Biology of the switchgrass gall midge and its impact on switchgrass in Ontario

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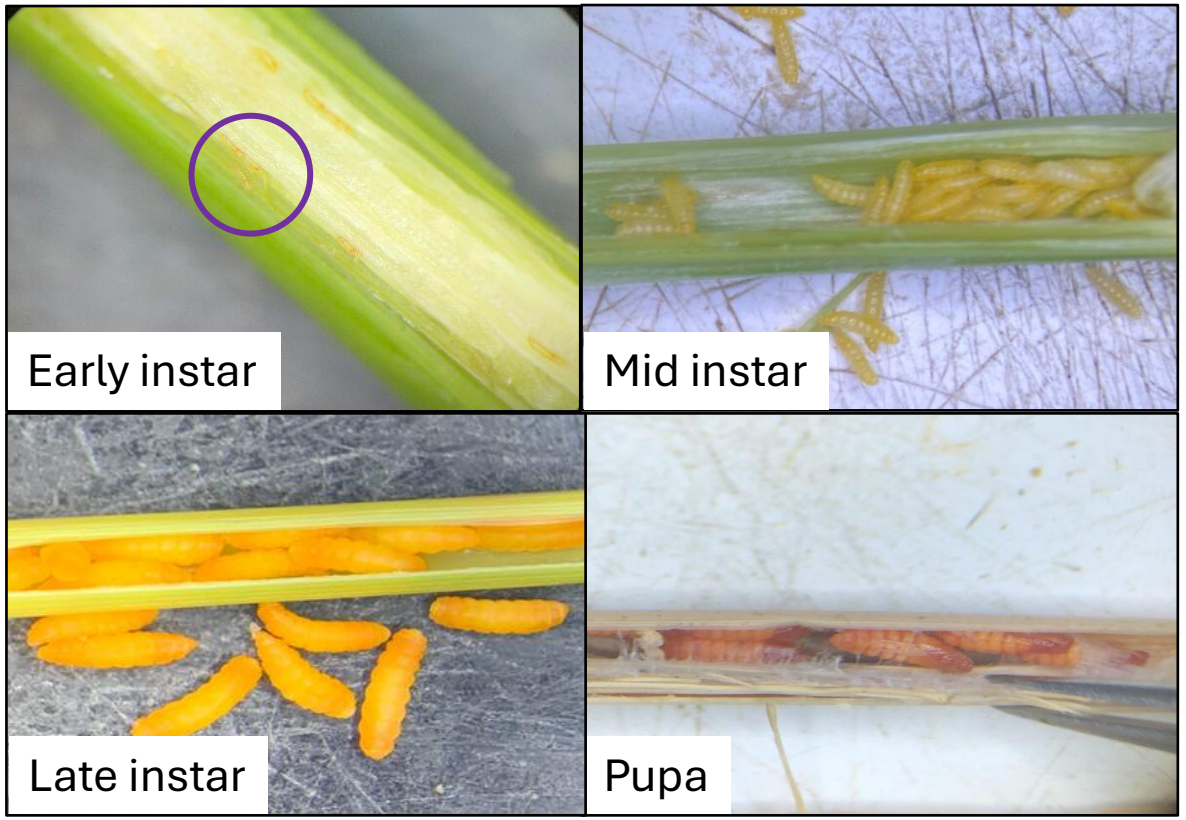
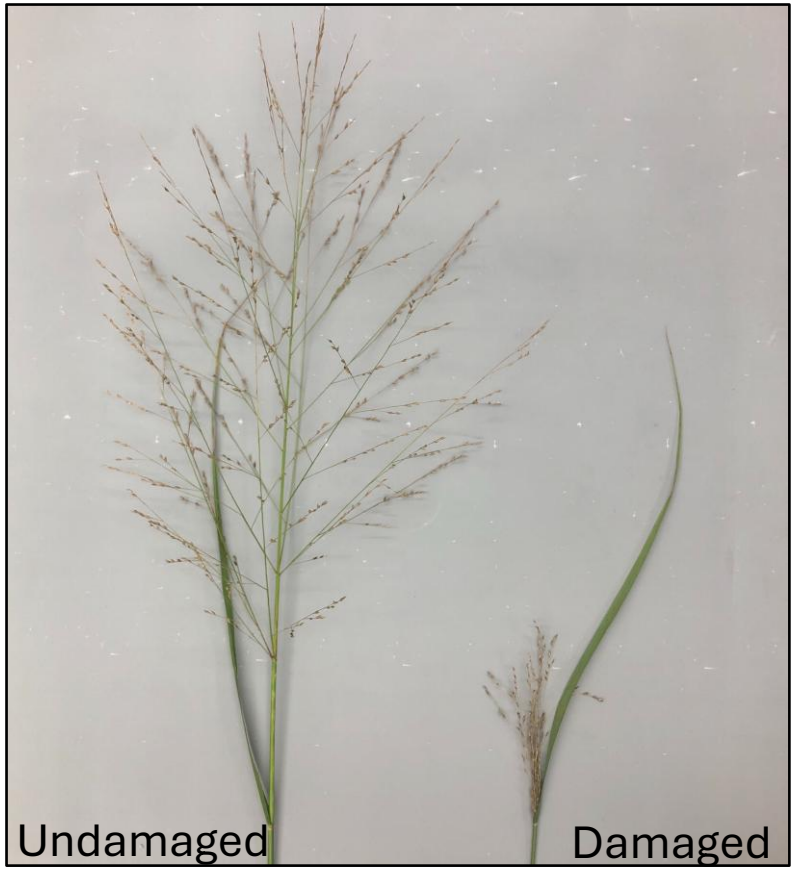
Switchgrass gall midge (SGM), *Chilophaga virgati* Gagné

- Caused nearly 100% seed loss and a 35% reduction in biomass per tiller in South Dakota
- Discovered both SGM and parasitoids in southern Ontario in 2020 by OMAFA





What we knew

Bioenerg. Res. (2011) 4:77–84
DOI 10.1007/s12155-010-9102-6

A New Species of Gall Midge (Diptera: Cecidomyiidae) Infesting Switchgrass in the Northern Great Plains

Arvid Boe · Raymond J. Gagné

Bioenerg. Res. (2014) 7:417–423
DOI 10.1007/s12155-013-9386-4

The Switchgrass Gall Midge (*Chilophaga virgati* Gagné) in the Northern Great Plains

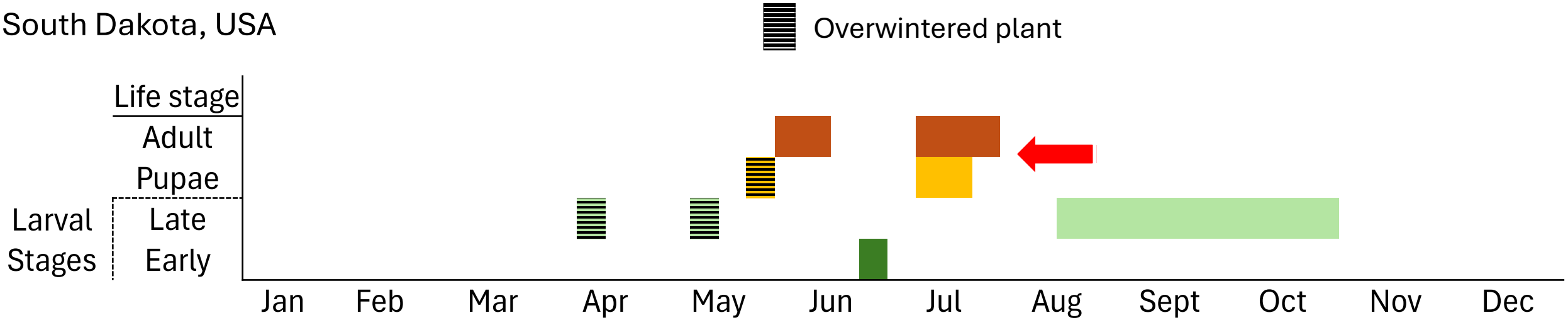
Veronica Calles Torrez · Paul J. Johnson · Arvid Boe

