Novel techniques for evaluating the potential host range of candidate biological control agent *Trissolcus japonicus* (Hymenoptera: Platygastridae)

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Traditional Host Range Evaluations

- **Choice** & **No-choice** testing = physiological host range
  - Constricted to the parasitoid-host interaction
- Some native species are physiologically-suitable hosts
  - ***Podisus maculiventris***
  - Possible over-estimation of NT effects
- How do we **improve** and/or **enhance** these host range assessments?

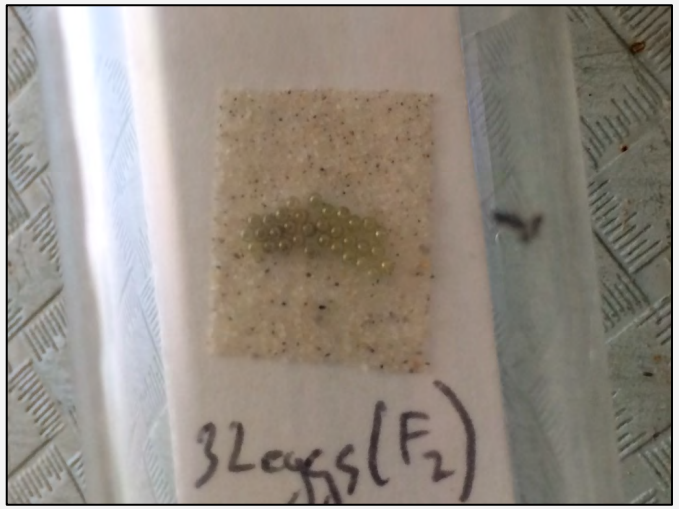


Photo by S.A. Marshall, University of Guelph

(1) Integrate egg parasitoid host foraging strategies

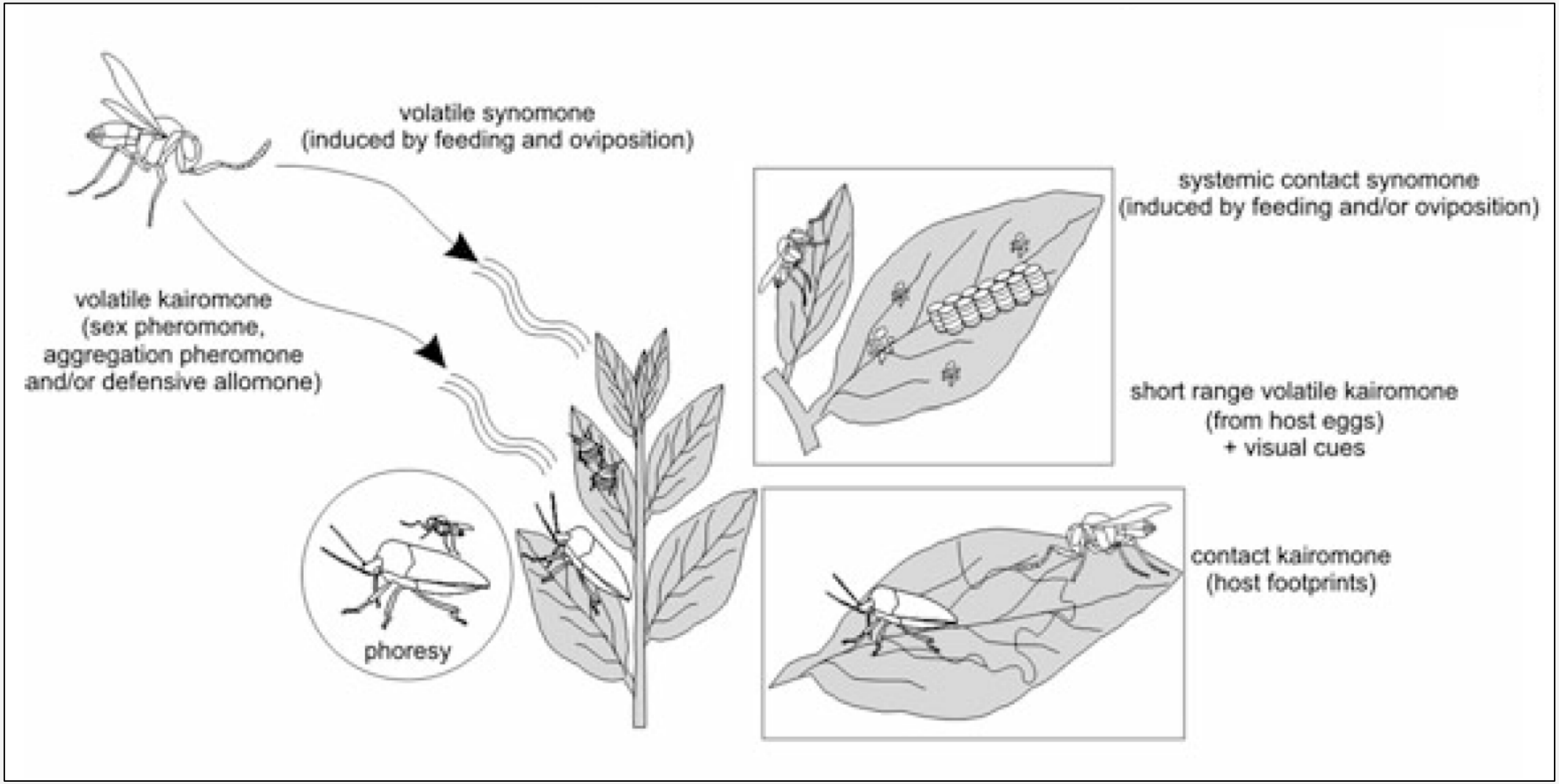
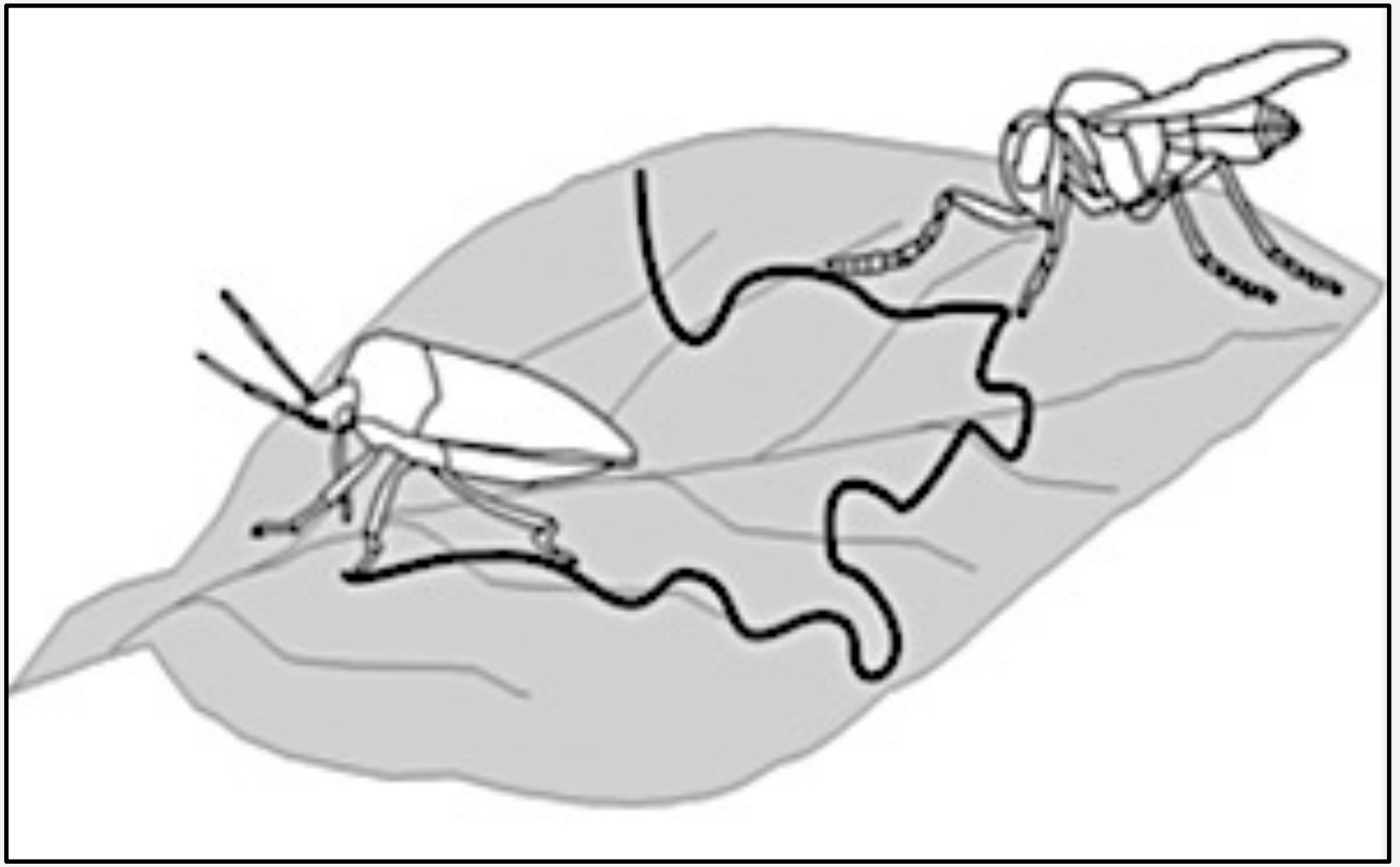


Photo by Conti et al. 2006

Adult contact kairomones (footprints)



Behavioral Responses to adult footprints

- Other *Trissolcus* spp display preference for specific chemical cues
  - Gravid female vs. non-gravid & male cues
    (Colazza et al., 1999, Conti et al., 2003)
  - Coevolved hosts vs. non-coevolved host
    (Salerno et al., 2006, Conti et al., 2004)

