Redistribution, dispersal, foraging, and reproduction of *Trissolcus japonicus*

Joe M. Kaser and Kim A. Hoelmer

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Specialty Crop Research Initiative

Collaborating Institutions

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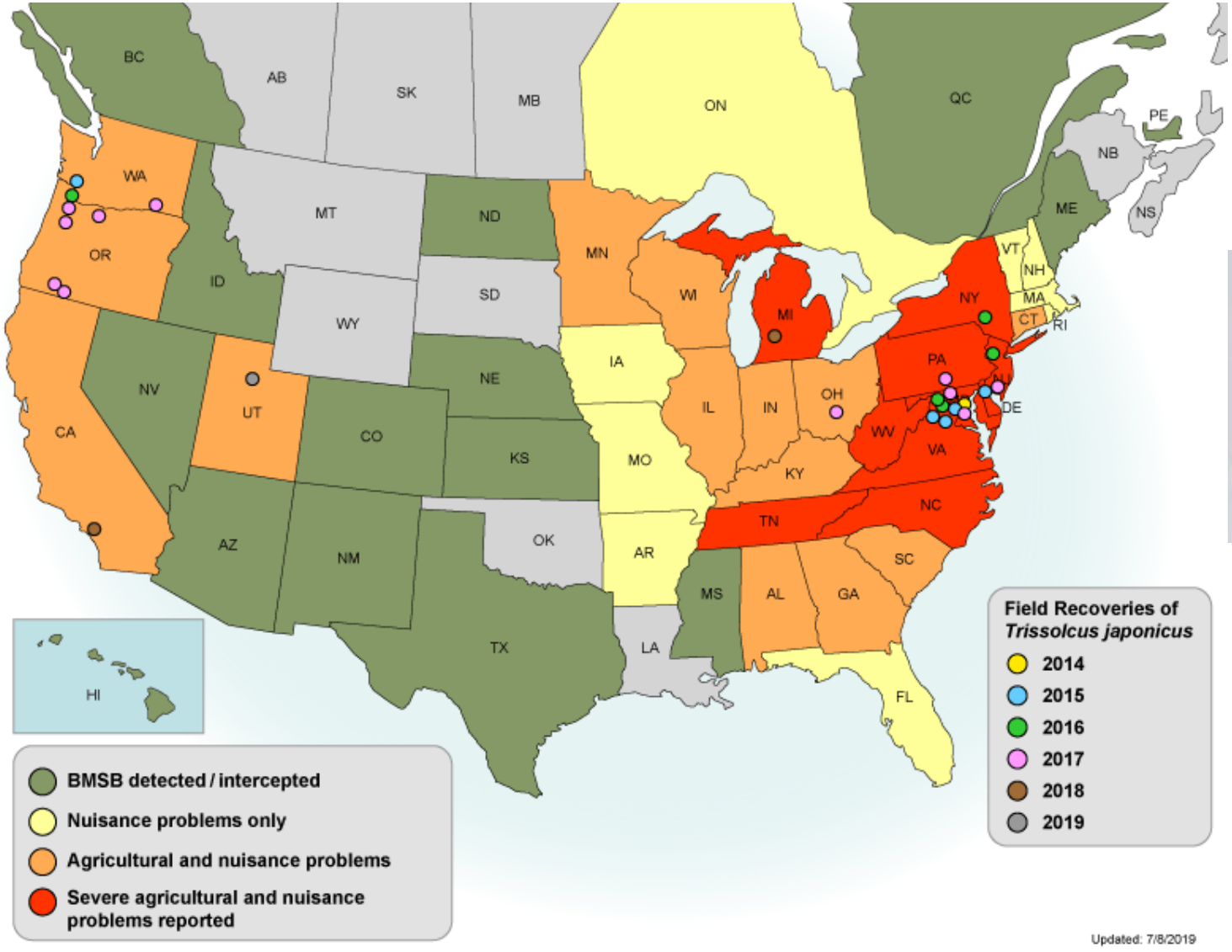
Trissolcus japonicus in North America



Geographic range is increasing, but local population densities remain mostly low. Why?

Population growth = birth - death + immigration - emigration

Haplodiploidy

Egg + sperm = female offspring

Egg + no sperm = male offspring

How long do parasitoids live?

