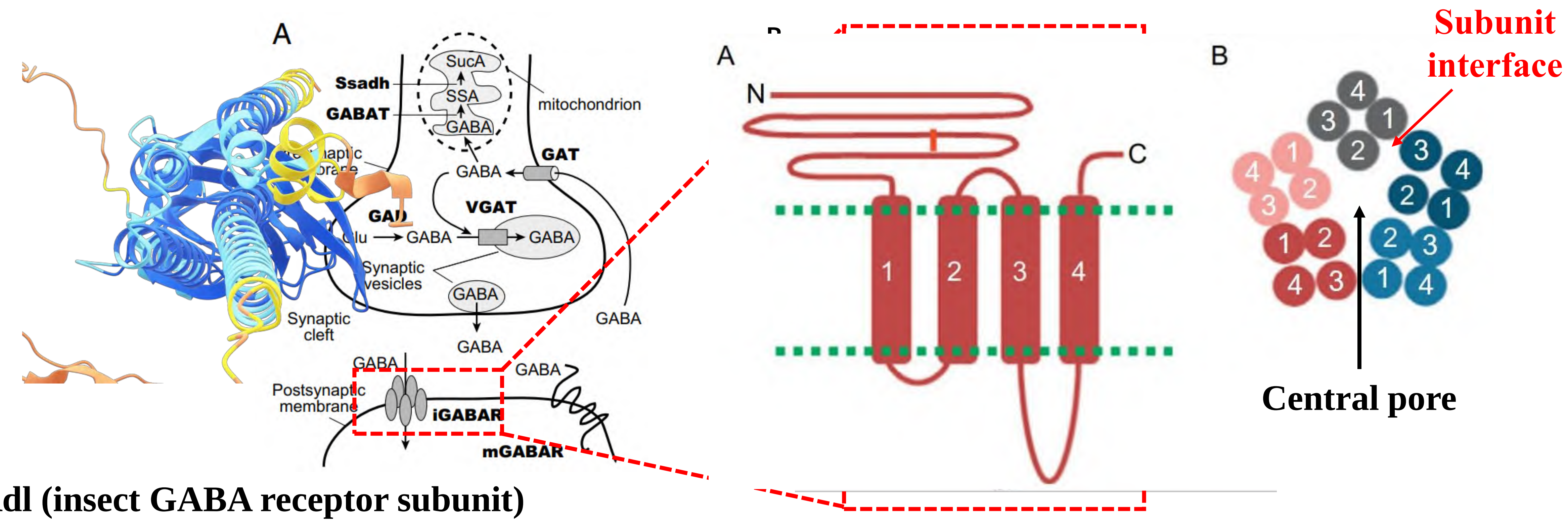
Biological control

Transgenic control

Stenberg JA, *Trends Plant Sci,* 2017

Definition of GABAergic insecticides.

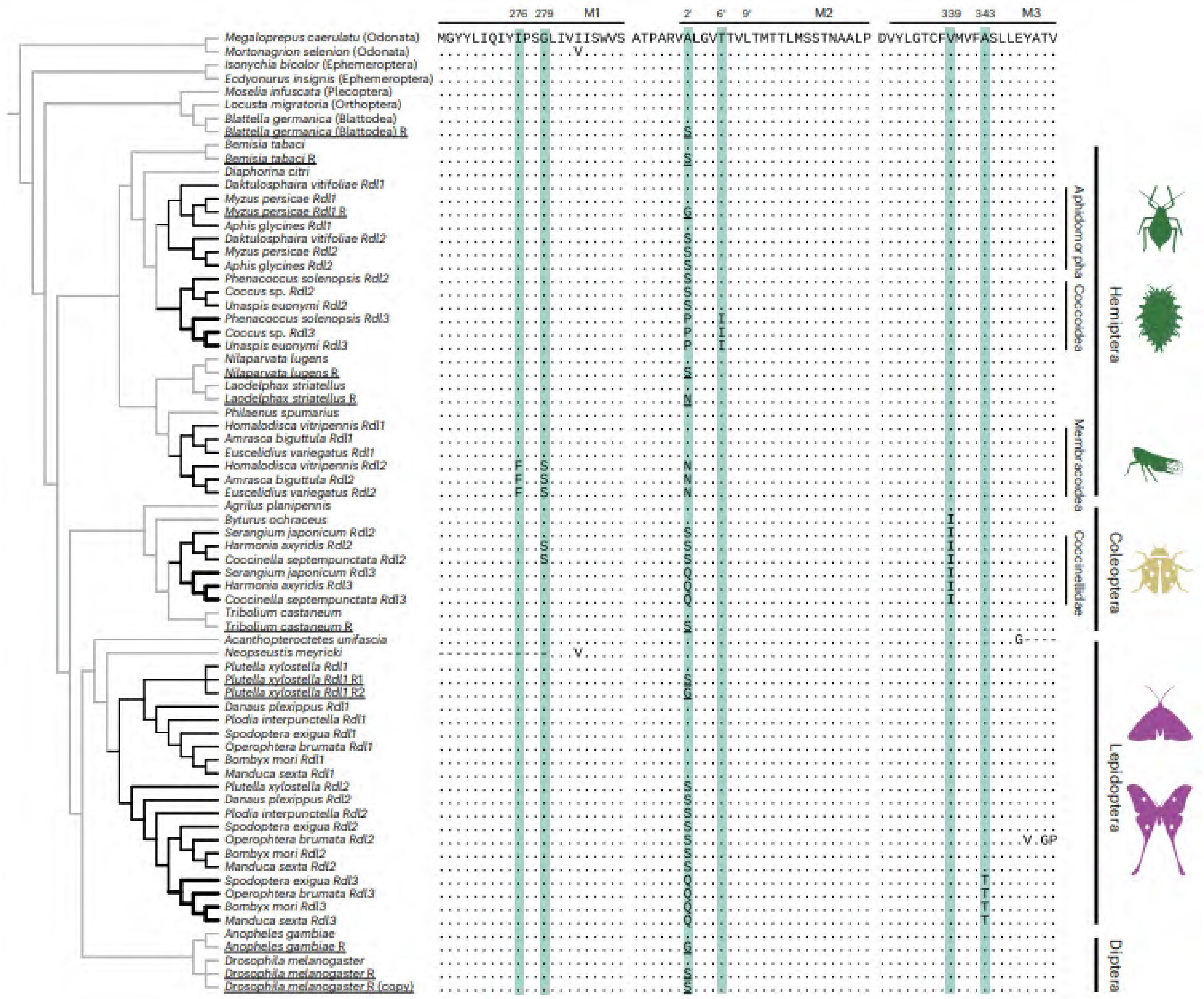
➢ Insecticides that target the γ-aminobutyric acid (GABA) receptor and therefore block GABA neurotransmission, thrilling the insects to death.



Rdl (insect GABA receptor subunit)

Raymond V et al., *Nat Rev Drug,* 2002

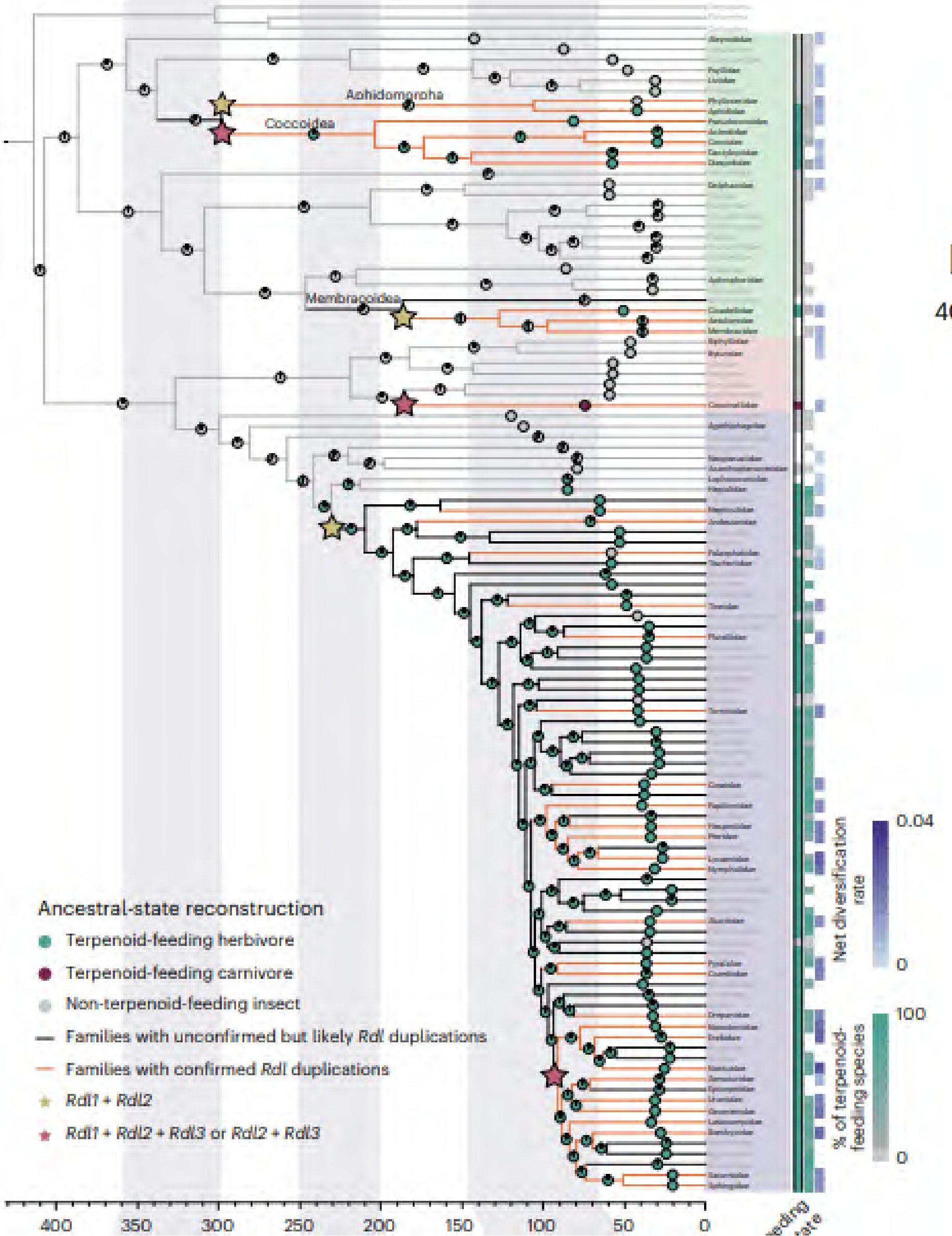
RDL A2’ point mutations lead to resistance in insects to 20th-century GABAergic insecticides.