Early instar
1.5-2.5 mm

Late instar
4.8 mm

Pupae

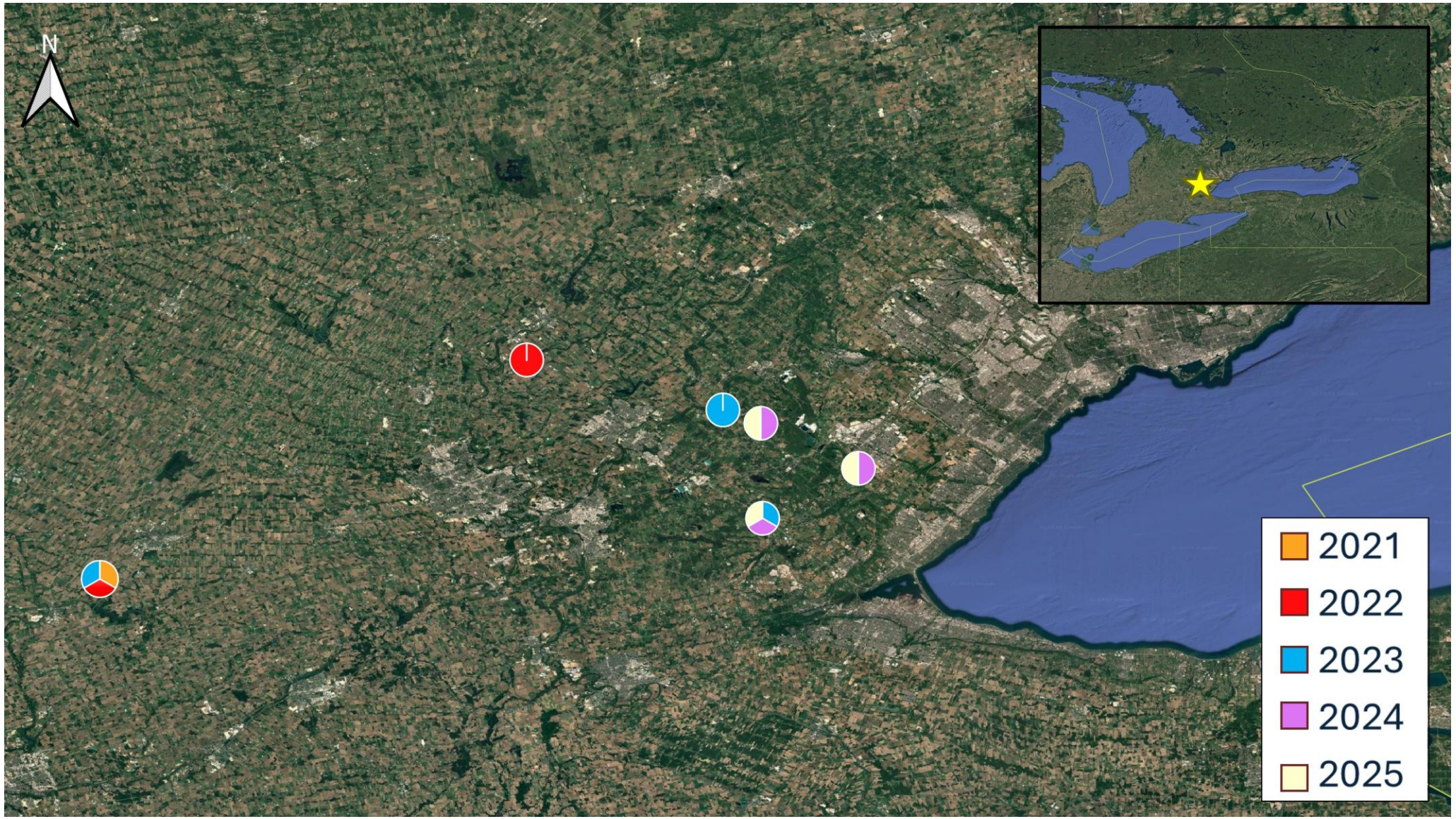
South Dakota, USA



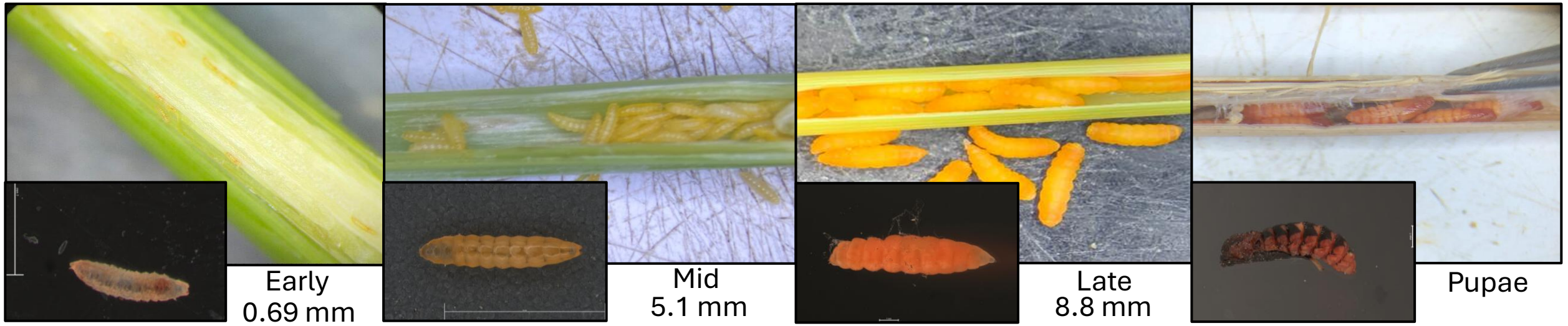
Objectives

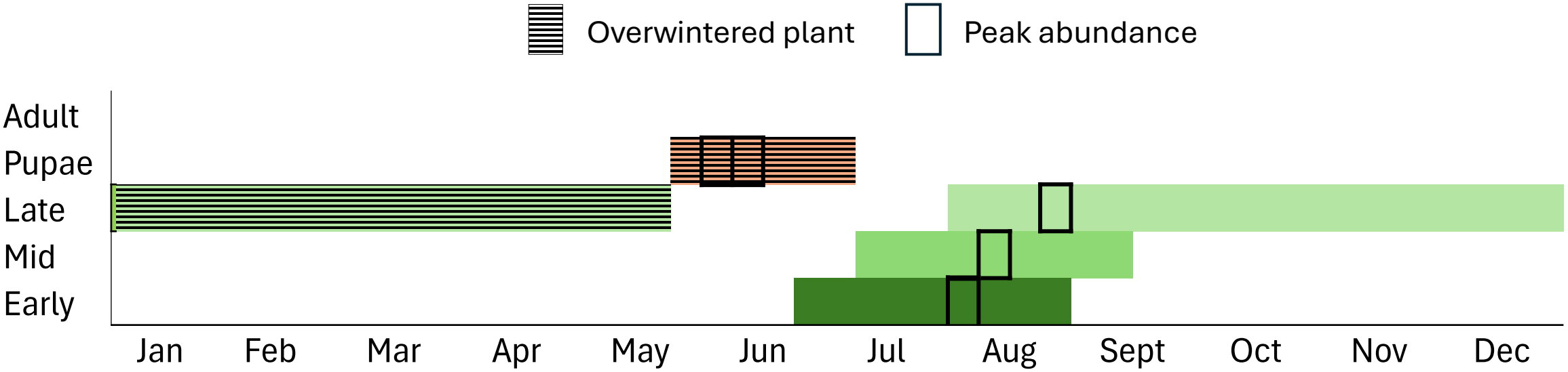
1. Determine the phenology of SGM; including the factors influencing diapause initiation and termination
    - Phenology: timing of each life stage throughout the year
    - Diapause: a period of paused development influenced by environmental conditions
2. Describe the parasitoid complex associated with SGM
3. Determine field infestation levels and impacts of SGM in commercial switchgrass fields