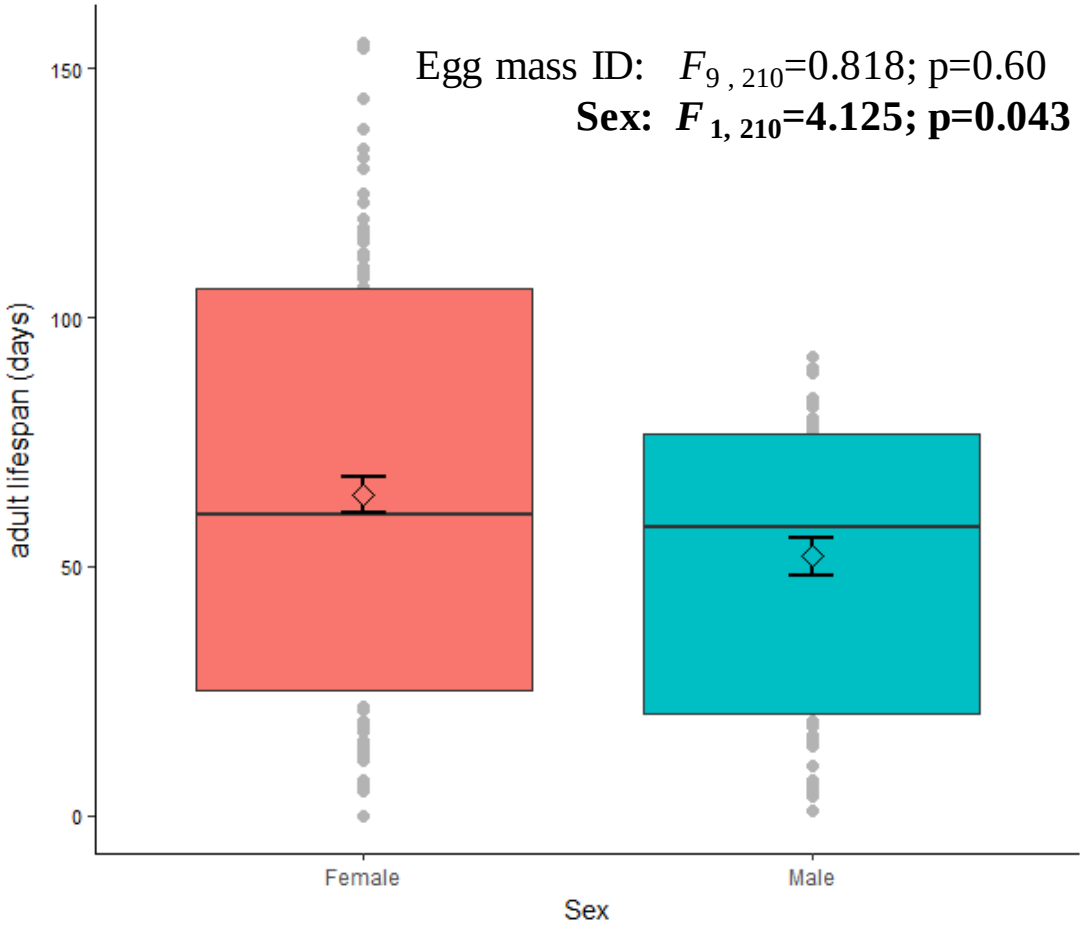
Males: 59 wasps
Females:162 wasps

Min lifespan: <1 day
Max lifespan: 155 days

Mean difference in lifespan:
Female (64.4 days) - male (52.0 days) = 12.4 days