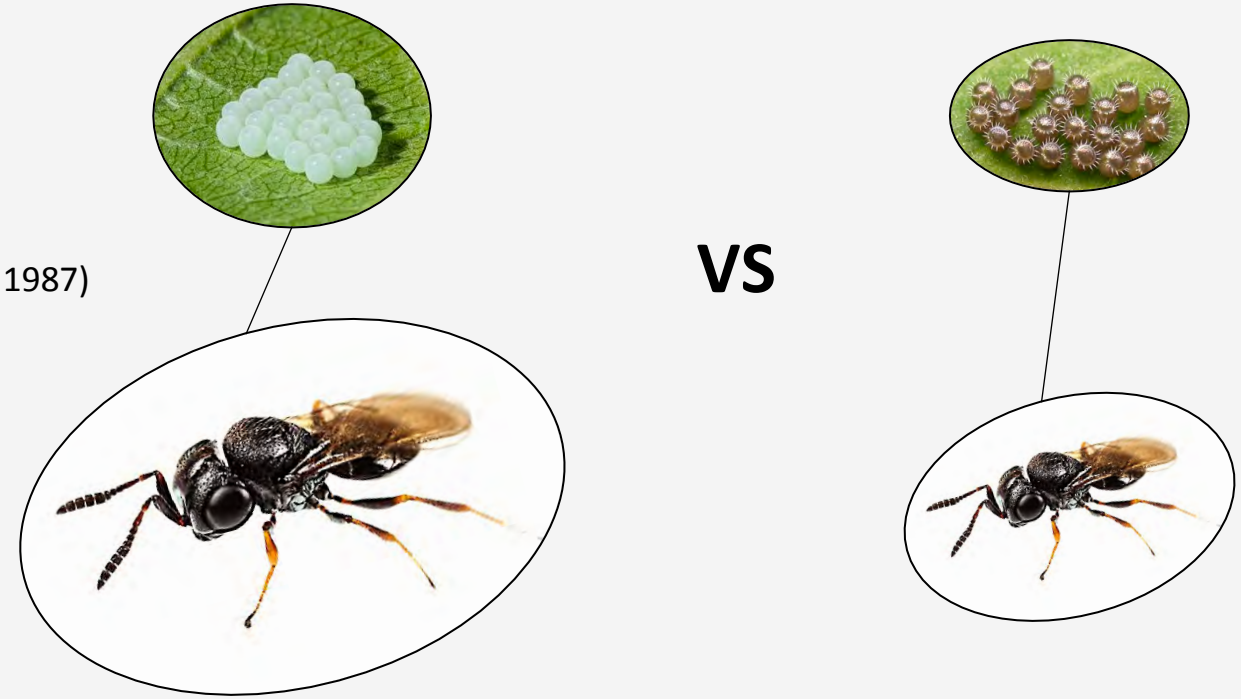
- Characterizing preference
  1. Delayed flight response
  2. Prolonged arrestment
  3. Slowed walking
  4. Increased turning while walking

- *T. japonicus* responses to host-related cues are largely unknown!

(2.) Simulate a non-target parasitism event

- "**Devil's advocate**" approach
  - If *T. japonicus* emerges from (suitable non-target species), …

- **Parental host effects**
  1. Phenotypic traits (Abrams et al., 2015)
  2. Associative learning (Peri et al., 2006)
  3. Fitness traits (Allahyari et al., 2004; Keller, 1987)
  4. Host preferences (Henry et al., 2010)



VS

- *T. japonicus* host range tests have only used BMSB as the rearing host

Research Objective #1

Distinguish the host foraging preferences of *T. japonicus* through its exposure to different host contact kairomones on various plant substrates

Research Objective #2

Identify if parental host species affects *T. japonicus* kairomone-induced behavioral responses

Research Objective #3

Determine if parental host species influences *T. japonicus* performance in no-choice tests using large, more complex arenas