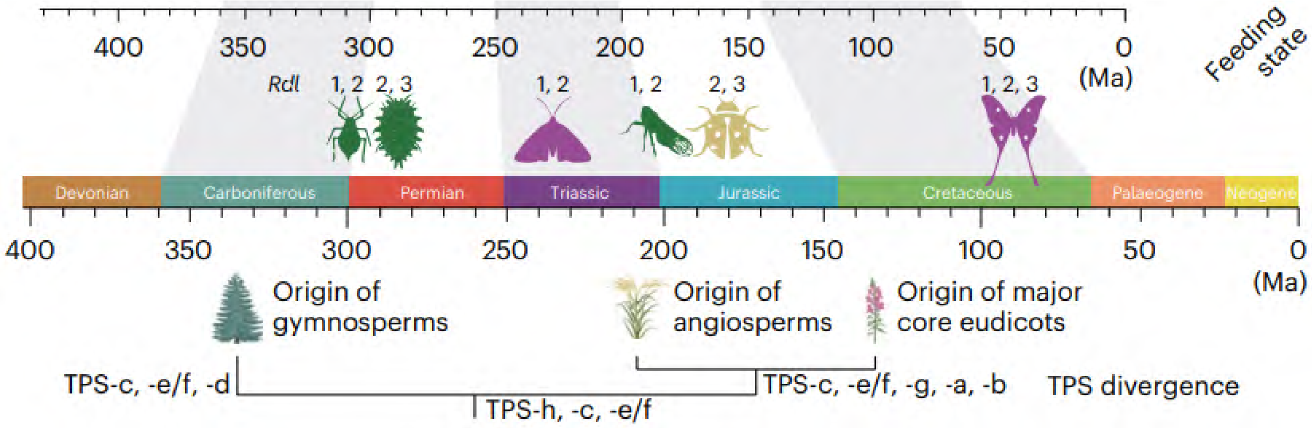


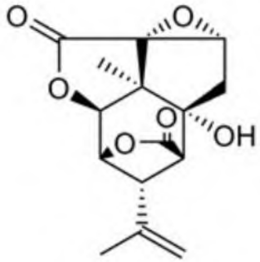
- A2’ point mutations are widespread among insect species.
- Many insects have two or more Rdl duplications which contain A2’ point mutations .

Guo L et al., *Nat Ecol Evol*, 2023

Rdl duplication of insect occurred at a time that coincided with host plant evolution.





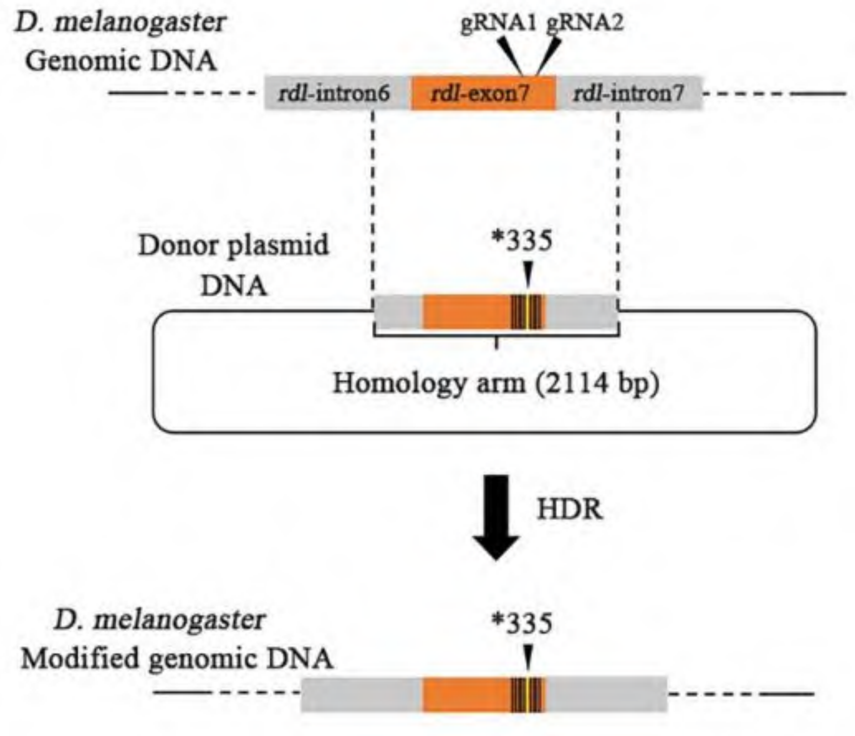


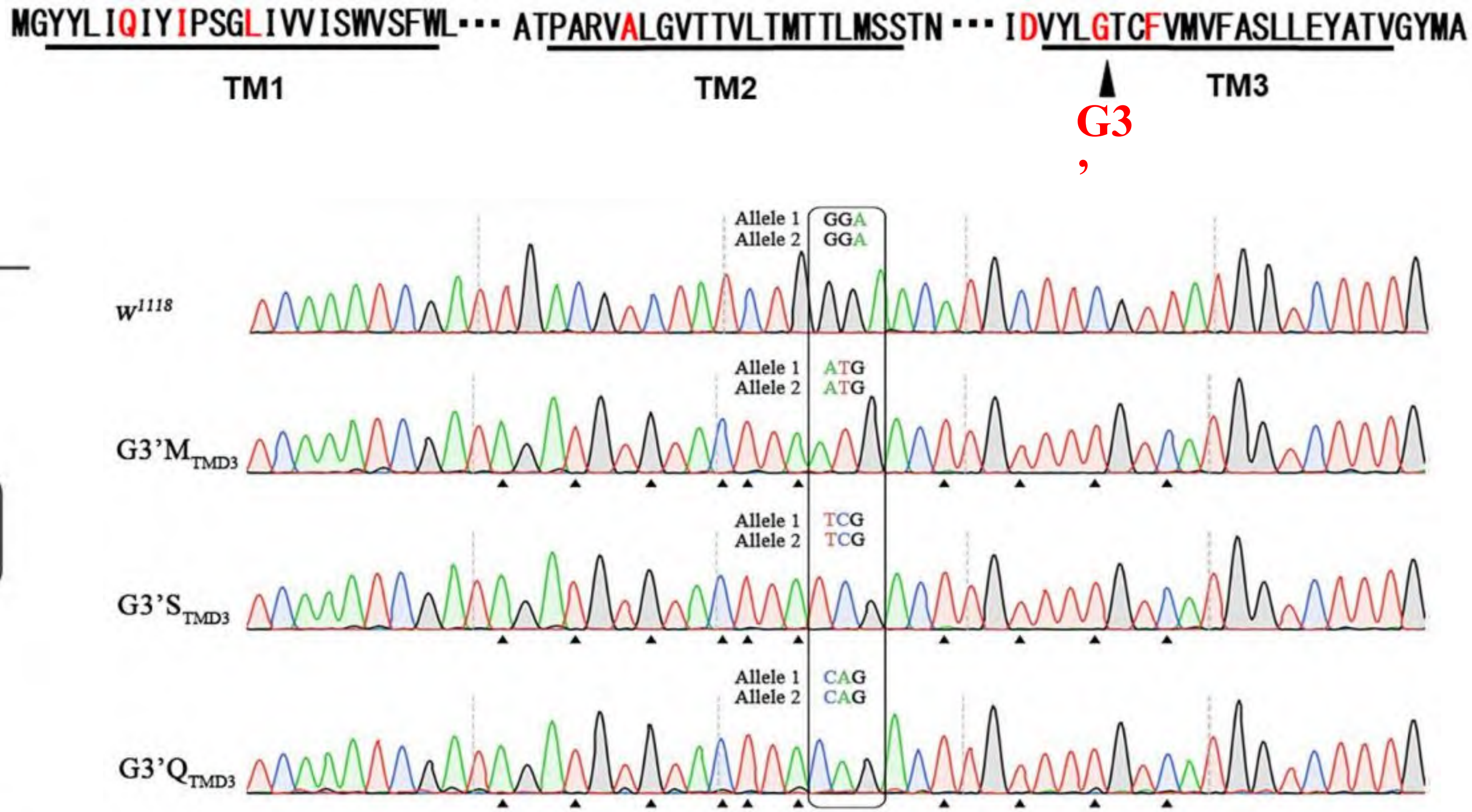
Picrotoxinin

Natural NCA-I compound gained by plants during evolution

Guo L et al., *Nat Ecol Evol*, 2023

What should an effective insecticide target site be like?