Phenology Sampling Methods

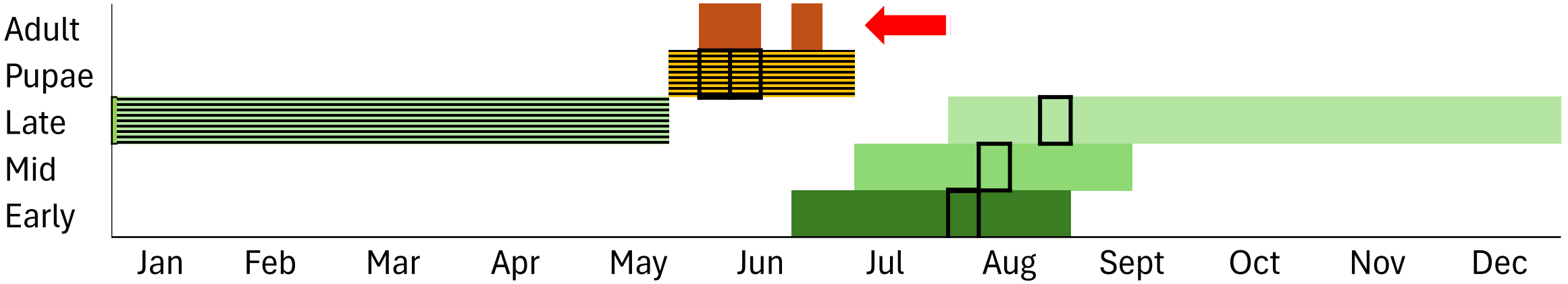


Larvae and Pupae

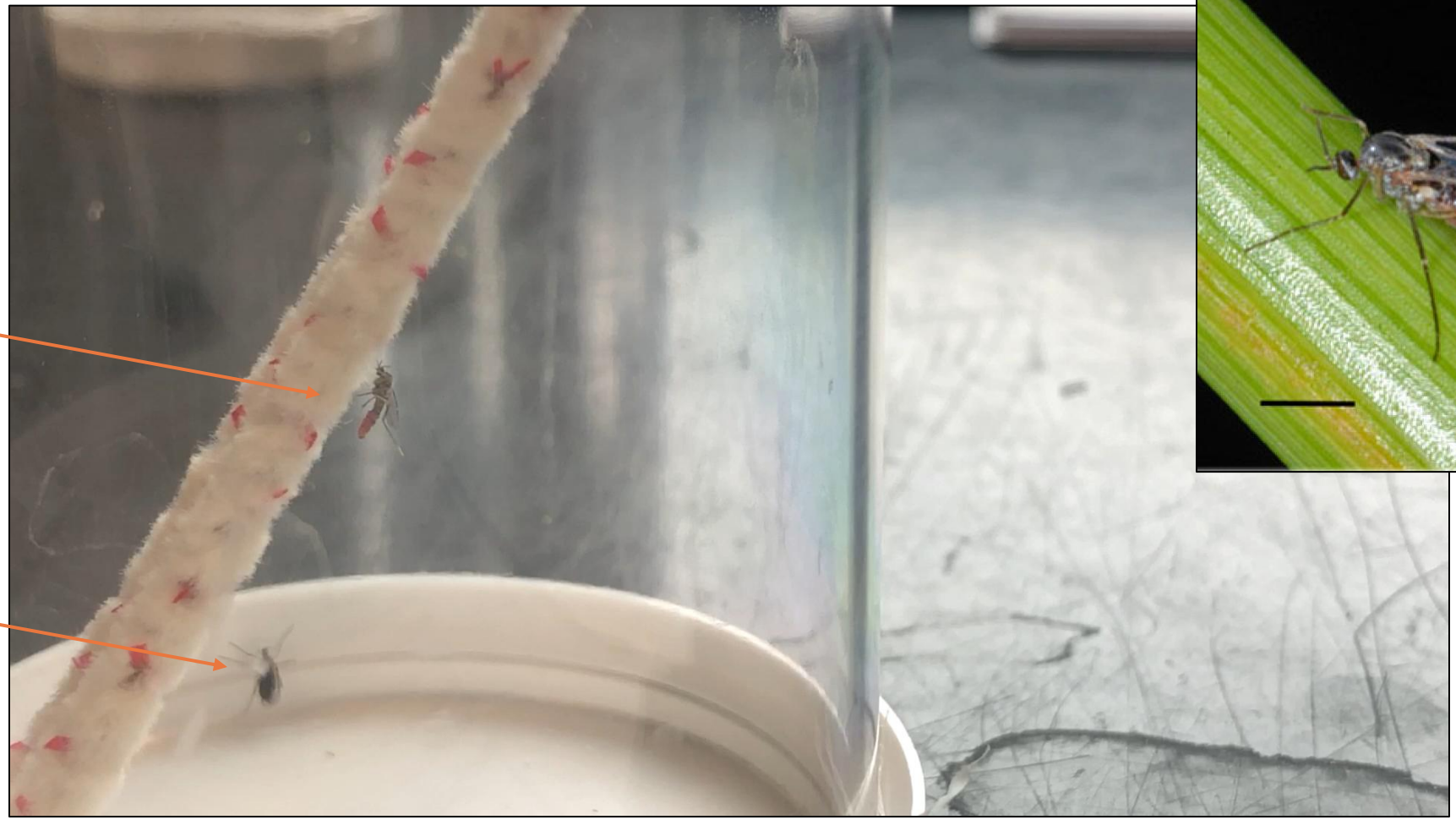




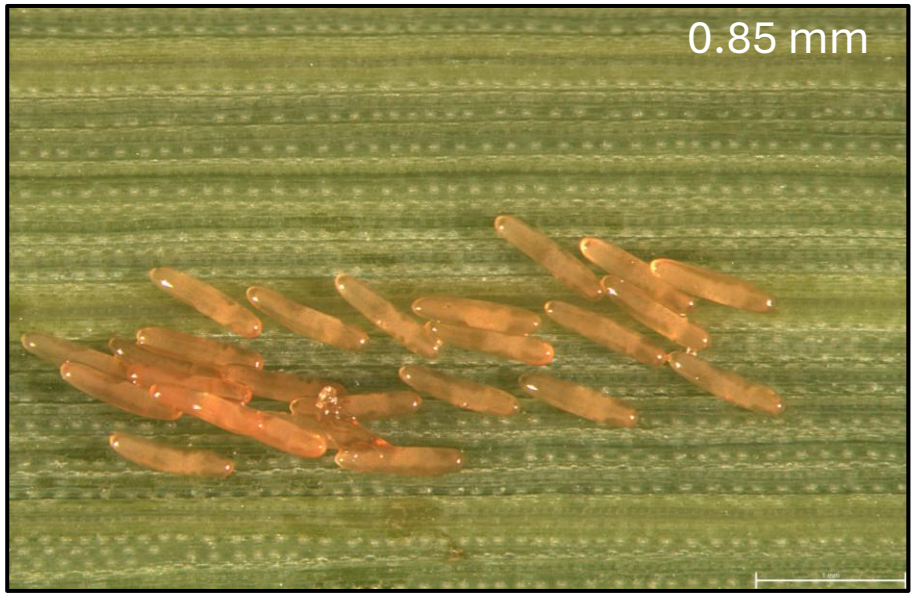
When do adults emerge?

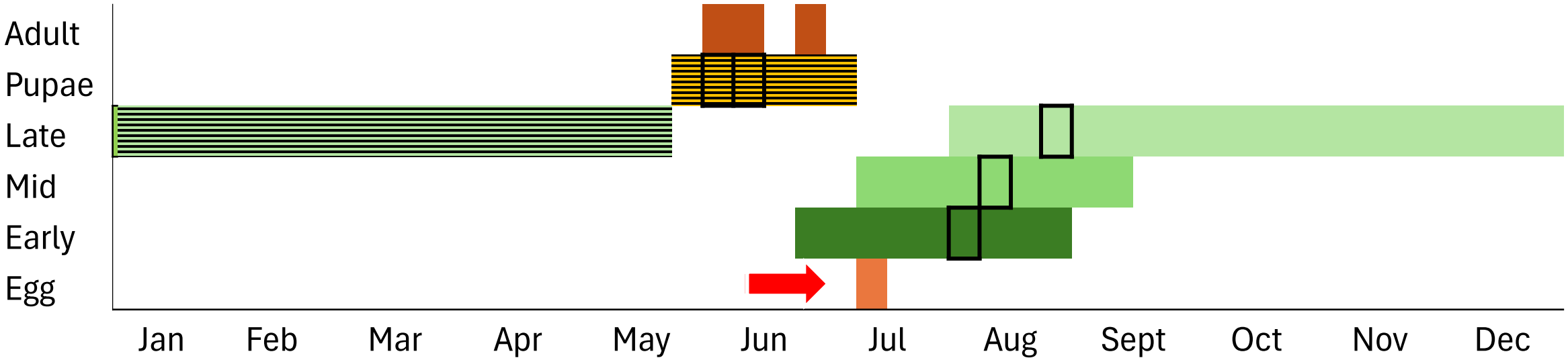


Potential Monitoring Method?