Objective #1 Experimental Set-Up: Behavioral Assays

Stink bug species

H. halys
P. maculiventris

gravid ♀'s

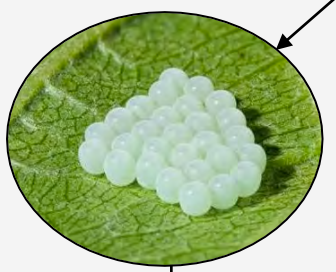
Plant species

Acer rubrum
Malus domestica
Glycine max

SA ≈ 16 cm^2

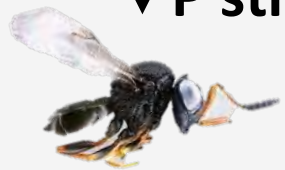
Leaf surface kairomone contamination

Objective #2 Experimental Set-Up: Behavioral Assays



H strain

P strain

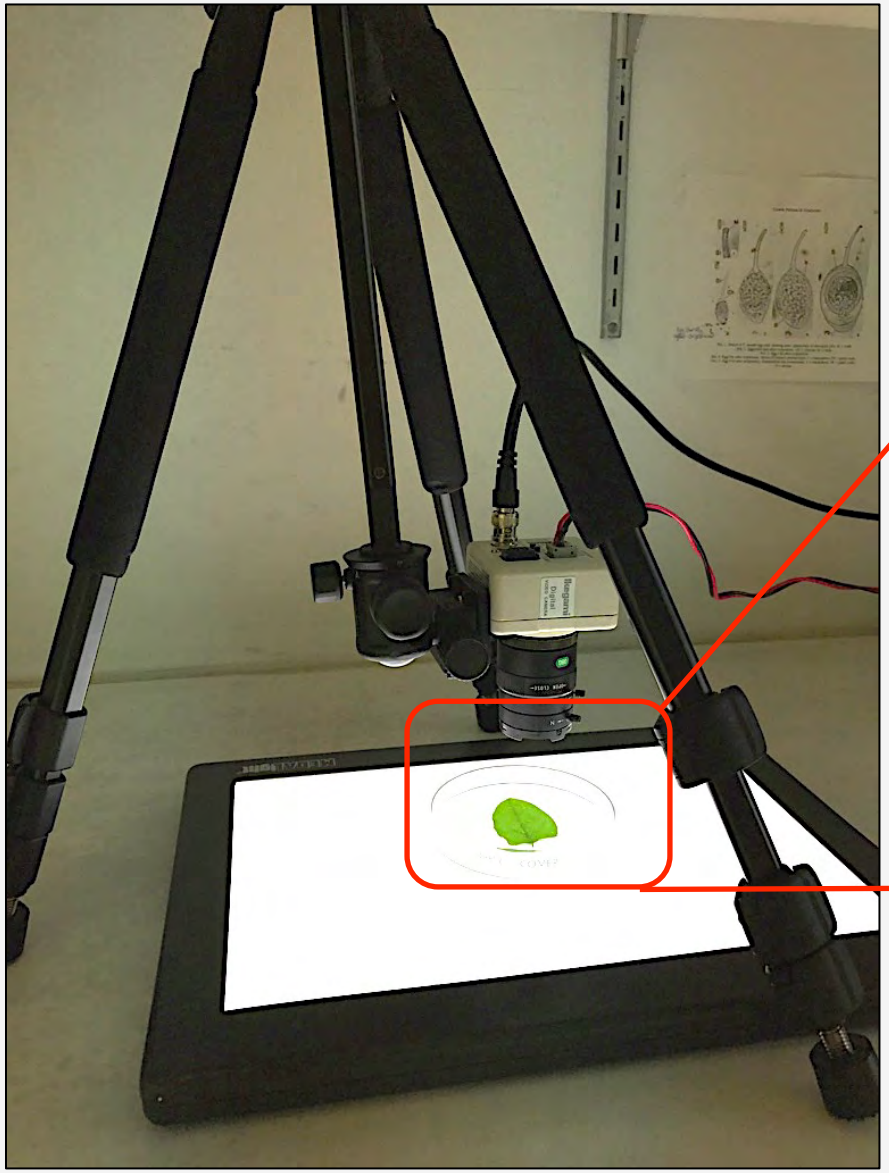


Establishment of 2 separate *T. japonicus* lines

***H. halys* or *P. maculiventris* gravid females**

Soybean leaf (~ 16 cm^2)

Experimental Set-Up: Behavioral Assays



60 mm petri dish arena

Ethovision XT 8.0 (Noldus Technologies)

Ethovision Tracking Software

<u>Recorded Behaviors</u>:

1. **Residence time (s)**
2. **Linear Walking Velocity (mm/s)**
3. **Angular Walking Velocity (°/s)**