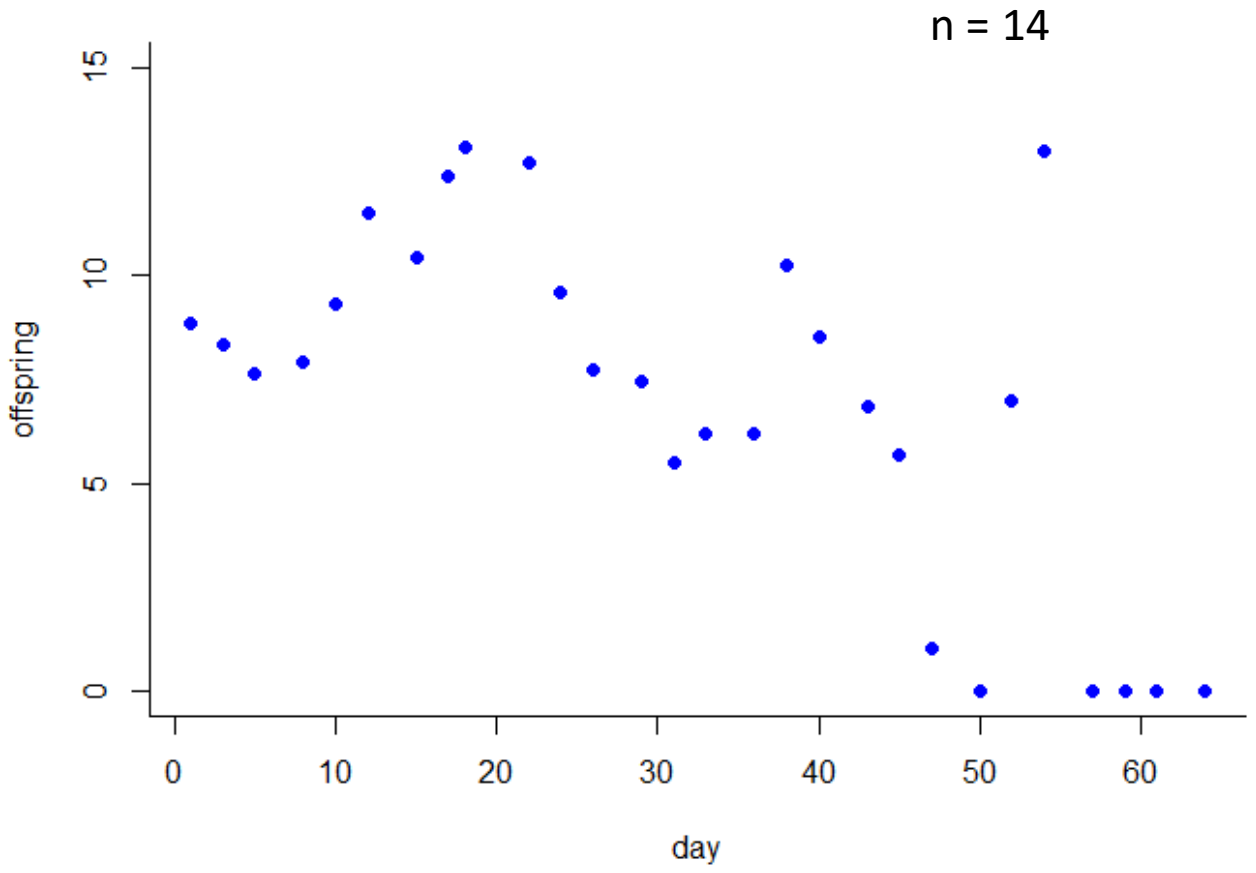
Lifespan ~ massID + sex

Egg mass ID: $F_{9,210}$=0.818; p=0.60
Sex: $F_{1,210}$=4.125; p=0.043