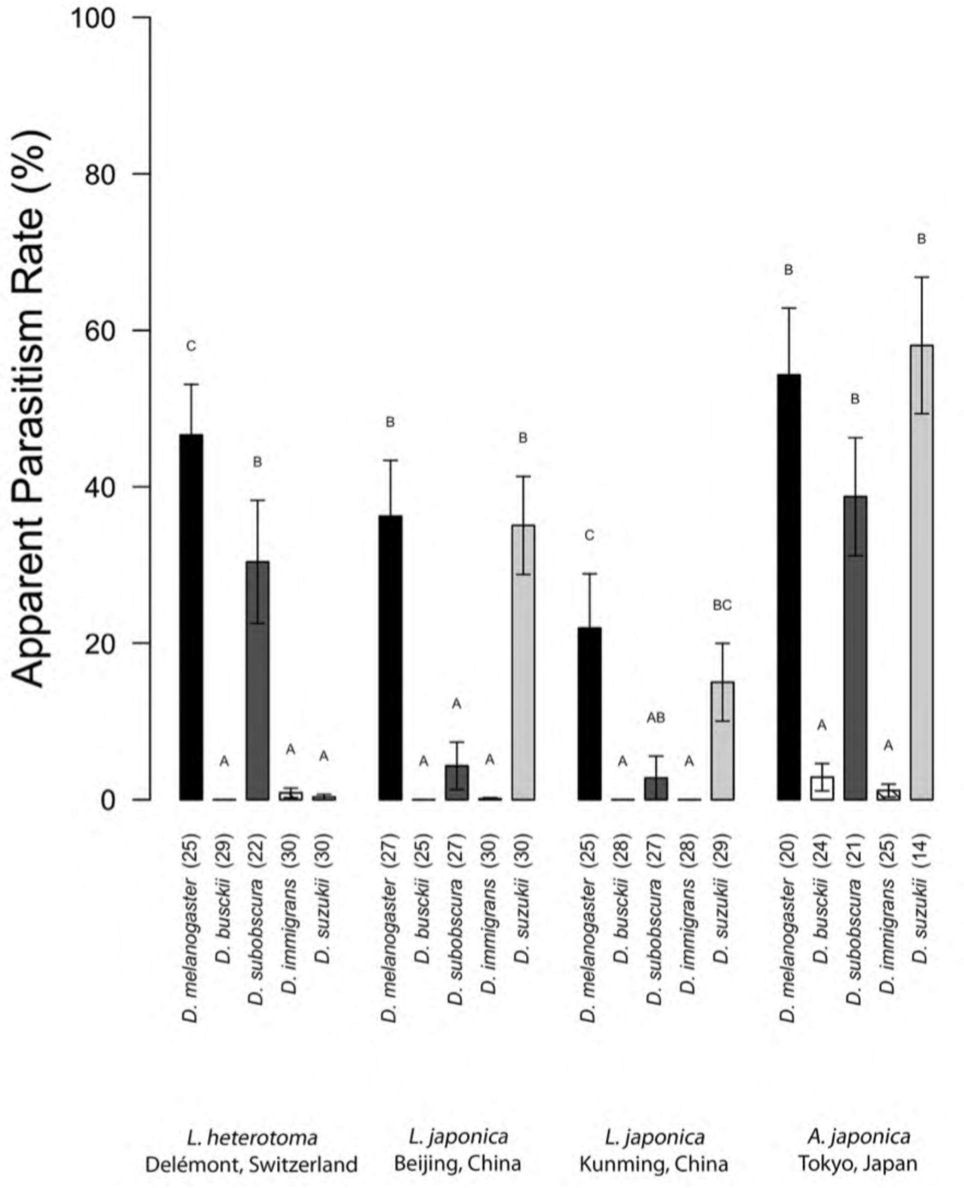


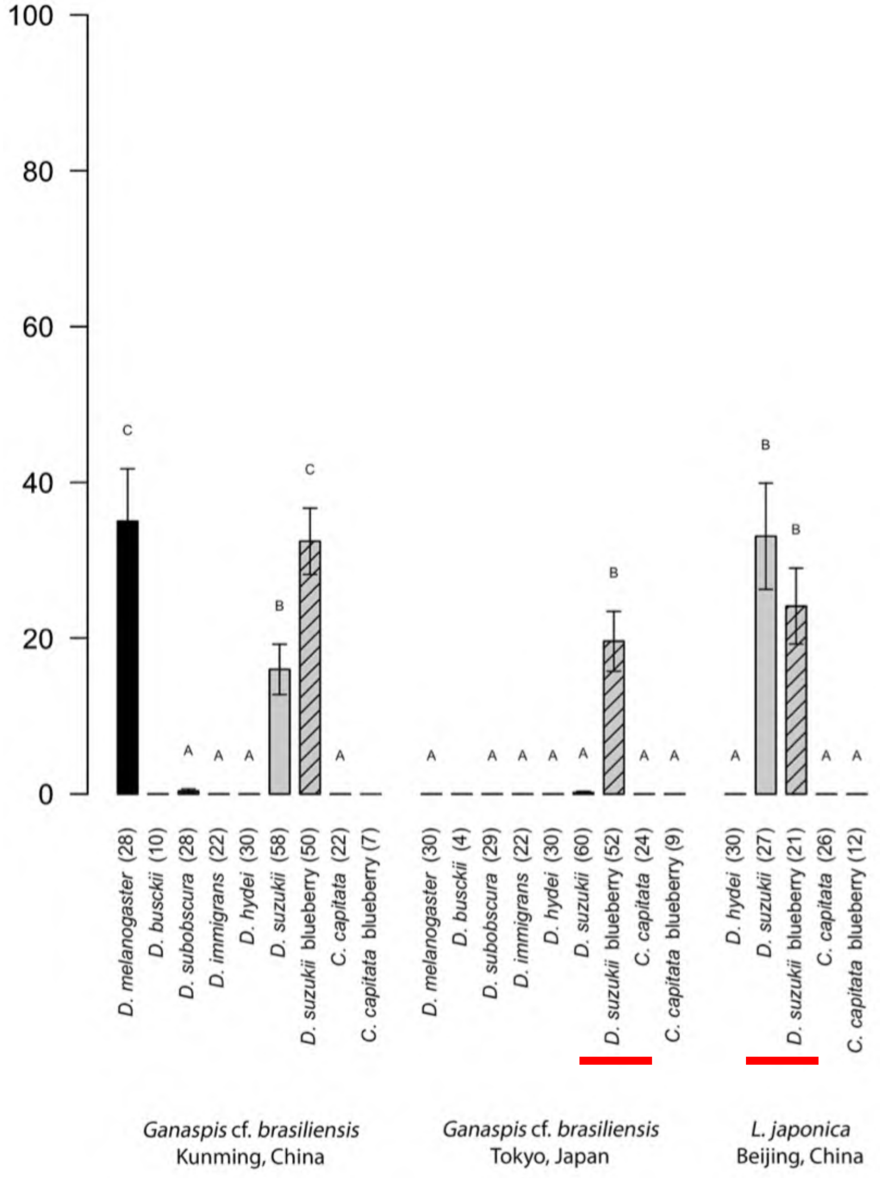


- G3'M mutation of Rdl conferred high resistance (＞900-fold) to NCA-II *in vivo*.

Zhang Y et al., *PLOS Genetics*, 2023

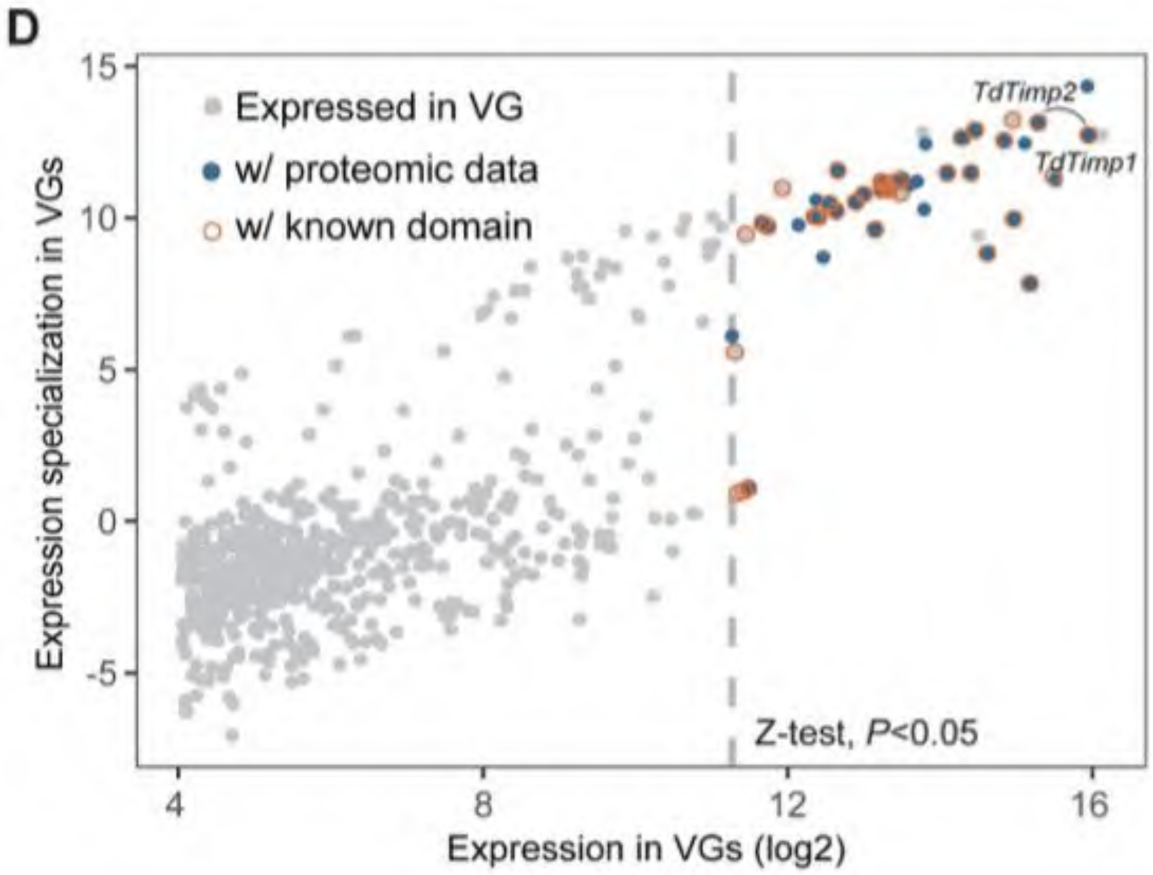
Asian parasitoids exhibit potential for targeted biological control of *D. suzukii*.

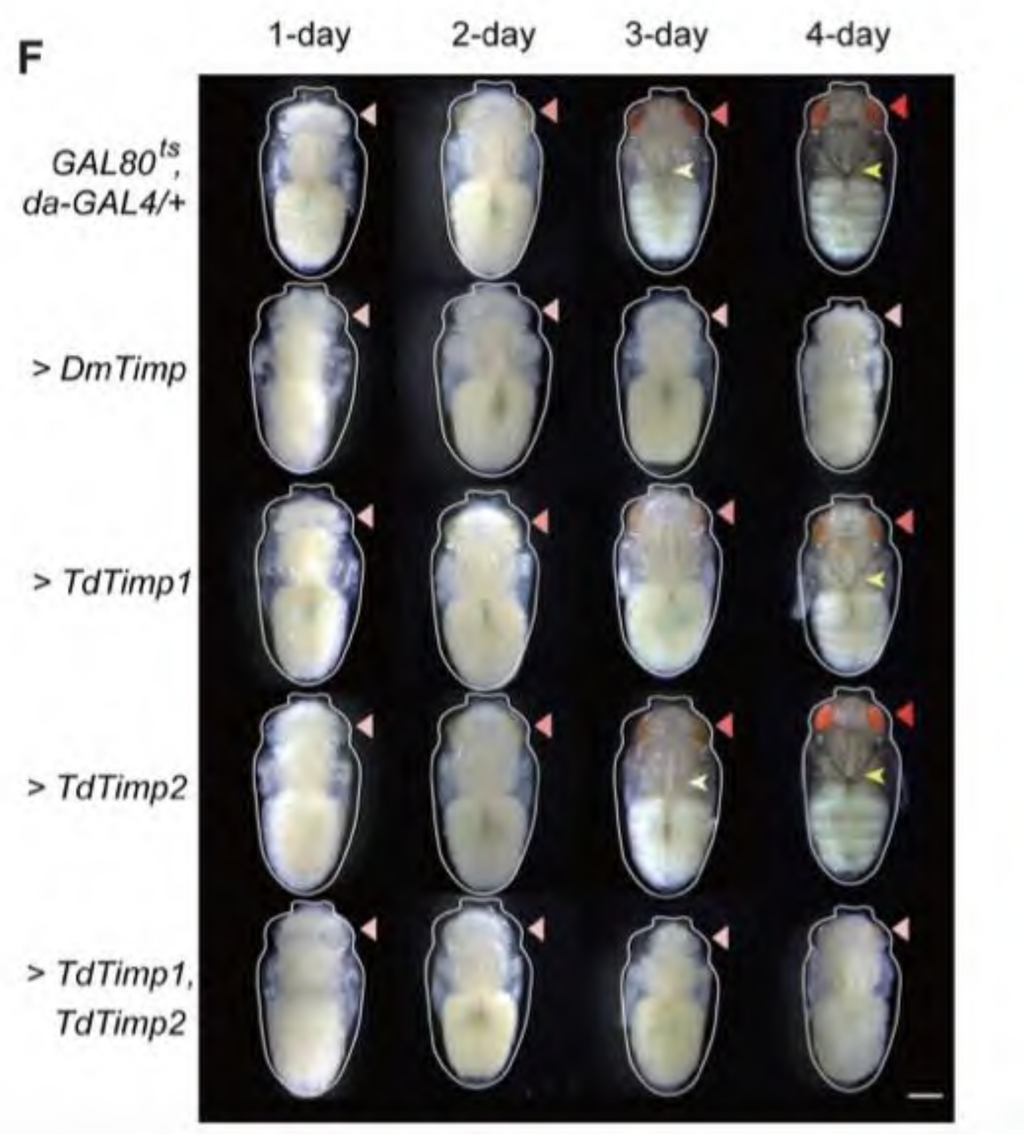




Girod P et al., *J Pest Sci*, 2018

The efficient parasitic mechanism of *Trichopria drosophilae* against *D. suzukii*.