Objective #3

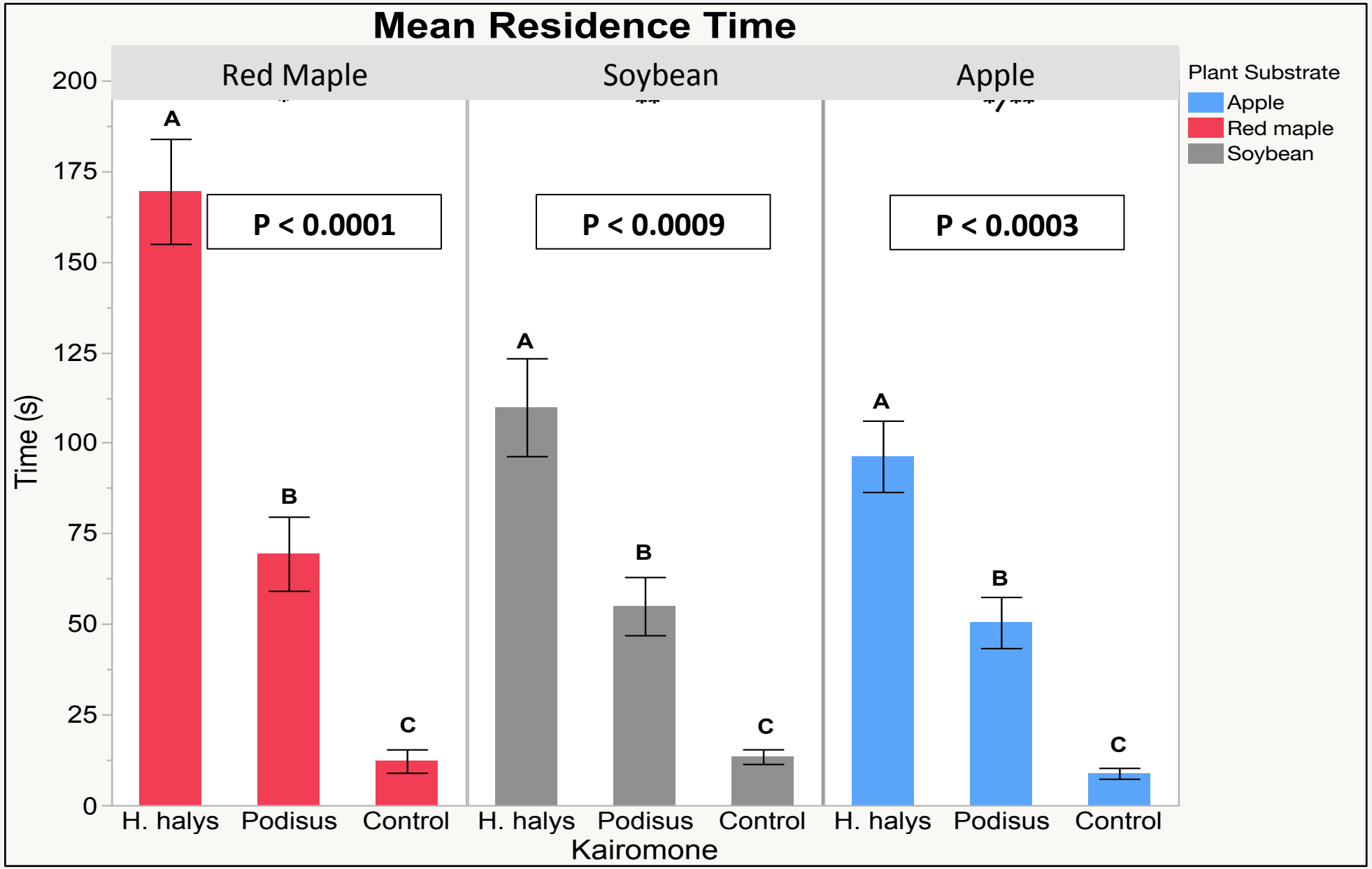
Experimental Set-Up: No-choice tests

Kairomone contamination of *P. vulgaris* leaf surfaces

Attach *H. halys* or *P. maculiventris* egg mass to contaminated plant

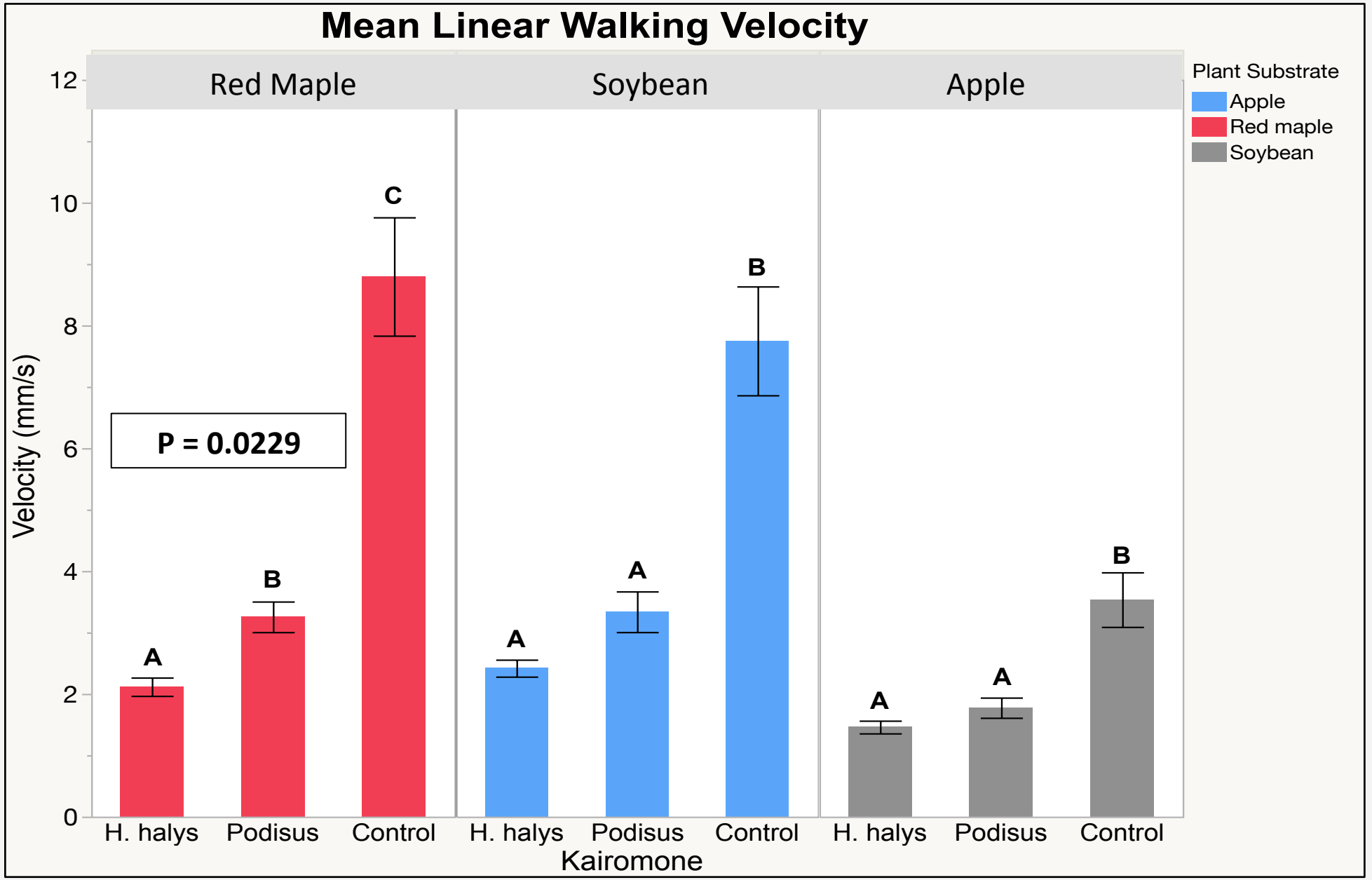
24 h exposure of H- or P-strain *T. japonicus* females (mated, naïve, 3-5 days old)