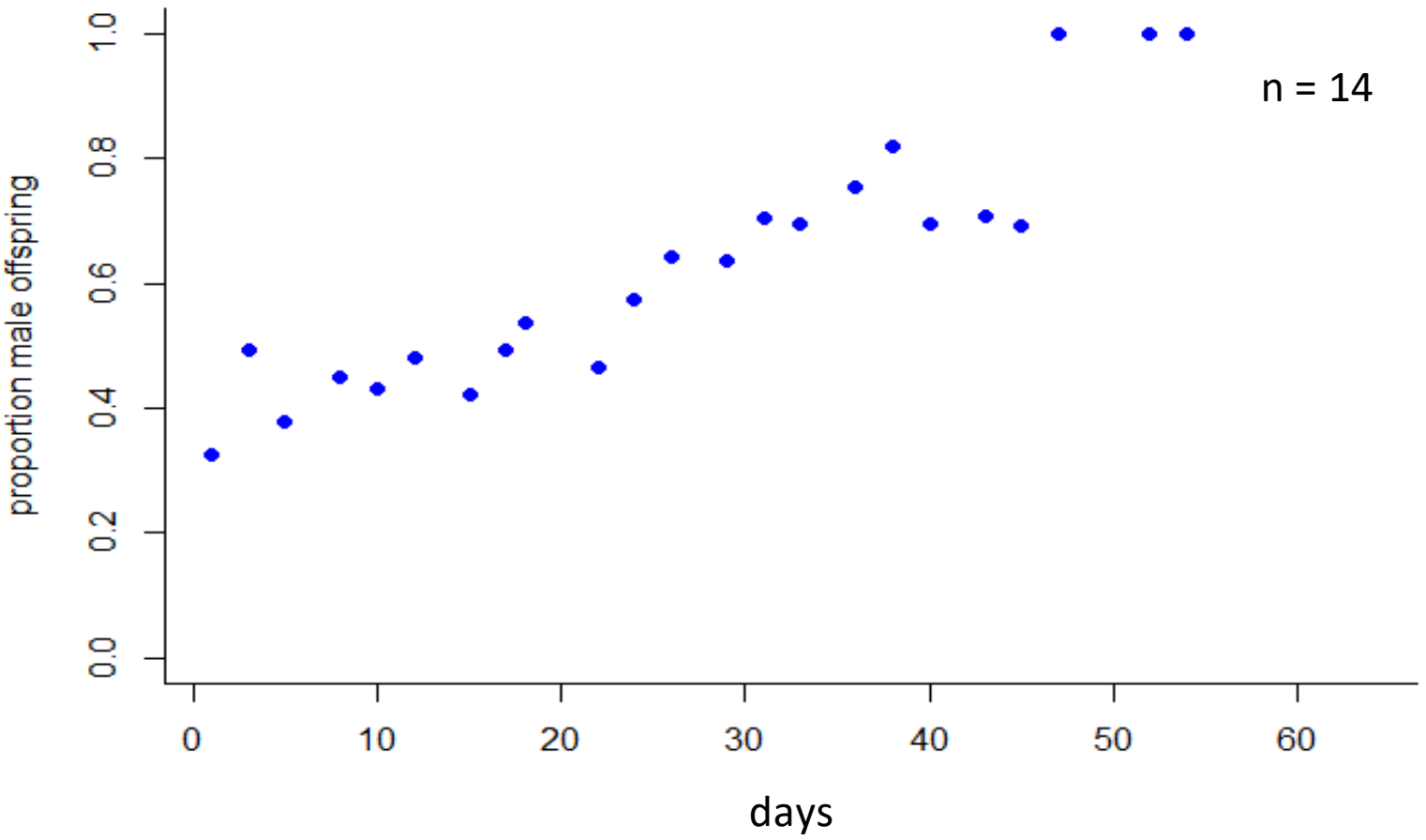
How many babies does *T. japonicus* make?

Mated females were exposed to egg masses every Mon, Wed, and Fri until they died. Females were only mated once.