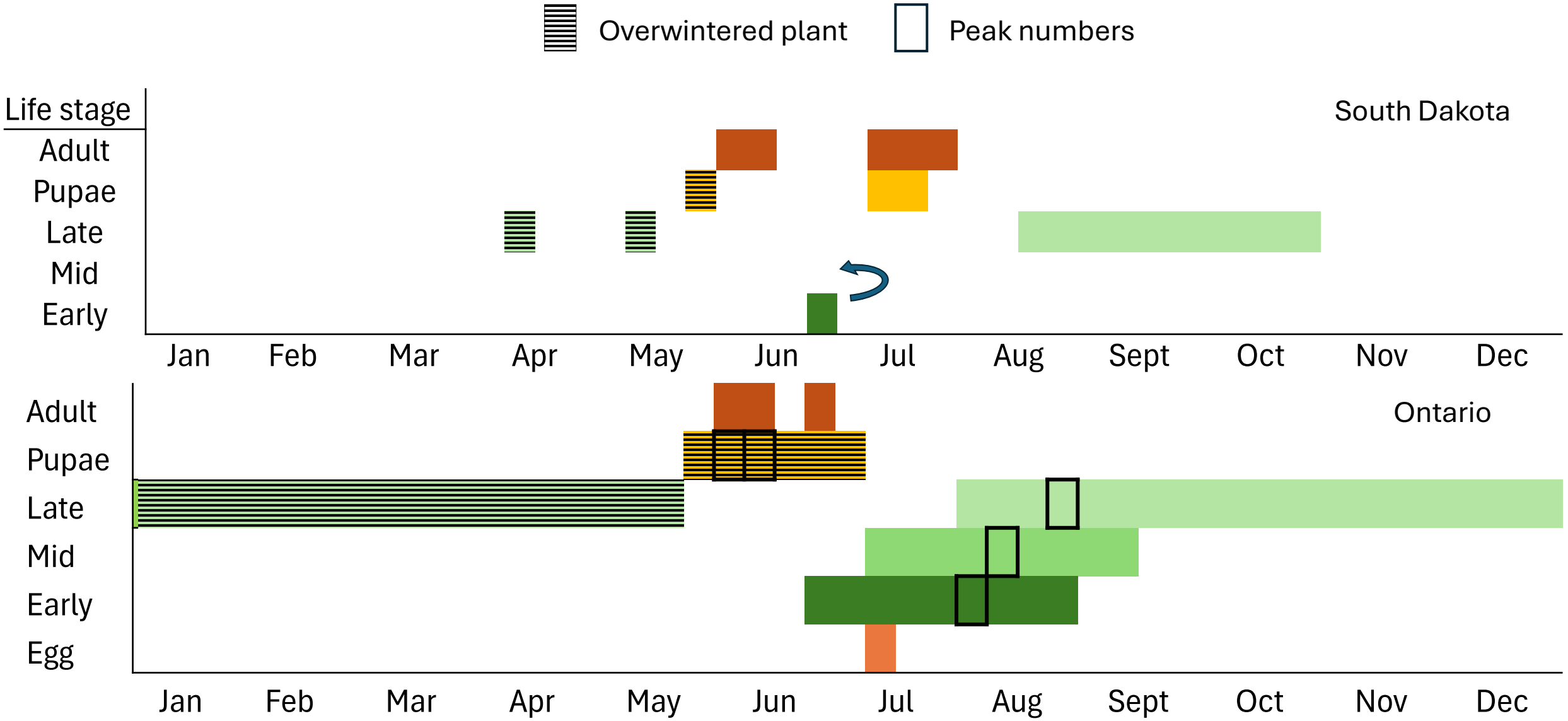


Eggs: What, Where, and When?



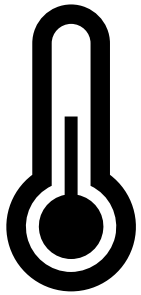


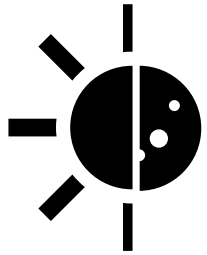
What We Know

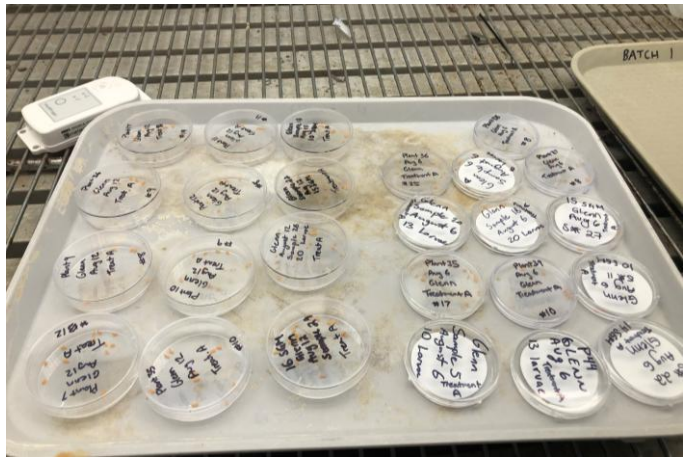

Overwintered plant
Peak numbers
Life stage
Adult
Pupae
Late
Mid
Early
South Dakota
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Adult
Pupae
Late
Mid
Early
Egg
Ontario
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec

Diapause Experiments

- Diapause: a period of paused development influenced by environmental conditions
- Larvae from late summer were placed under short, medium and long daylengths
- Confirmed that diapause is facultative → a second generation may develop under the right environmental conditions in the field

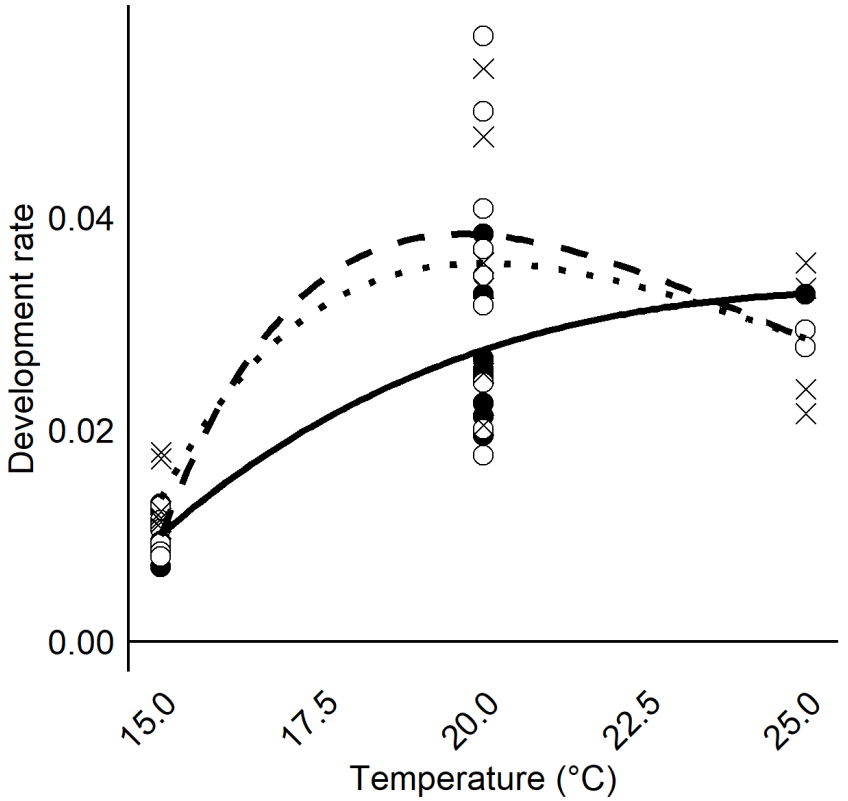






Spring Development

- Overwintering larvae were placed under different temperatures to determine their developmental rate and predict the lower temperature threshold
- Models indicate that the temperature at which larvae begin developing in spring is between **11.9** and **14.5 °C**