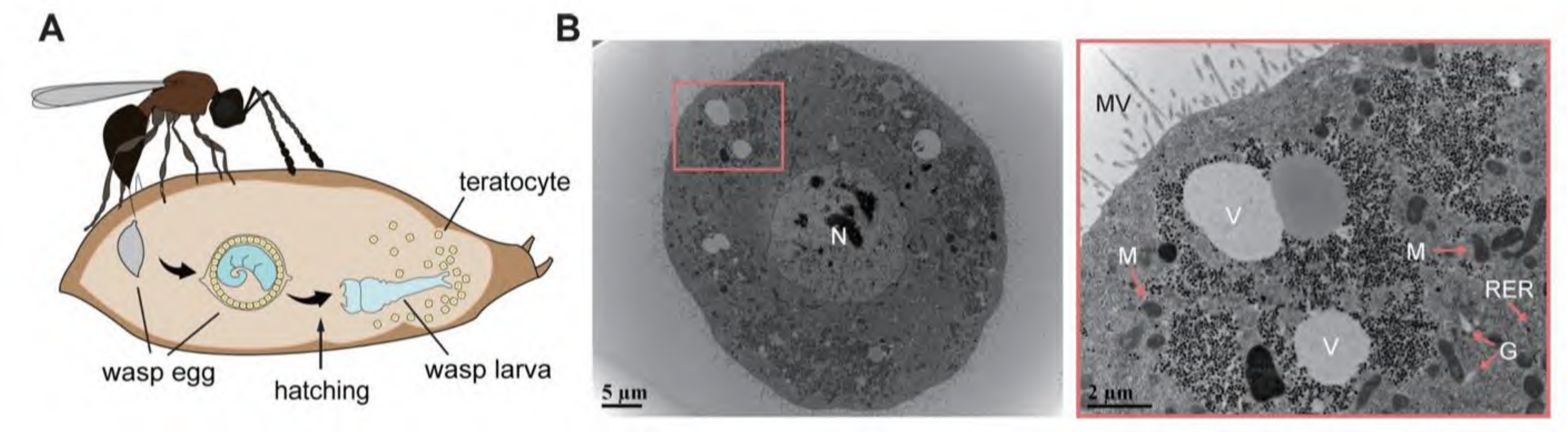




Timp proteins in the venom can inhibit the host's development, thereby improving nutrient absorption efficiency

Pang L et al., *eLife*, 2024

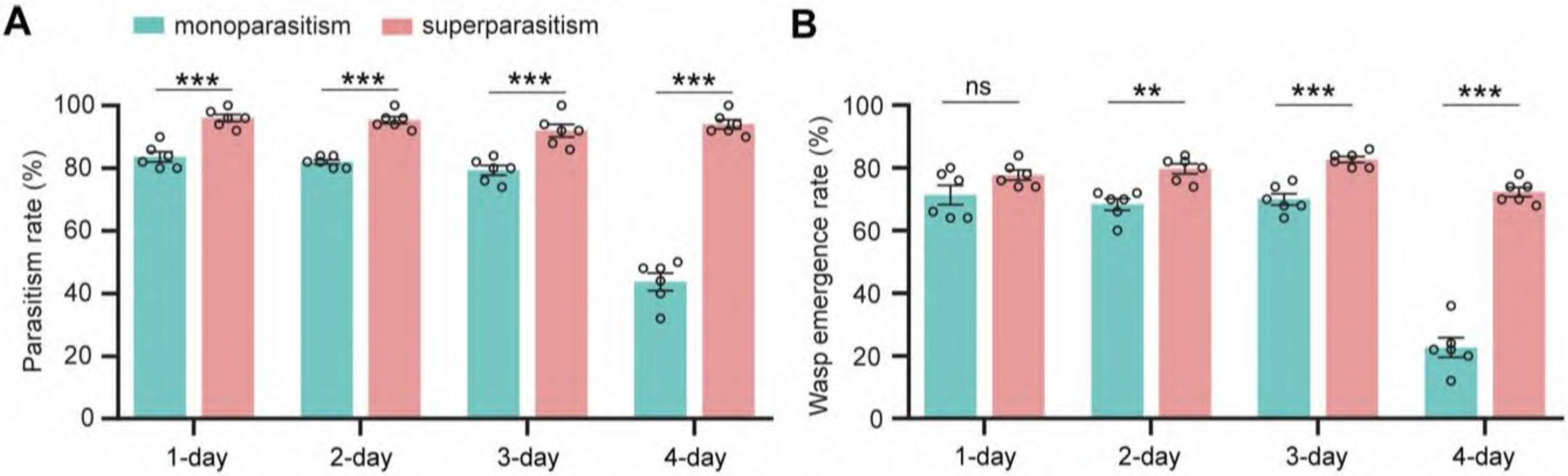
Trichopria drosophilae can avoid intraspecific and interspecific competition during parasitism.



During parasitism, *Trichopria drosophilae* releases teratocytes and secretes trypsin to dissociate host tissues.

Pang L et al., *eLife*, 2024

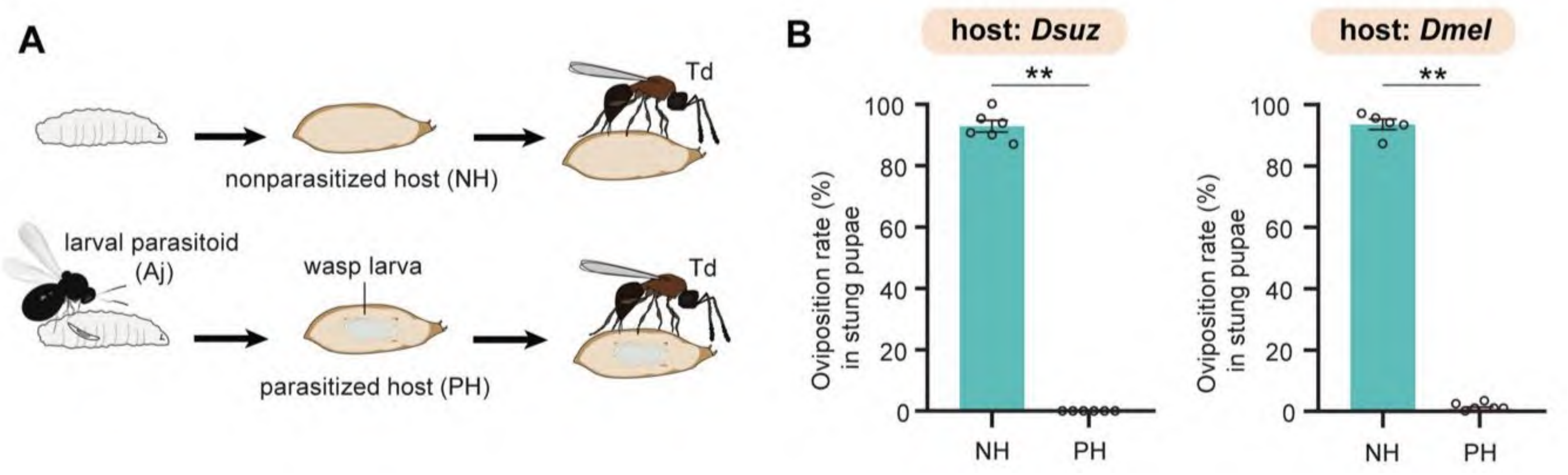
Trichopria drosophilae can avoid intraspecific and interspecific competition during parasitism.



Trichopria drosophilae adopts superparasitism in older hosts to increase parasitism success rates in these hosts.

Pang L et al., *eLife*, 2024

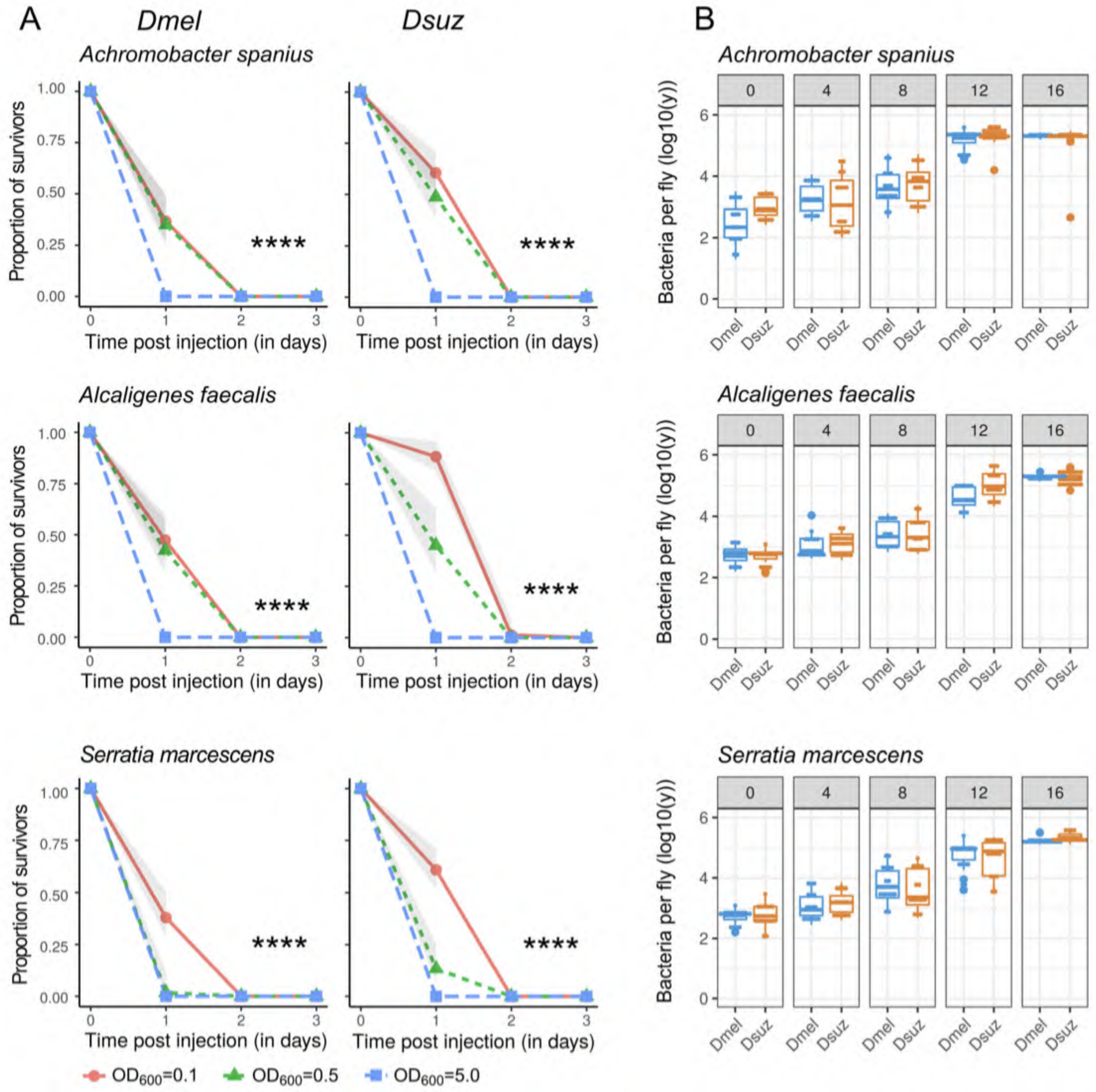
Trichopria drosophilae can avoid intraspecific and interspecific competition during parasitism.