Objective #1 Results



ANOVA + Tukey's HSD

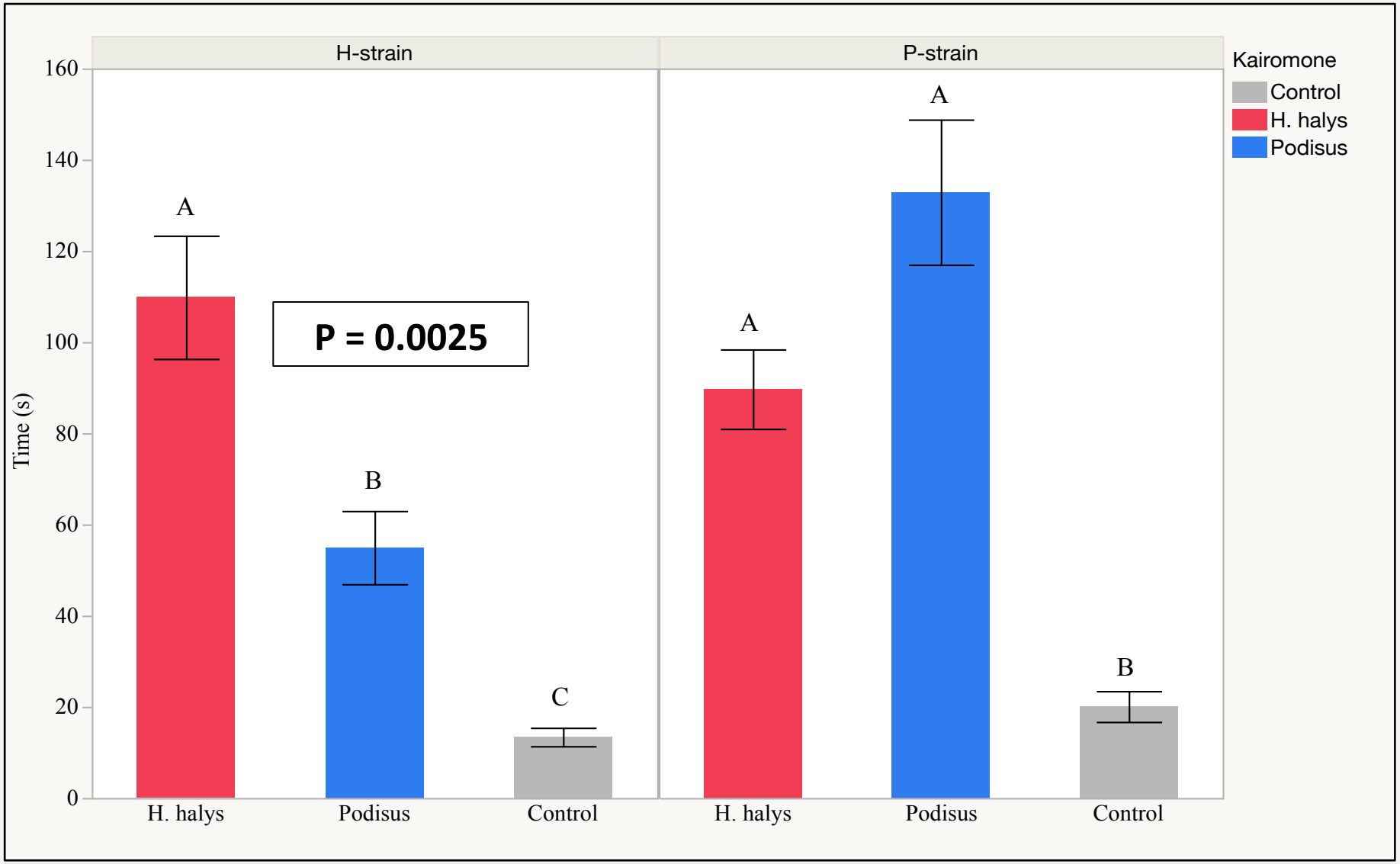
Objective #1 Results



ANOVA + Tukey's HSD

Objective #2 Results: Residence Time

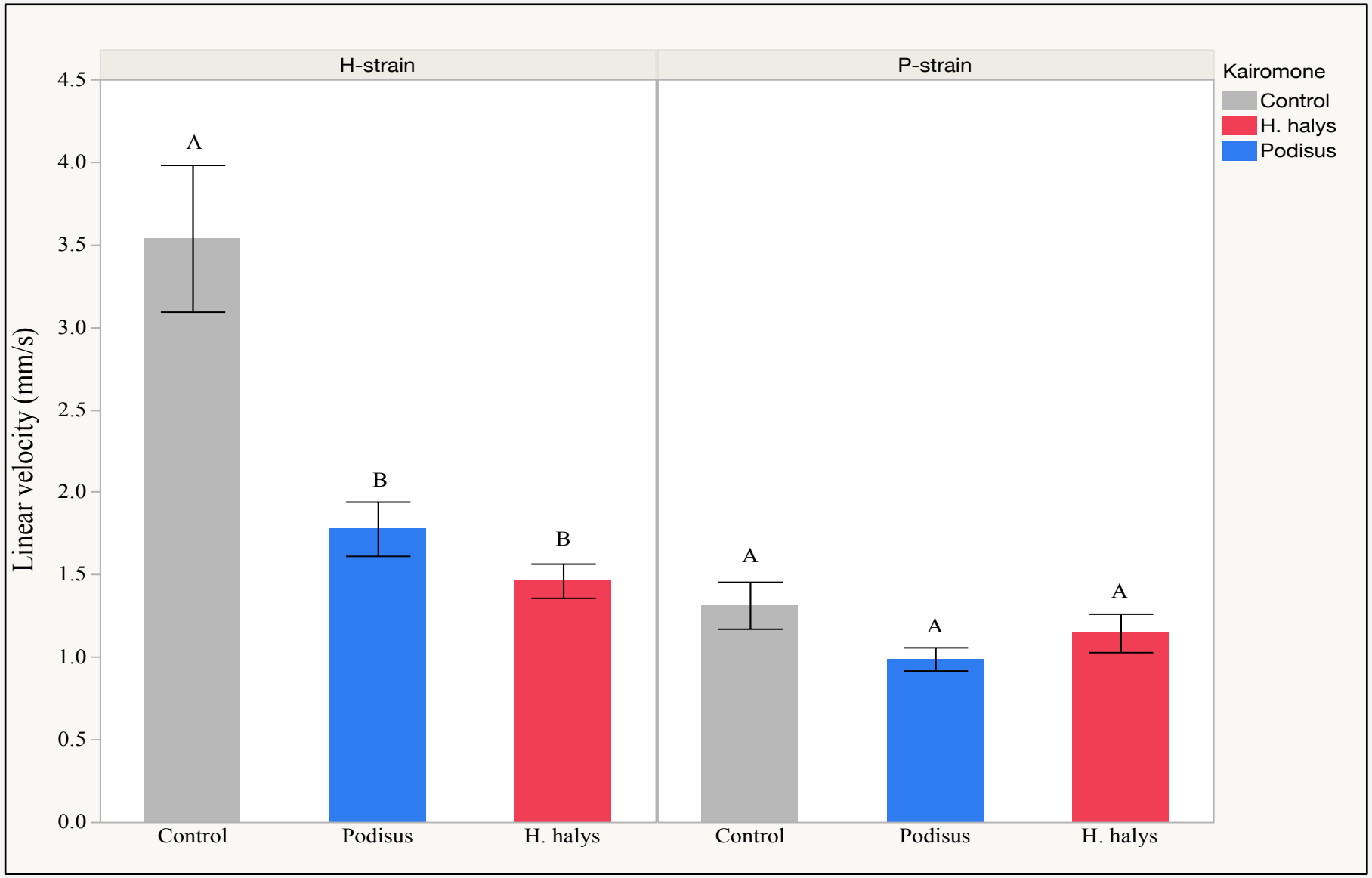
A significant interaction was observed between wasp strain and kairomone type (***P* = 0.0013**)