Average lifetime reproduction = 152 offspring

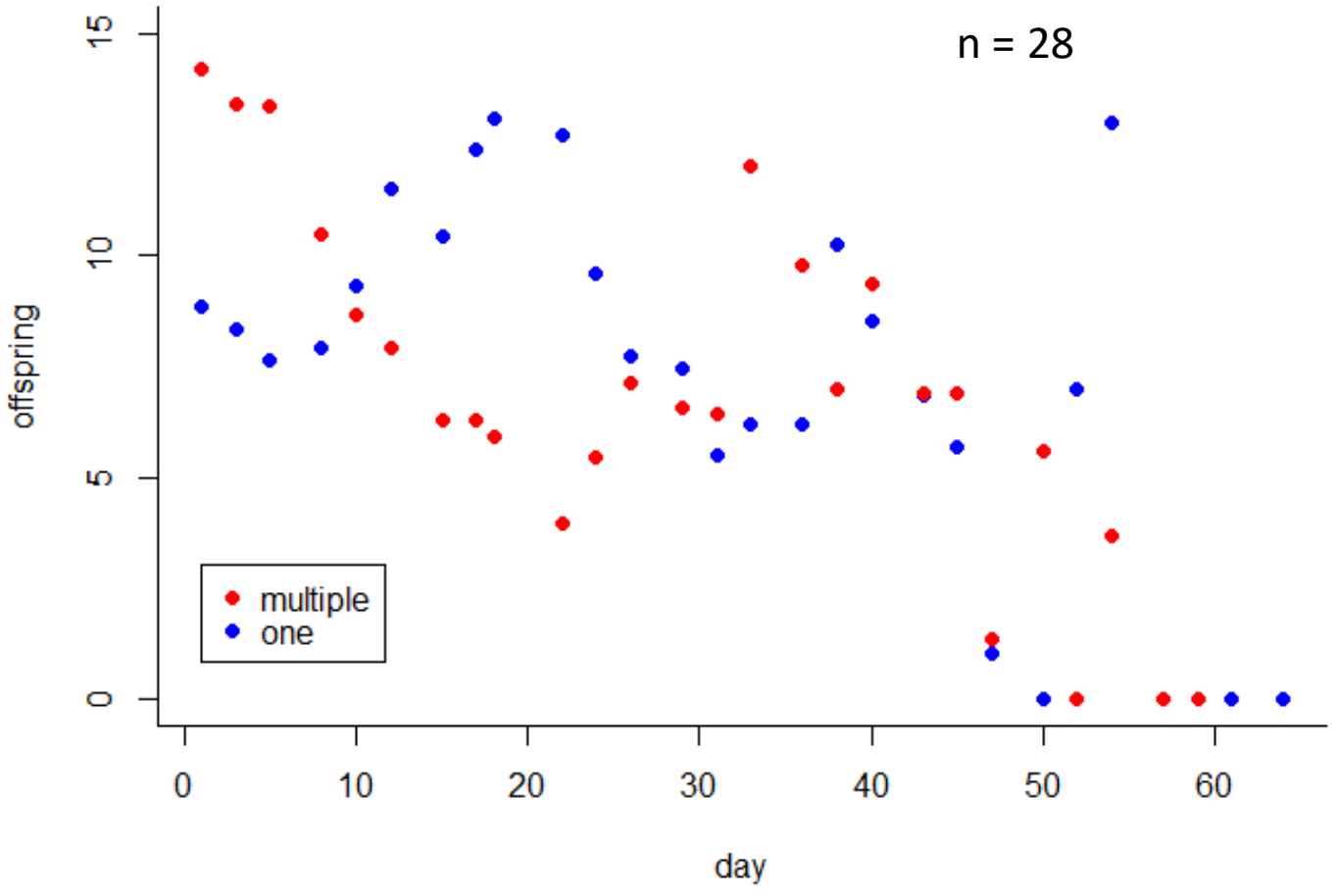
Proportion males



Average lifetime reproduction = 89 daughters + 63 sons
41% male

Reproduction and sperm limitation