Td uses its ovipositor to detect the larva of other parasitic wasps within the host, thereby avoiding interspecies competition.

Pang L et al., *eLife*, 2024

Natural pathogens of the *Drosophila suzukii* can be considered as potential resources for control.

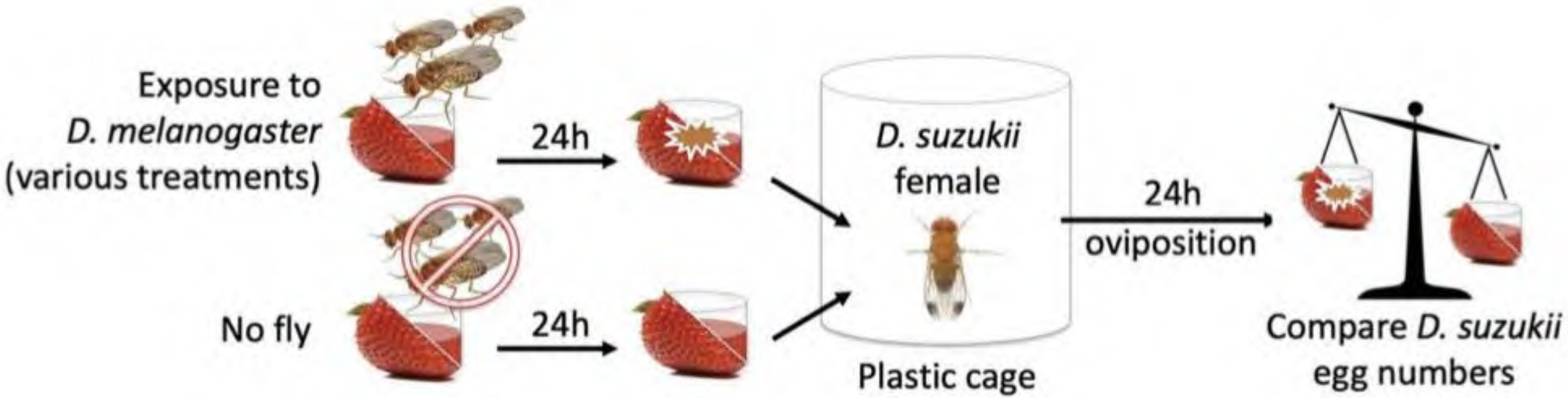


- The three bacteria can effectively kill the *D. suzukii*.

- These kinds of bacteria are capable of proliferating within the host.

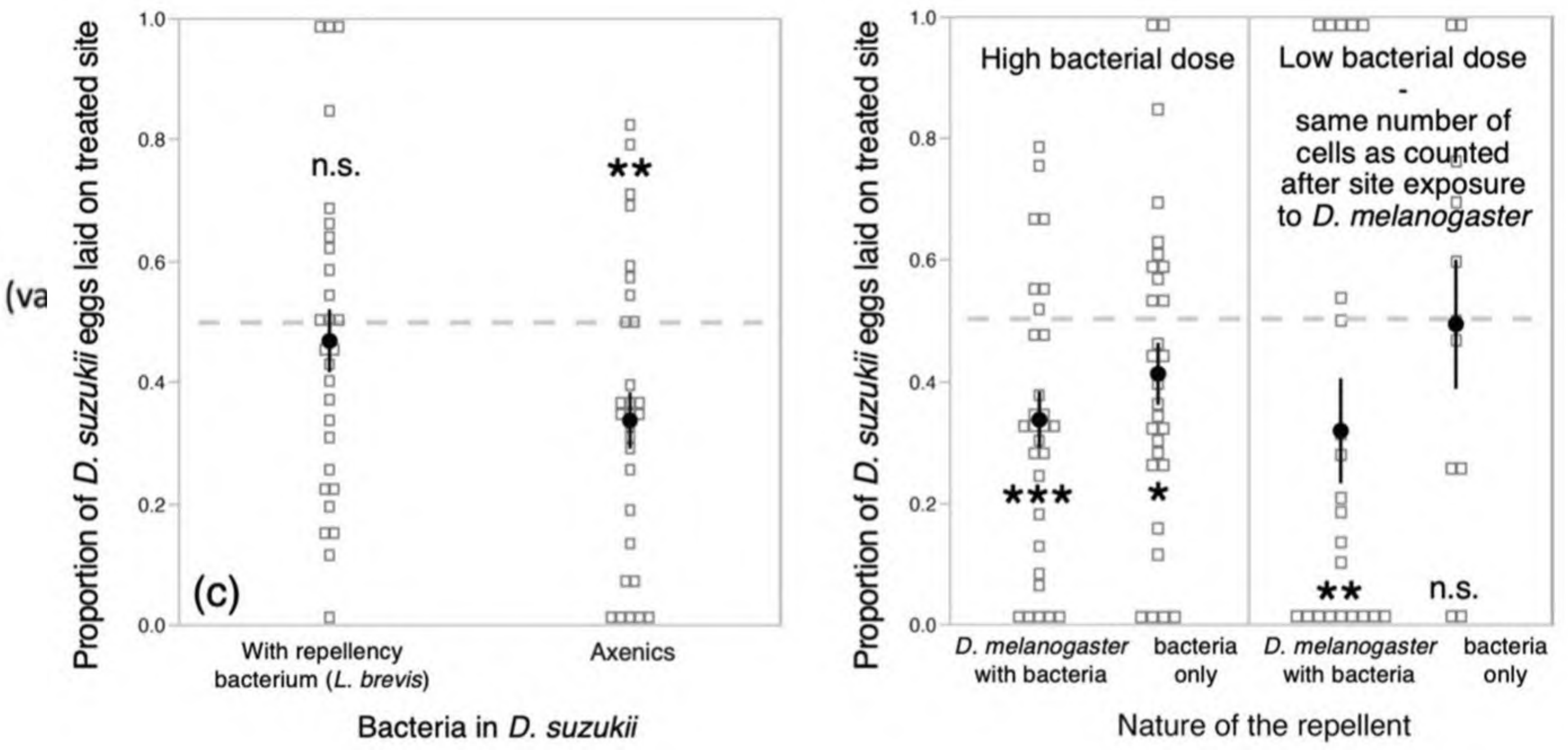
Bing XL et al., *Pest Manag Sci*, 2021

Microbiota-mediated competition between *D.mel* and *D.suzukii*



Rombaut A et al., *Microbiome*, 2023

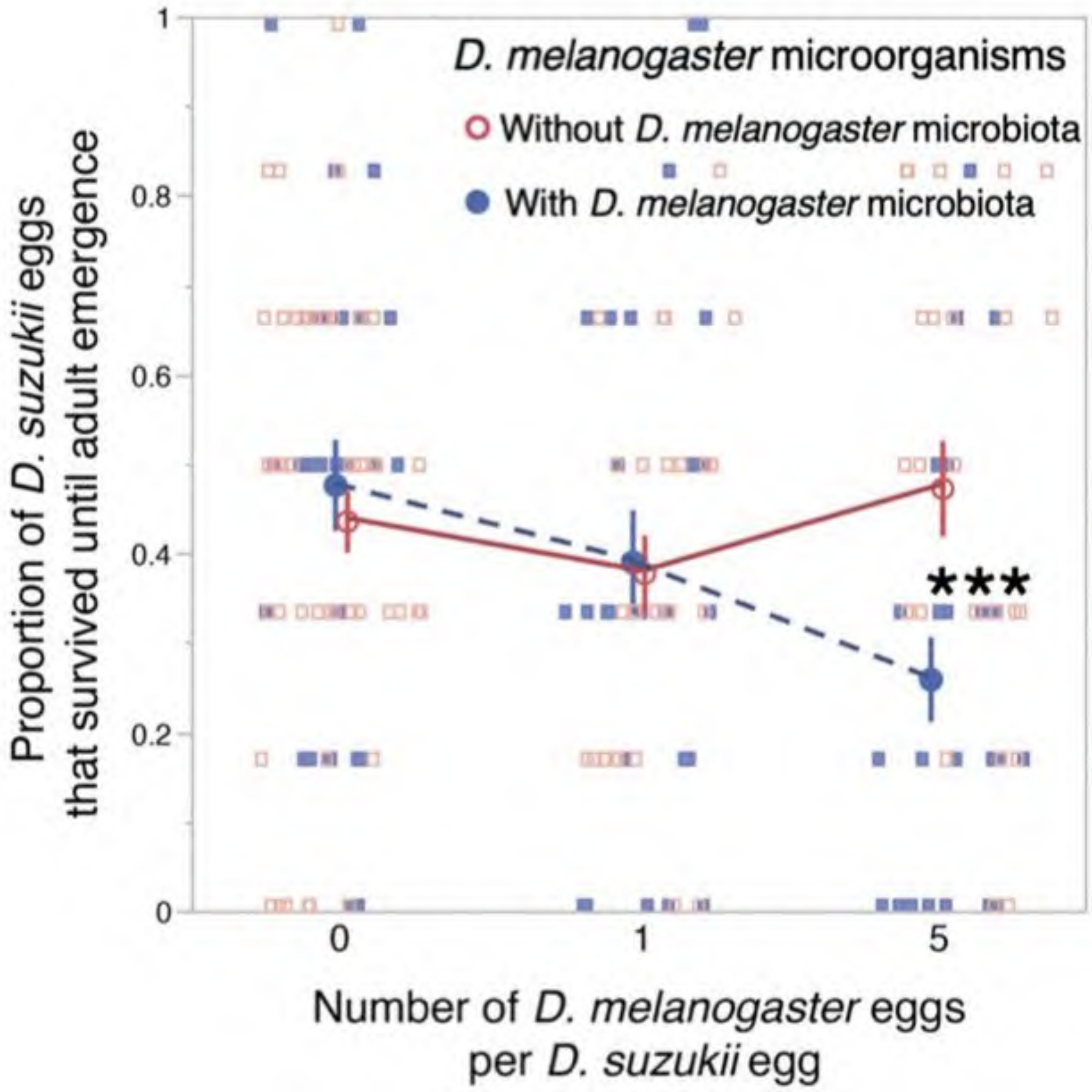
Microbiota-mediated competition between *D.mel* and *D.suzukii*



The symbiotic of *D. mel* are crucial for its repellency, while *D. suzukii* does not require its own microbiota to perceive these repellent signals.