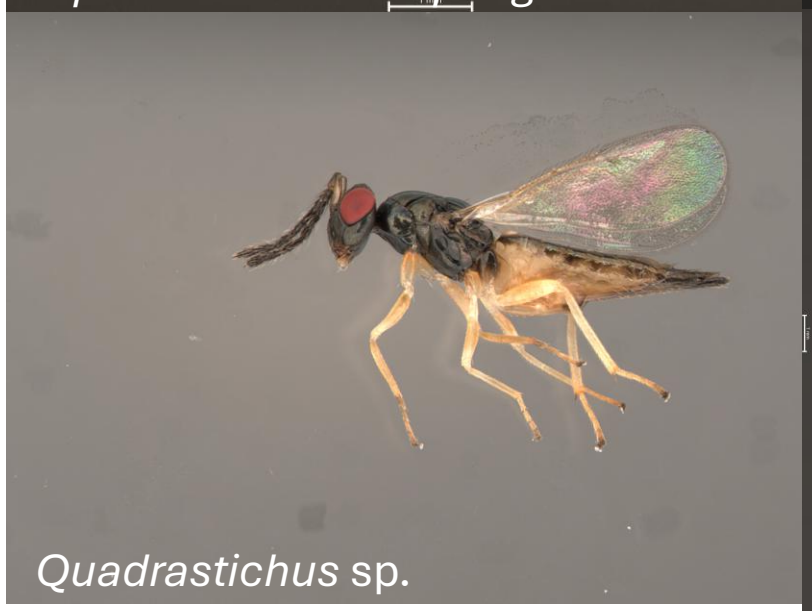


Parasitoids of SGM

Platygaster chilophagae

Trichacis rufipes

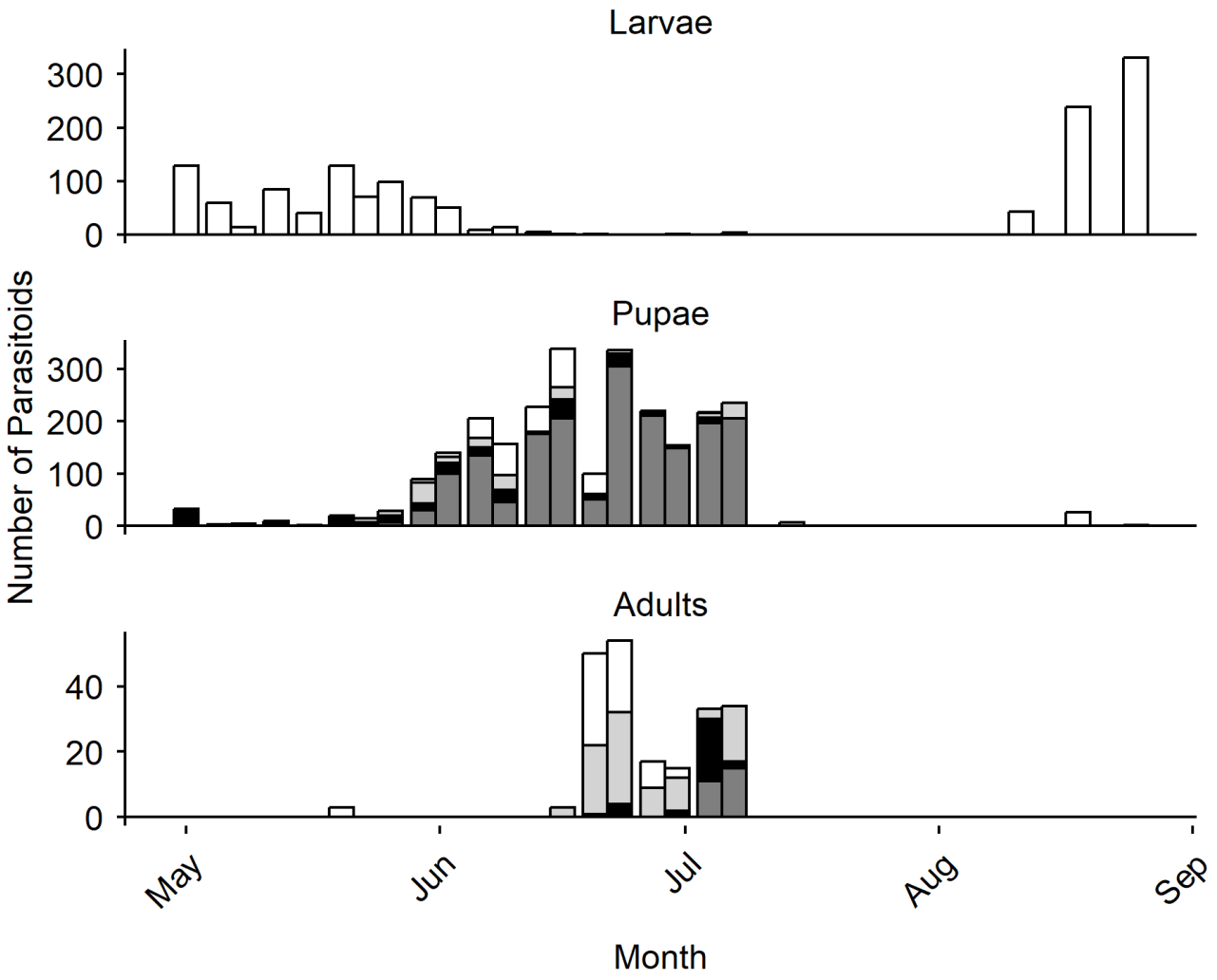
Aprostocetus chilophagae



Quadrastichus sp.

Parasitoids are abundant

- 50-58% tillers contained at least one parasitoid in 2024 and 2025
- Parasitoids develop as adults within overwintered tillers and emerge as adults just after SGM adult emergence