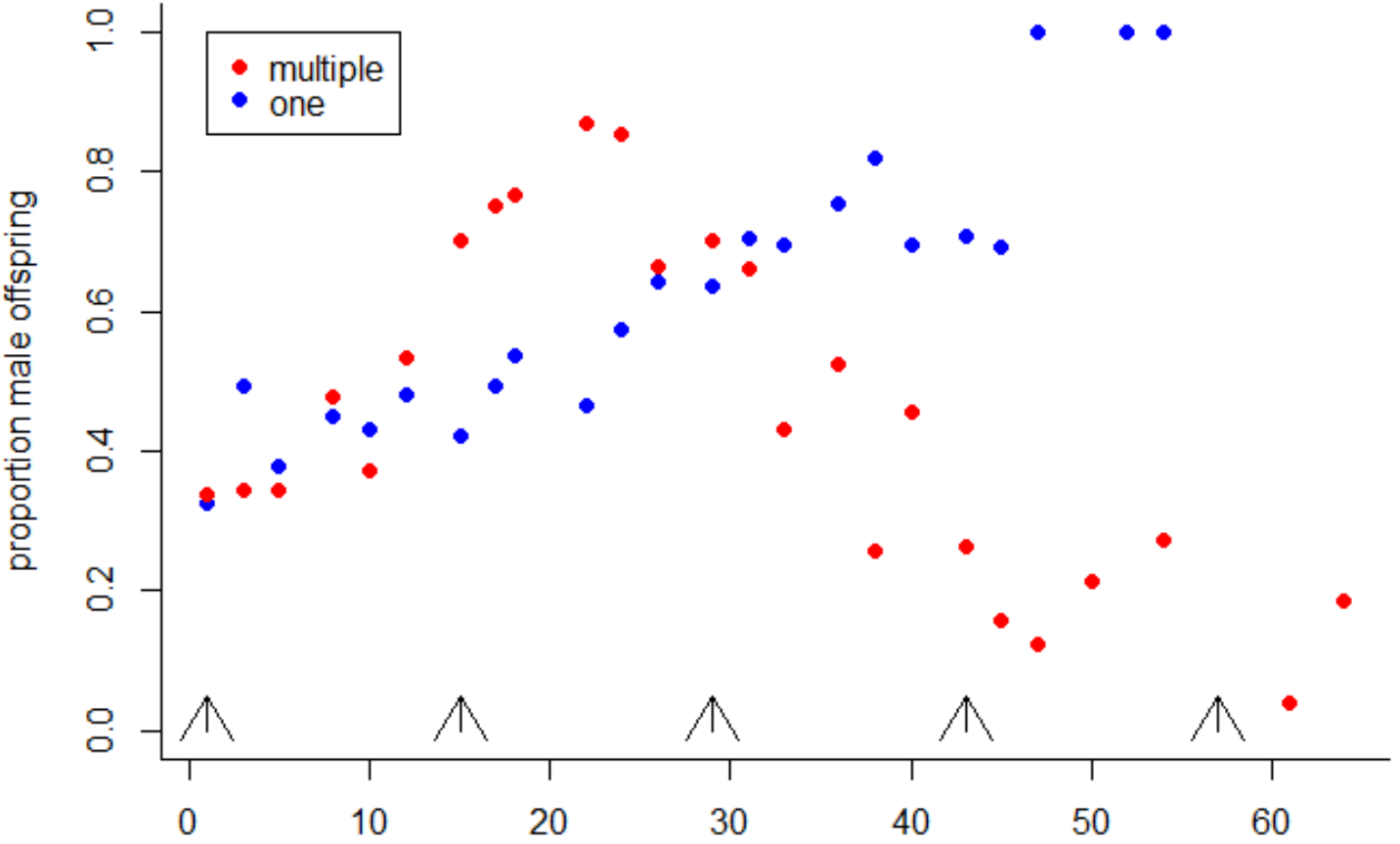
Mated females were exposed to egg masses every Mon, Wed, and Fri until they died. Blue indicates singly mated females. Red indicates females that were exposed to males multiple times (every ~2 weeks)