Rombaut A et al., *Microbiome*, 2023

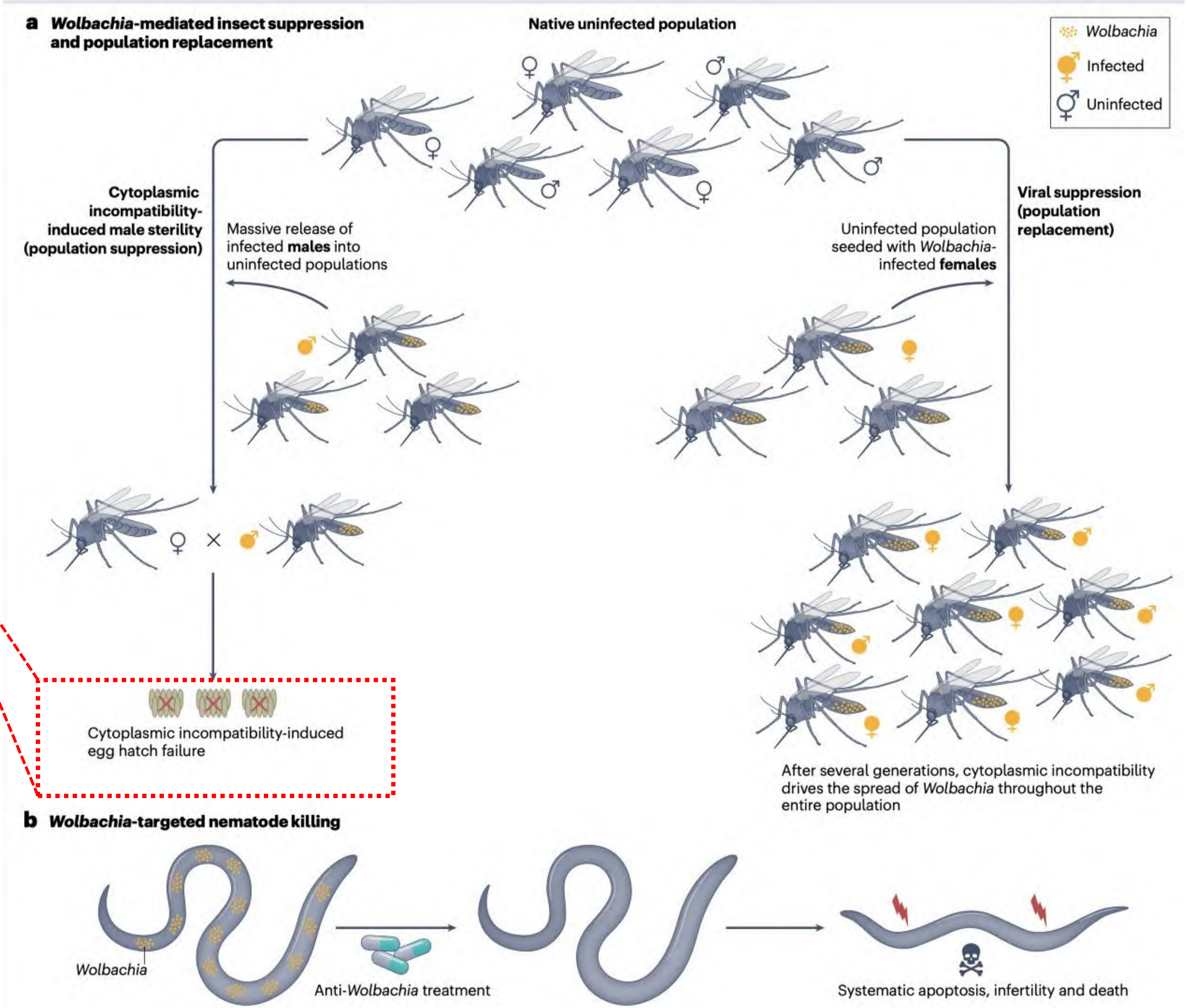
Larva of *D.mel* and their microbiota negatively impact the development of *D. suzukii*.



Rombaut A et al., *Microbiome*, 2023

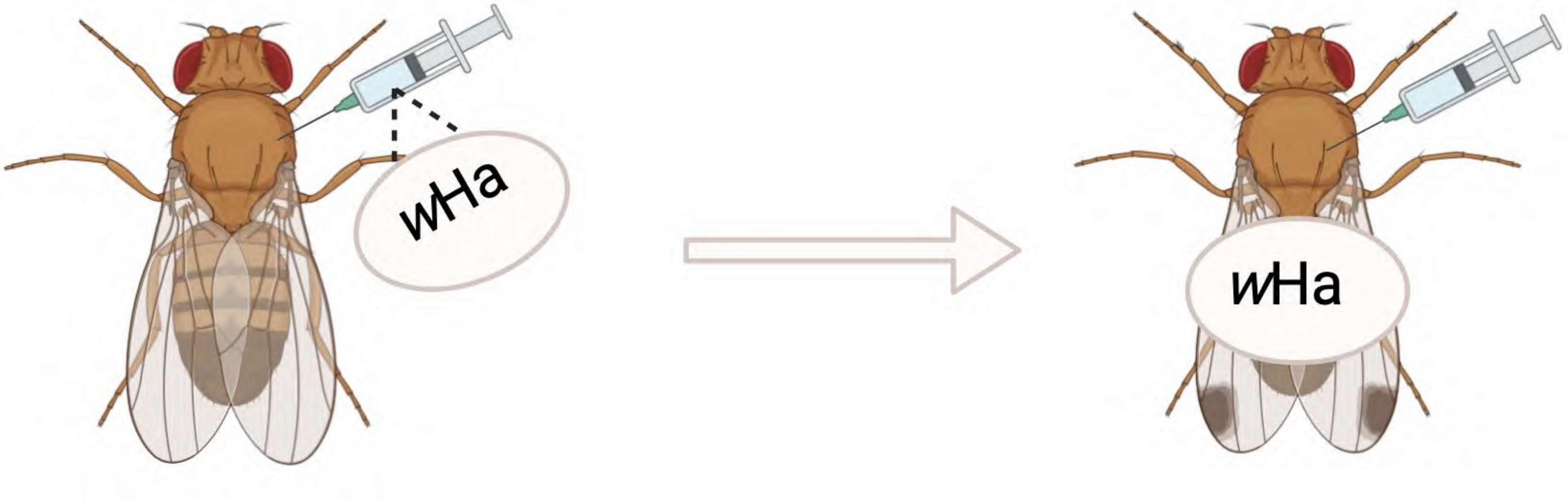
Introduction to *Wolbachia*.

Cytoplasmic incompatibility: Mating between *Wolbachia* infected males ♂ and uninfected females ♀ results in a severe reduction in egg hatch.



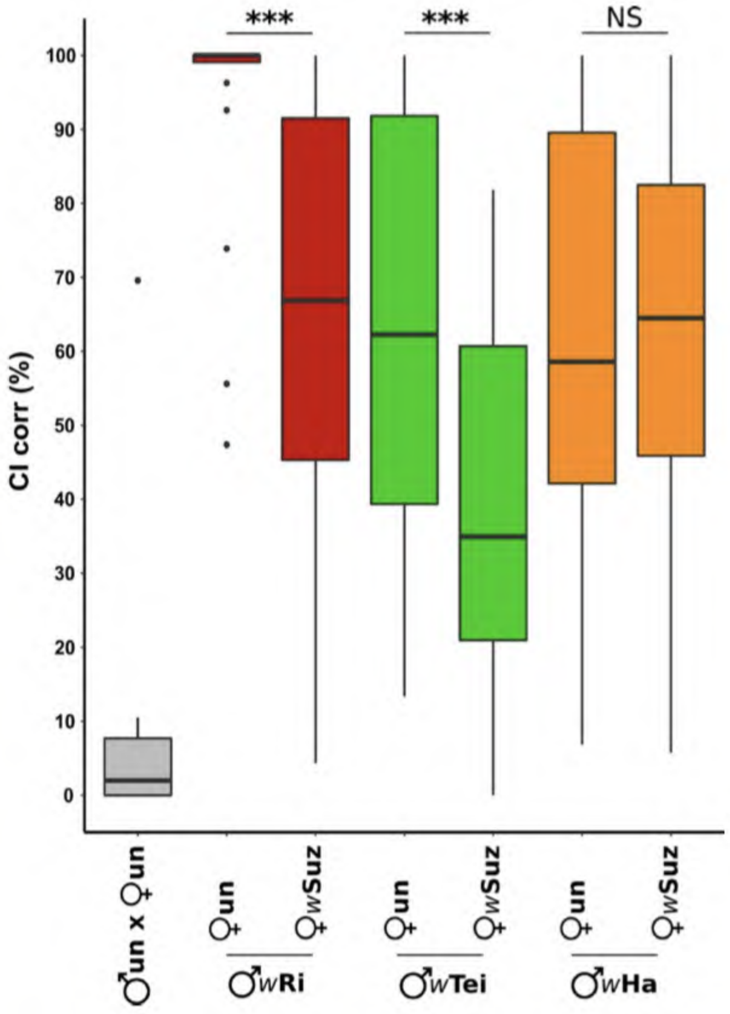
Porter J et al., *Nat Rev Microbiol*, 2023