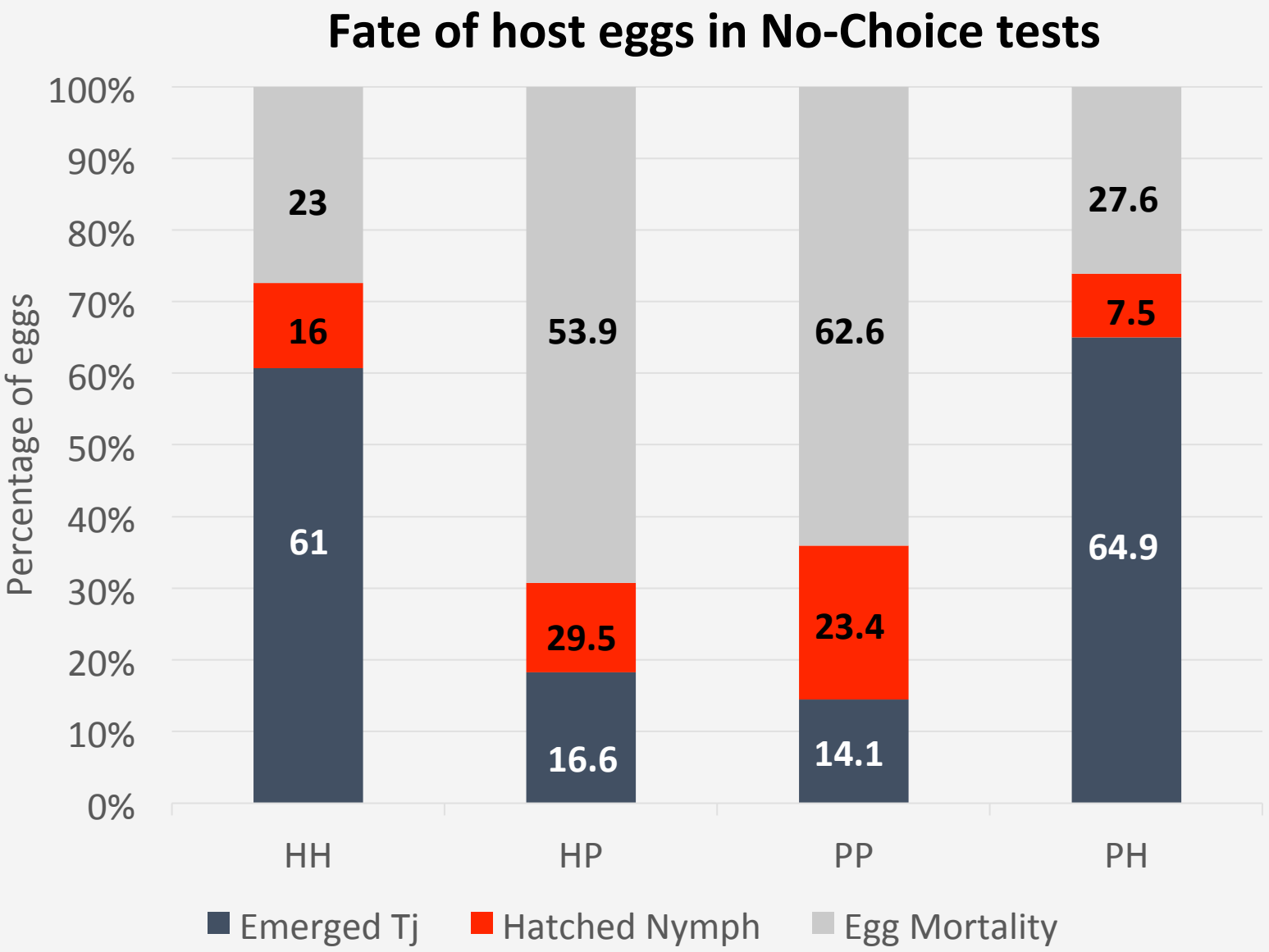
ANOVA + Tukey's HSD

Objective #2 Results: Linear Walking Velocity

A significant interaction was observed between wasp strain and kairomone type (***P* = 0.0022**)