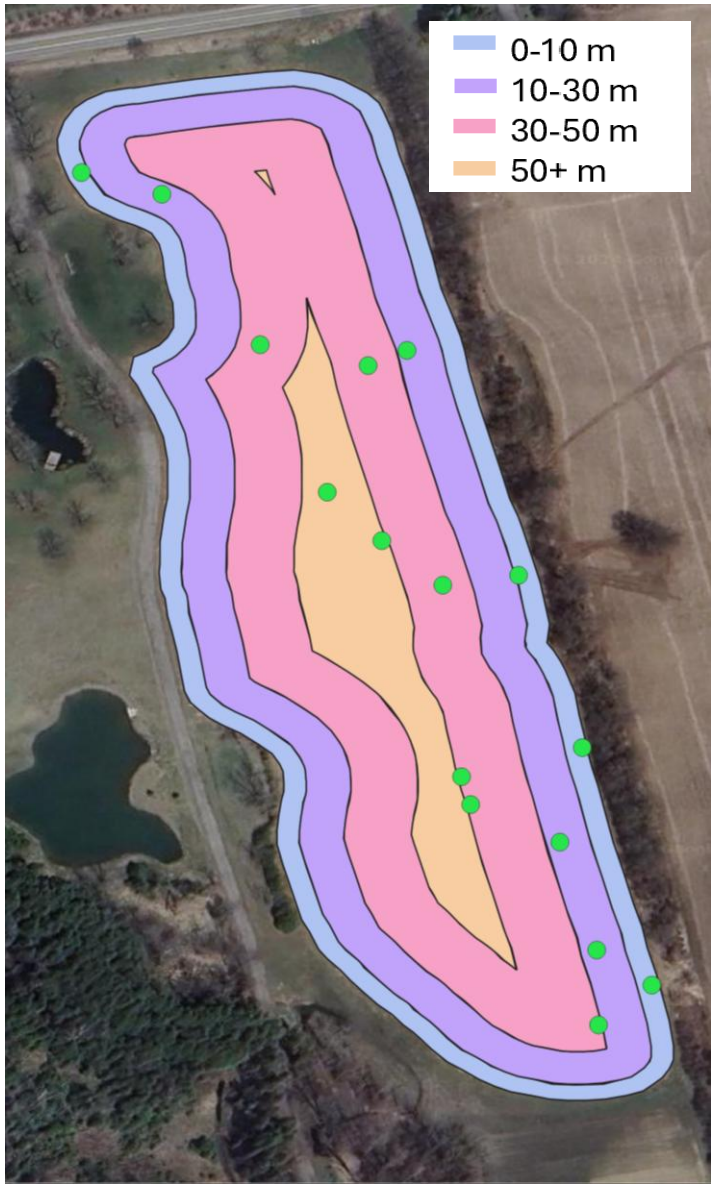


SGM infestation rates and yield impact

Site 1

Quadrat: 0.75 m^2

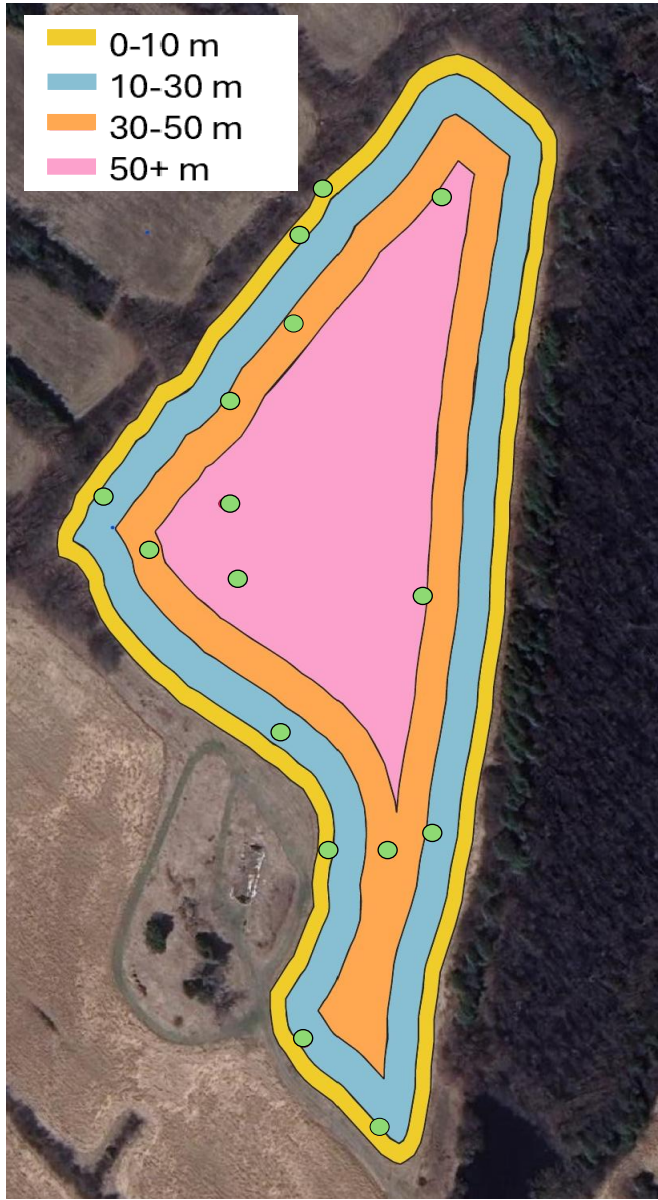
- Locations with infested tillers
  - 2024: **16/16**
  - 2025: **14/16**
- Mean infestation per quadrat sample
  - 2024: **8.9%**
  - 2025: **1.3%**