Transfection of *Wolbachia* induces Cytoplasmic Incompatibility in *D. suzukii*

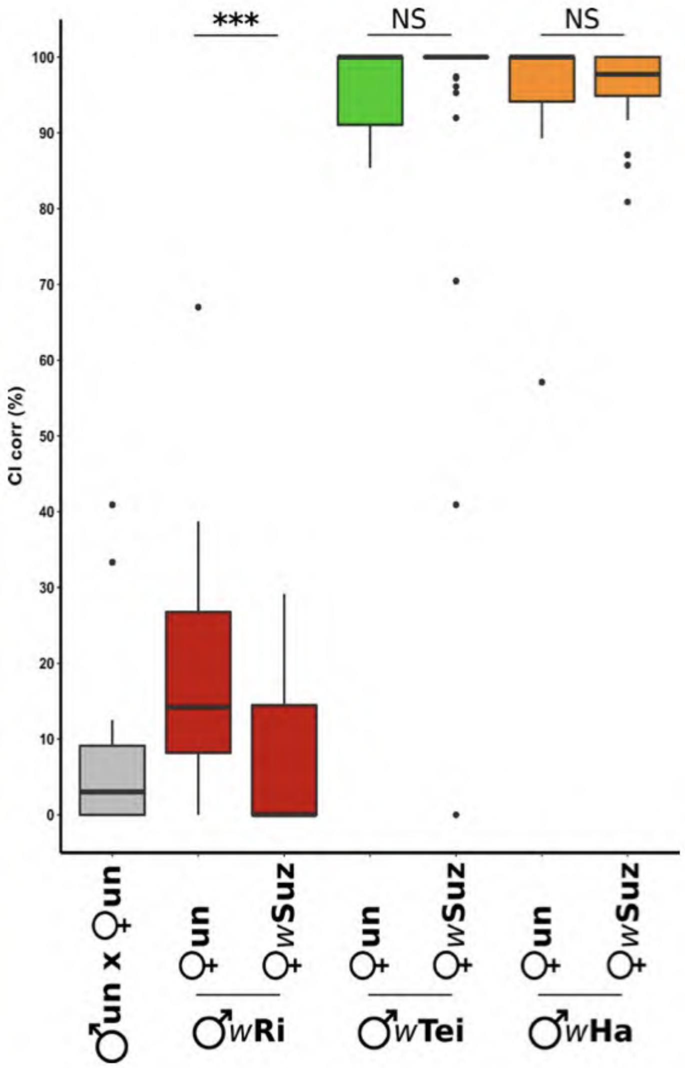


Cattel J et al., *Journal of Applied Ecology*, 2018

Transfection of *Wolbachia* induces Cytoplasmic Incompatibility in *D. suzukii*

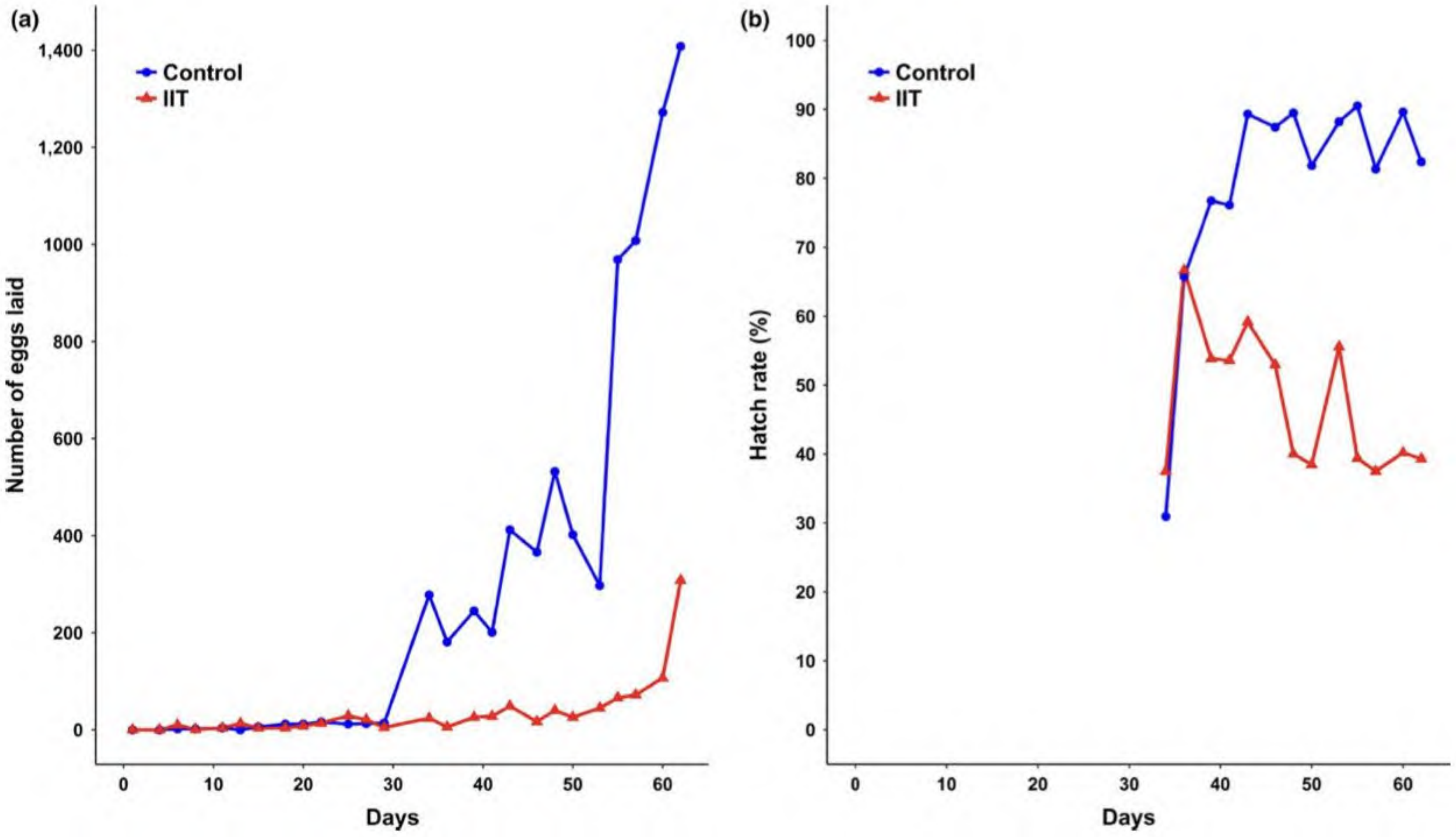


*w*Suz can partly rescue CI in *D. simulans*



*w*Tei & *w*Ha can induce strongly CI in *D. suzukii*

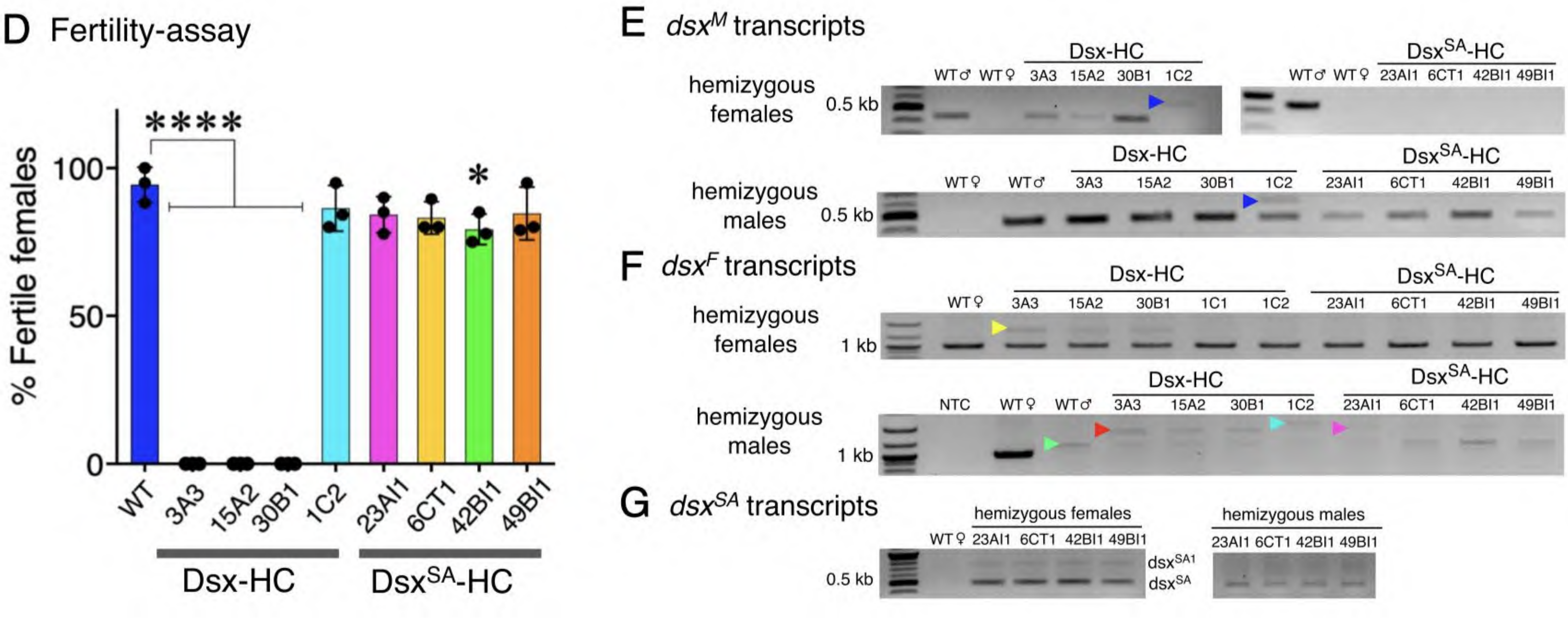
Cattel J et al., *Journal of Applied Ecology*, 2018



IIT effectively suppresses the reproductive success of *D. suzukii*, as evidenced by minimal egg production and sharply declining hatch rates

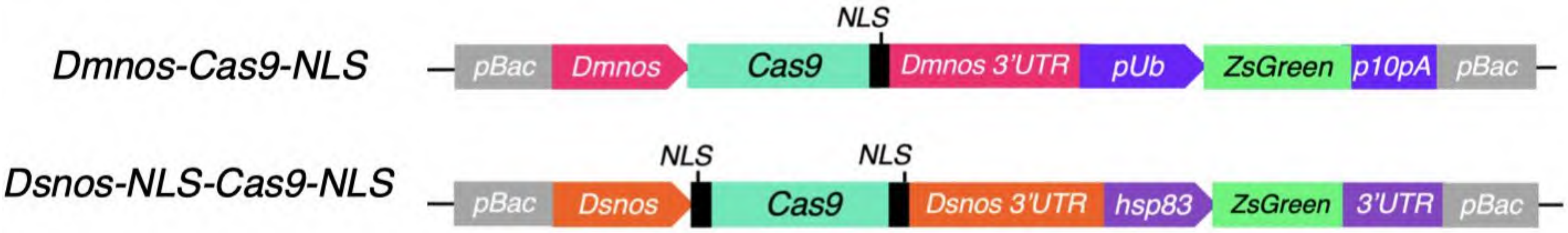
Cattel J et al., *Journal of Applied Ecology*, 2018

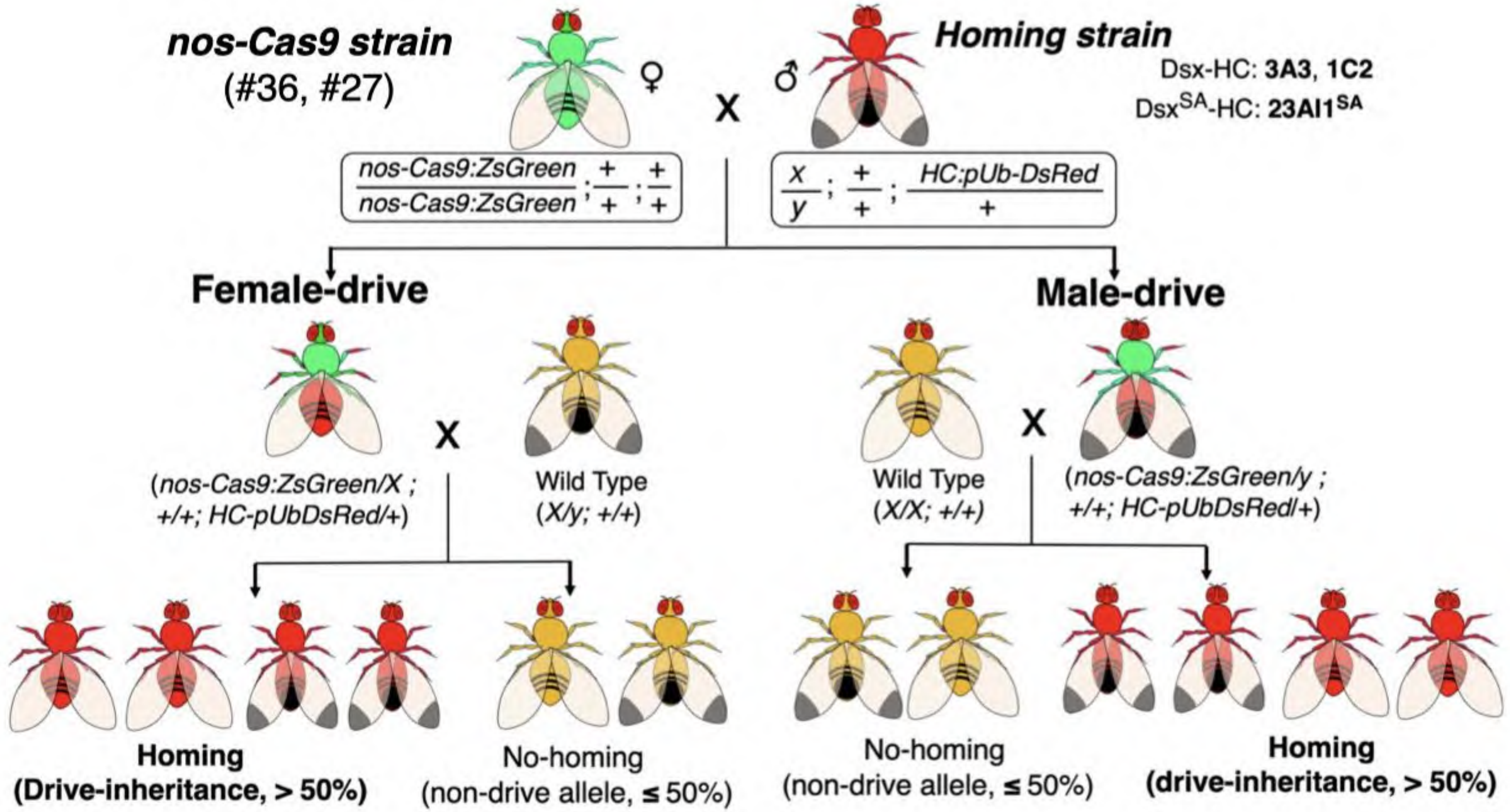
Gene drive strategy for suppression of *Drosophila suzukii* populations.