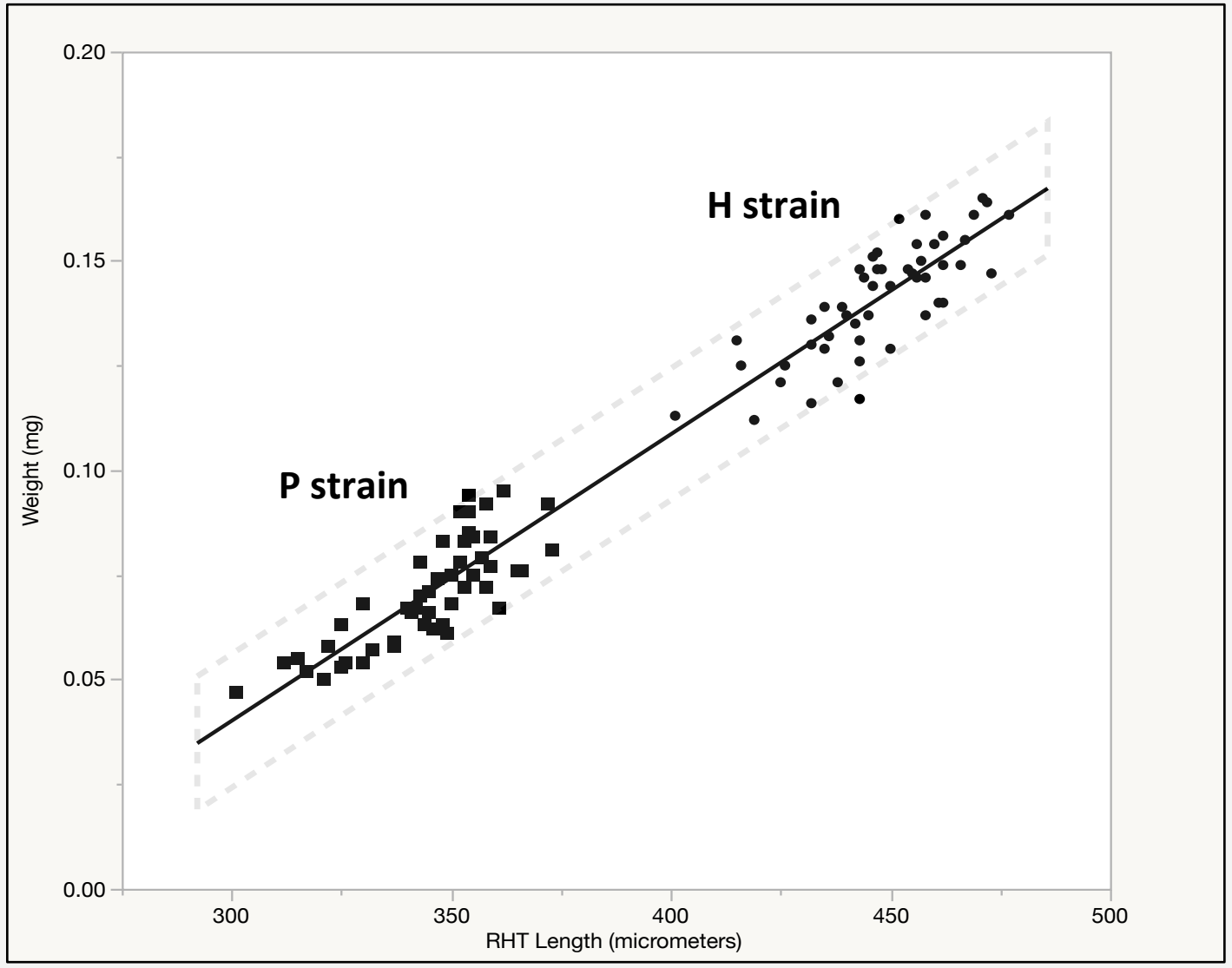
Objective #3 Results



- H and P strain wasps parasitized equal percentages of eggs from the same host species
- Among parasitized egg masses, *H. halys* eggs were more suitable than *Podisus* eggs for both strains (***P* < 0.0001**)

ANOVA + Tukey's HSD

Parasitoid Size



- H strain wasps possessed 30% longer RHT (***P* < 0.0001**; ANOVA)
- H strain wasps weighed roughly twice as much as P strain wasps (***P* < 0.0001**)
- Strong positive correlation between *T. japonicus* RHT length and weight (**R^2=0.957; *P* < 0.0001**)


H Strain
P Strain

Conclusions

- Our study was the first to display *T. japonicus* preferences for *H. halys* adult contact kairomones on leaf substrates.
- Signs of host fidelity were exhibited in kairomone behavioral assays
  - A function of early adult experience with parental host egg ?
- Reduced walking velocity of P-strain *T. japonicus* may indicate reduced foraging abilities
  - Soybean pubescence clearly hindered smaller wasps' movement
- Parental host species alters phenotypic traits of *T. japonicus*, but does not change its preference for *H. halys* in laboratory no-choice tests
  - Successive rearing generations on *P. maculiventris* would validate these results

Questions???