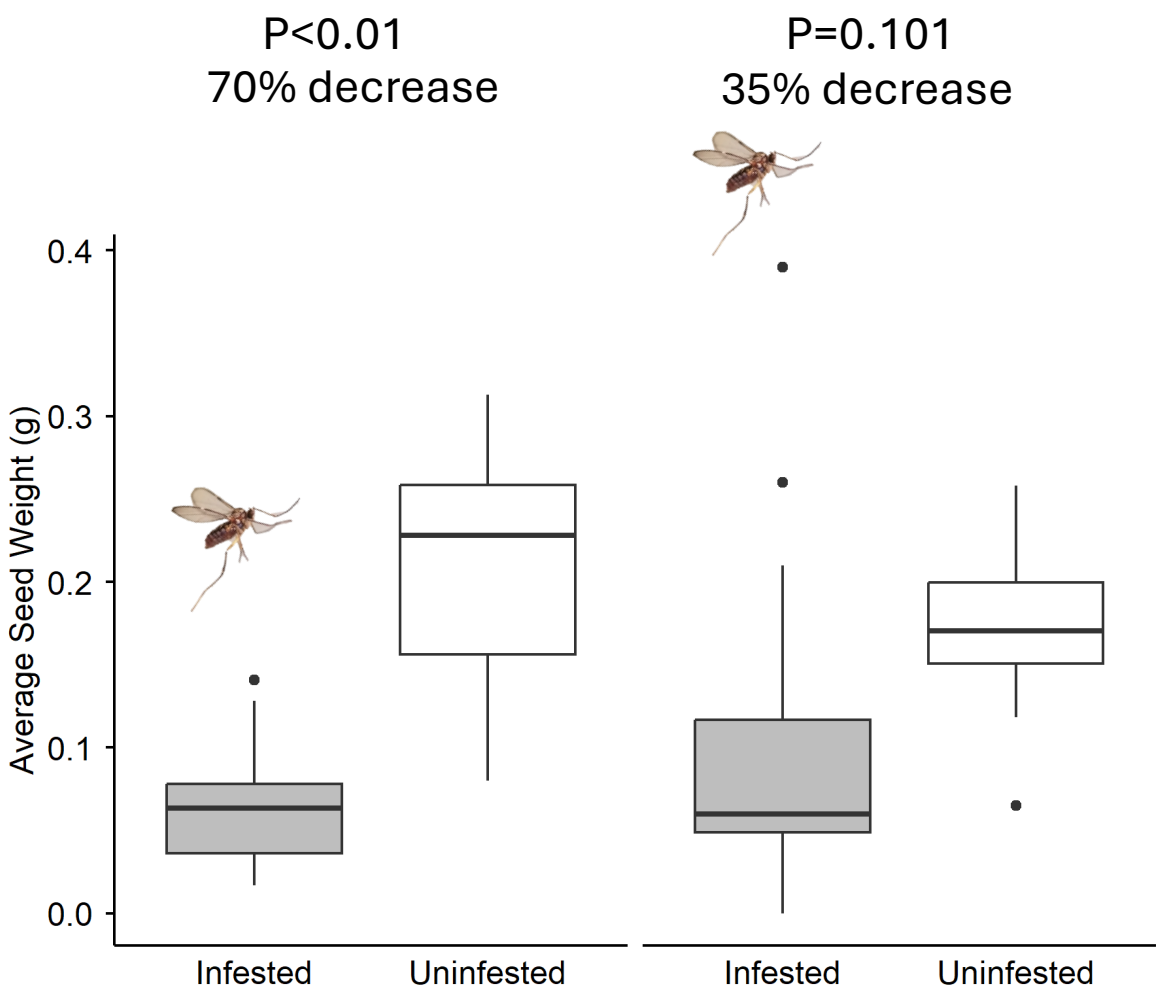
Site 2

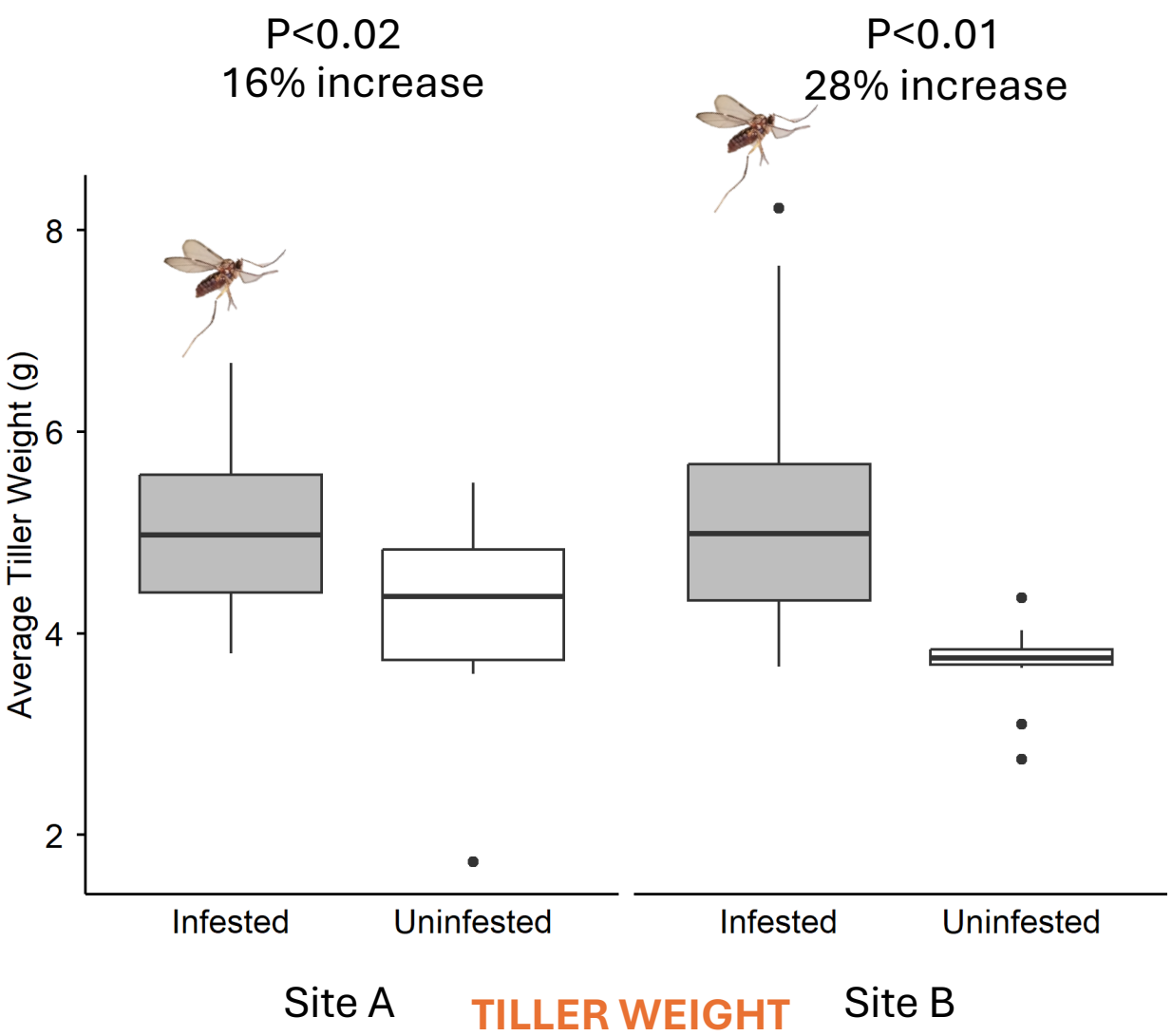
Quadrat: 0.75 m^2

- Locations with infested tillers
  - 2024: **15/16**
  - 2025: **9/16**
- Mean infestation per quadrat sample
  - 2024: **2.1%**
  - 2025: **1.9%**