Yadav AK et al., *Proc Natl Acad Sci U S A*, 2023

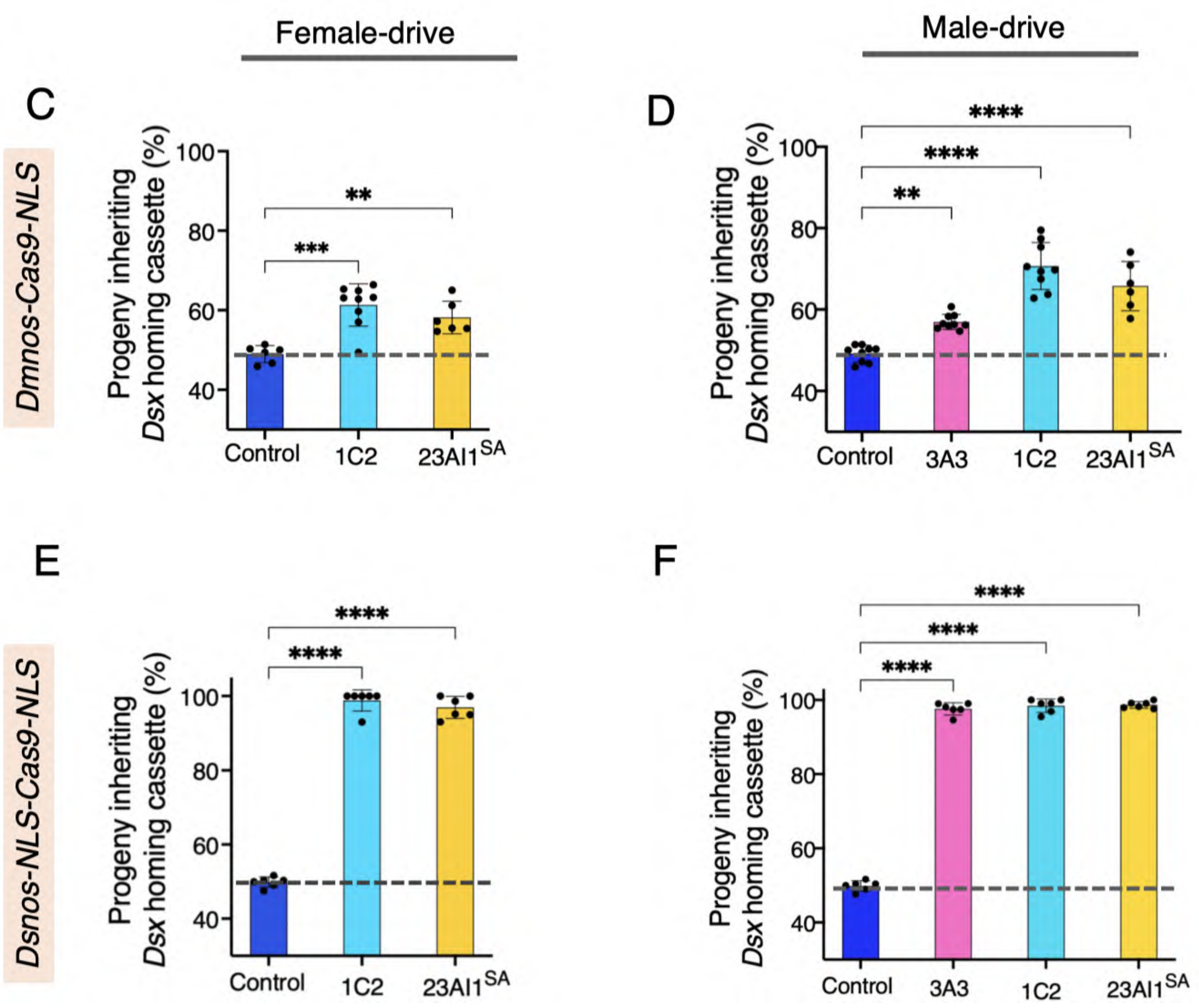
Strategies and outcomes of Homing gene drive.

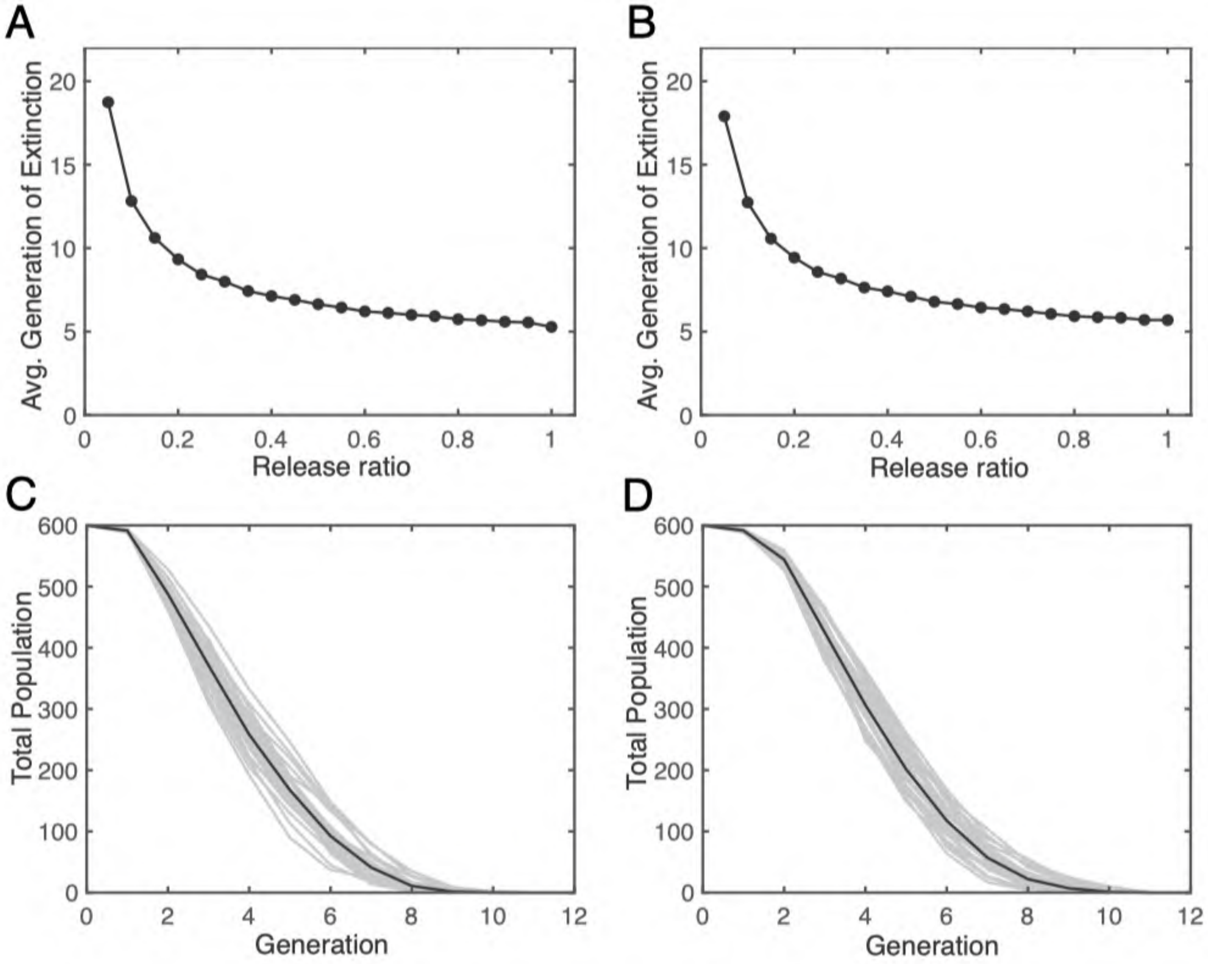




Yadav AK et al., *Proc Natl Acad Sci U S A*, 2023

Efficient gene drive inheritance exceeding 90% in *D. suzukii*





Continuous releases of gene drive male flies at a low ratio (1:4 drive to wild type) can suppress the population within 10 generations.

Yadav AK et al., *Proc Natl Acad Sci U S A*, 2023

Take home message

- **Gene Drive Caution**: Employ gene drive technologies responsibly, considering ecological and ethical implications to avoid unintended consequences.

- **Integrated Pest Management**: Always remember the integration of chemical and non-chemical methods in pest management to minimize environmental and health risks.

- **Expanding Microbial Pest Control**: Leverage a wider array of symbiotic microbes, such as *Wolbachia* and *Cardinium*, alongside exploring diverse microbial functions including repellency, pathogenicity, and their roles in pest control to enhance sustainability.

What can we learn from this report?

- *Drosophila suzukii* is an invasive pest native to Asia but spreads rapidly around the world, and the serrated ovipositor of females allows them to infest ripe fruits.
- Behavioral research is in its early stage focusing mainly on phenotypes, with insufficient understanding of their neural mechanisms.
- Oviposition behavior has been most studied. Most of these studies stay at the sensory level, and the alterations in the CNS remain to be further investigated.
- More genetic tools in *Drosophila suzukii* are needed.
- *Drosophila suzukii* management is challenging with few current technologies that provide relief as a standalone option. Integrated pest management is necessary.