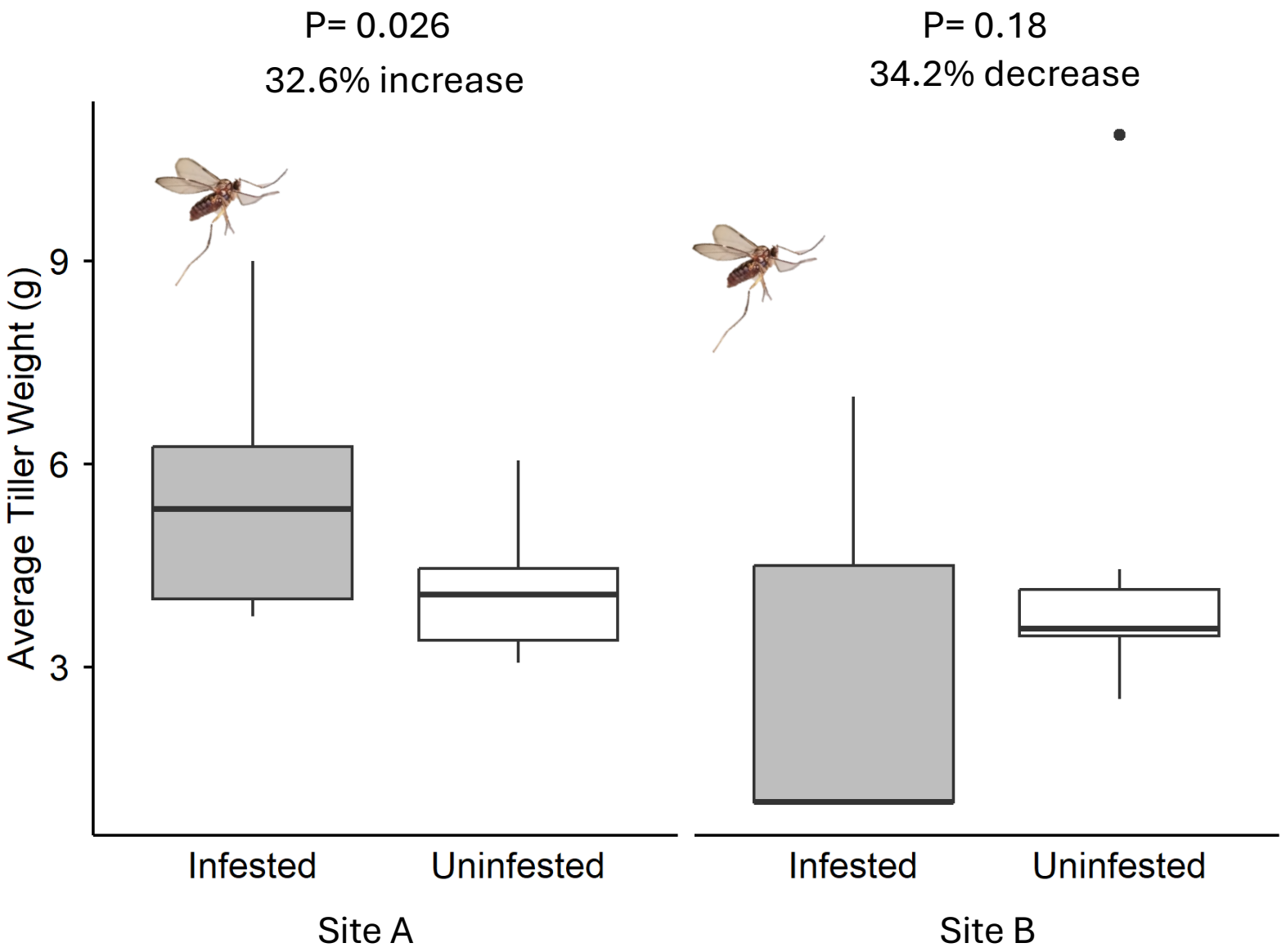


Only seed weight was negatively impacted by SGM

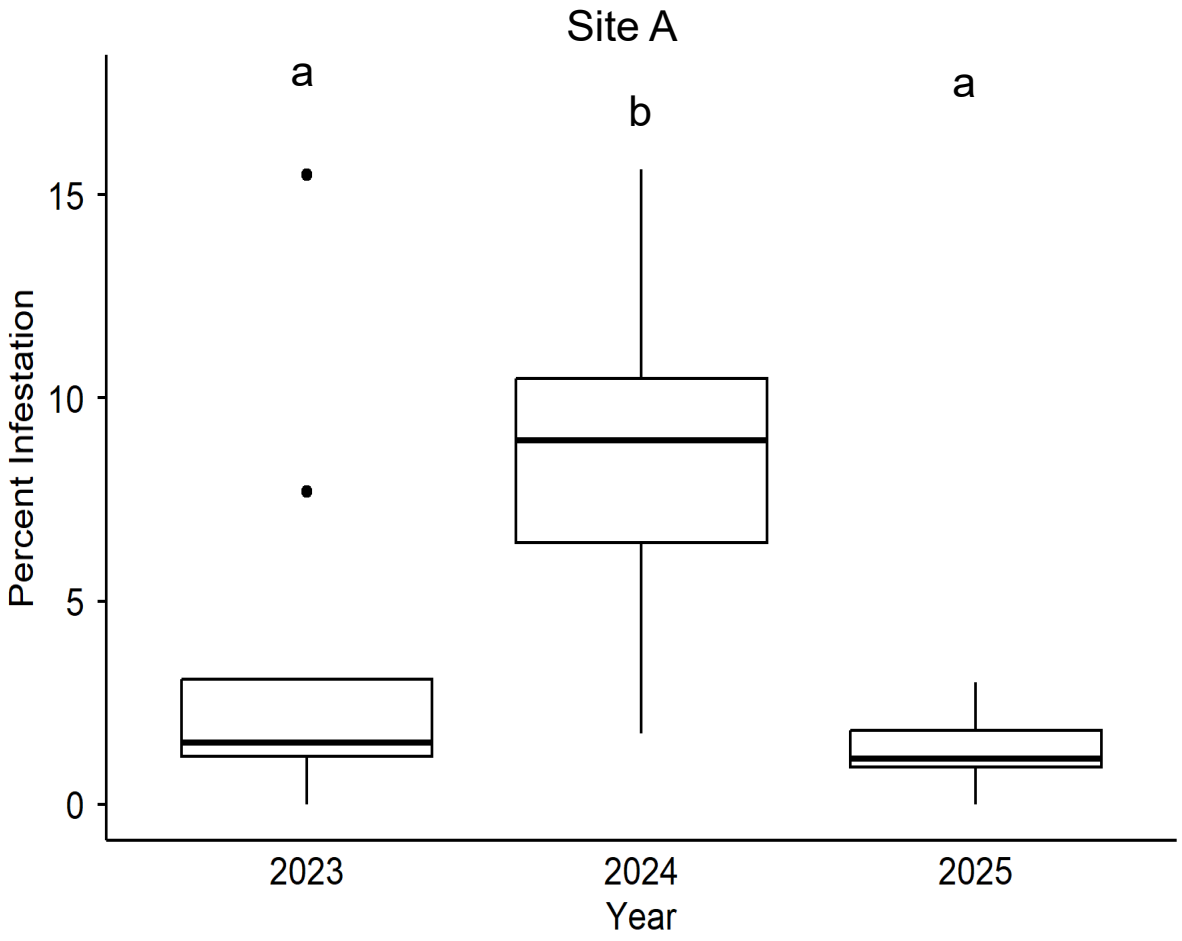


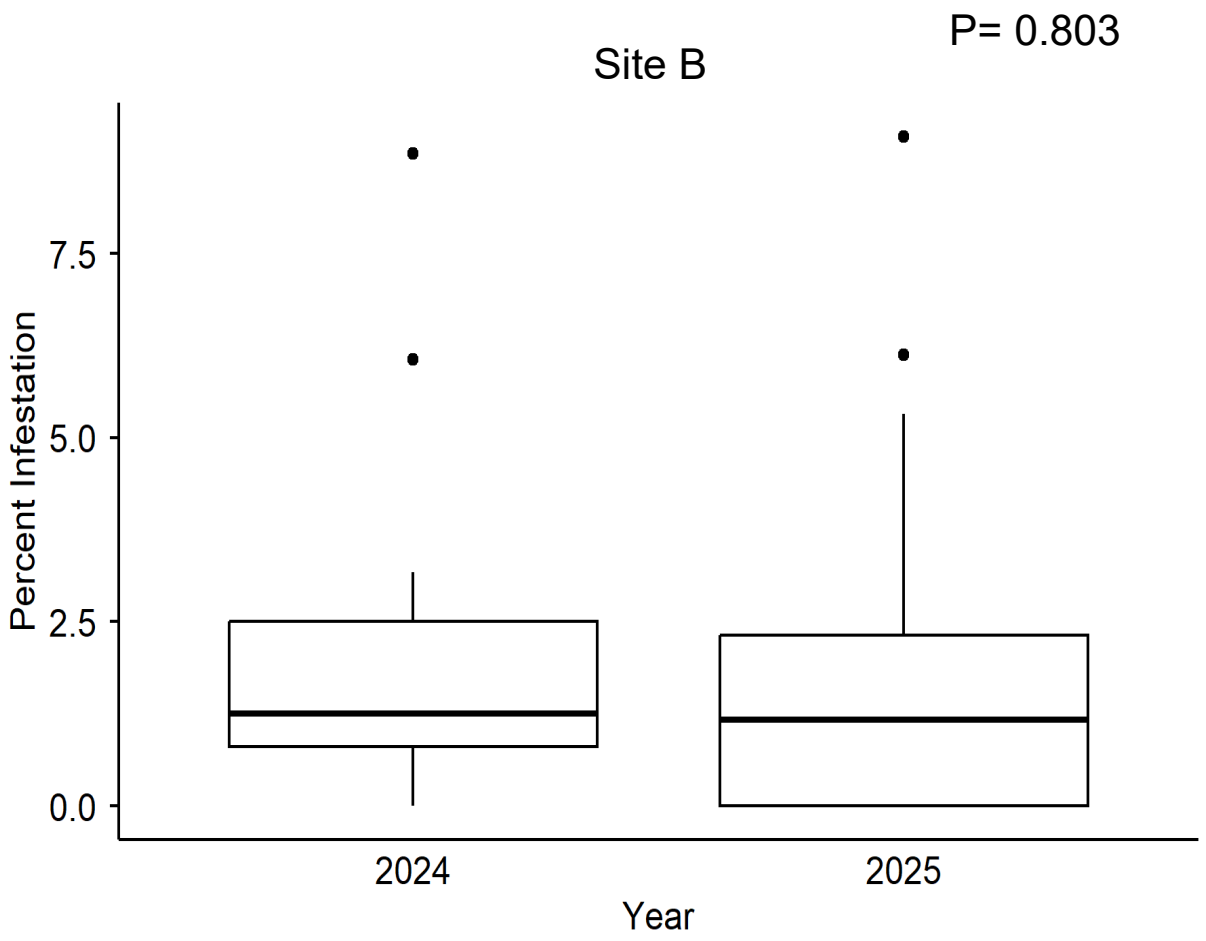


Whole tiller weight was not negatively impacted by SGM



Percent infestation is low





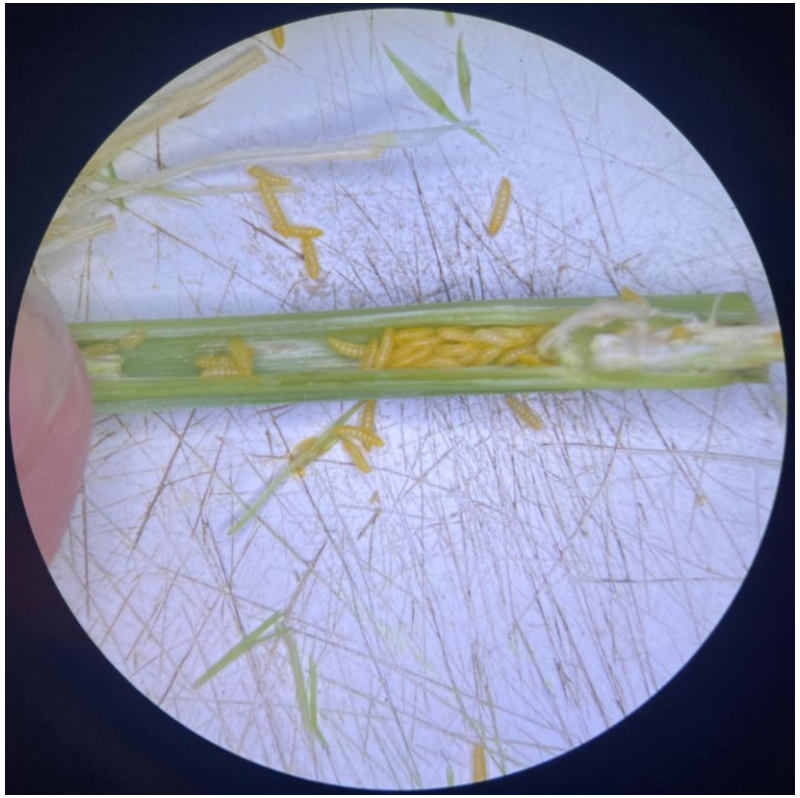
SGM impacts tiller and seed mass

With a 1.6% infestation rate per field

- 27.3% increase in tiller weight per tiller -> **0.44% increase**
- 52.5% decrease in seed weight per tiller -> **0.84% decrease**

Conclusions

- SGM injury is only identifiable at the reproductive stage
- SGM has one generation per year, but diapause is not a requirement
- Percent SGM infestation is low, but variable
- Only seed production is negatively impacted by SGM
- Parasitoids are abundant



Recommendations

- Monitor SGM infestation in August or September when identification of injury is accurate to track potential population increases
- In stands with high infestation, consider selling for biomass instead of seed to minimize loss
- Removal of all overwintered tillers prior to May, including those on field edges, will remove population sources for that growing season
- Confirm the presence of SGM parasitoids by sampling overwintered tillers in May or sweeping in fields in June

Future Research Directions

- Development of adult monitoring methods
  - Possibility of male sex pheromone
- Development of SGM larvae in different cultivars
- Population sources
  - Other host plants?
  - Soil overwintering?
  - Dispersal from other switchgrass fields

Ontario Agri-Food Innovation Alliance research program

Ontario Biomass Producers Co-operative Inc.

NSERC Alliance research program

Ontario

OMAFA Partners
Hannah Fraser
Mahendra Thimmanagari

Switchgrass Growers

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Chloe El Hani
Matteo Girardo
Colin Grant
Emily Stevens
Kaitlin Pengelley
Natalie Savoia
Sam Schmidtke

Thank You!