Added males for 24 hours every 2 weeks

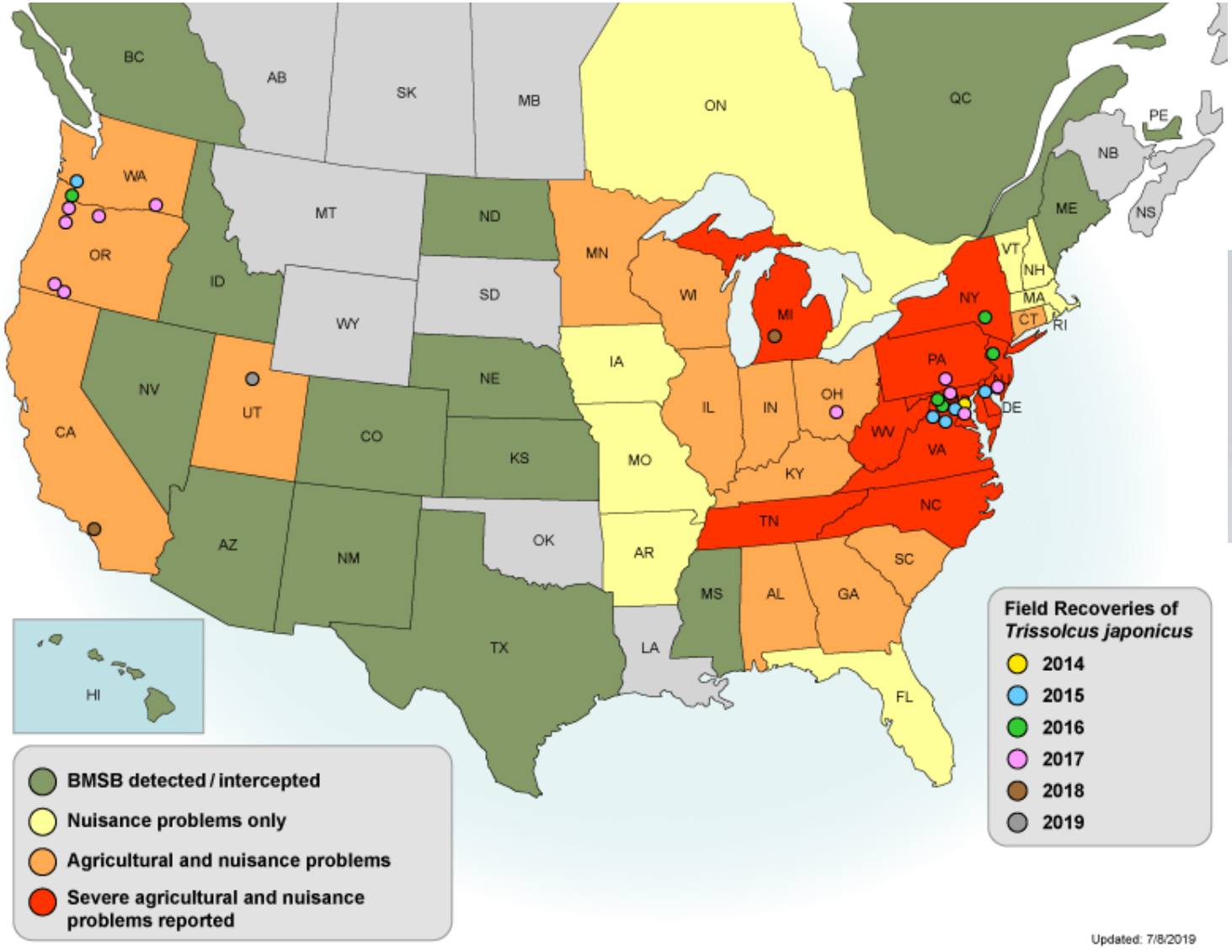
Reproduction and sperm limitation

n = 28



Arrows indicate when males were introduced

Trissolcus japonicus in North America



Parasitoid redistribution and the effects of release numbers

- *T. japonicus* is establishing across a broad geographic range
- However local population densities are quite variable
- Redistribution efforts may increase spread, local density, and biological control impact

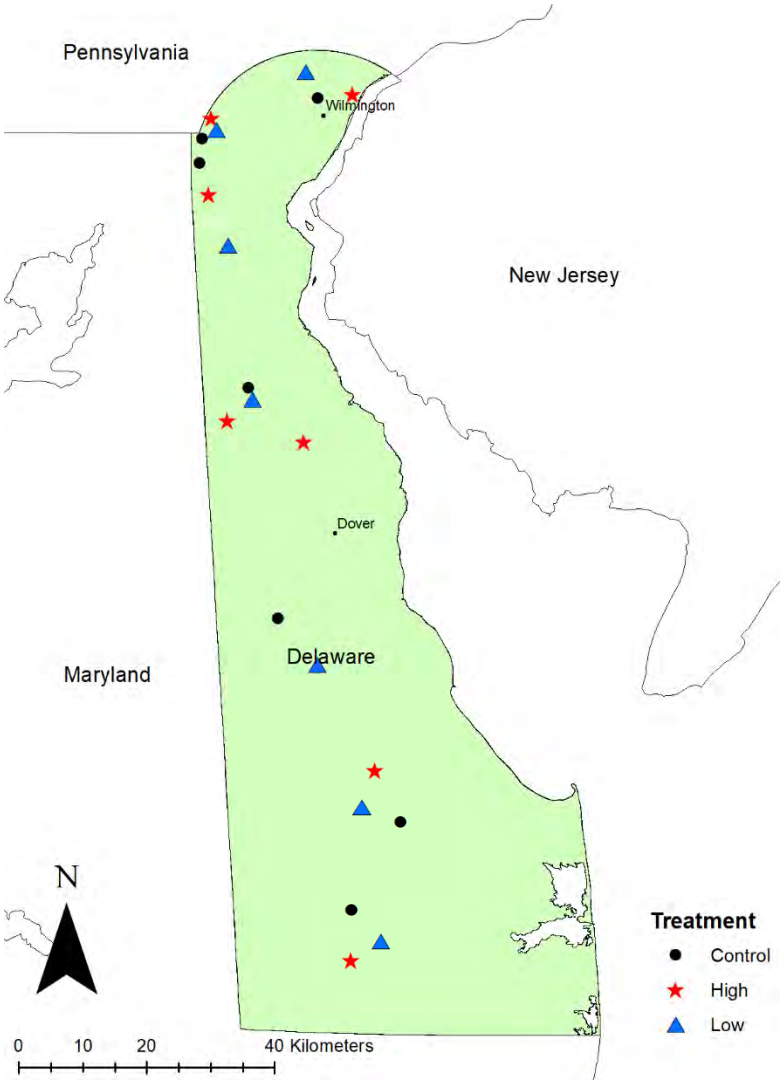
What is the optimal release strategy??

- Opportunity to study colonization processes

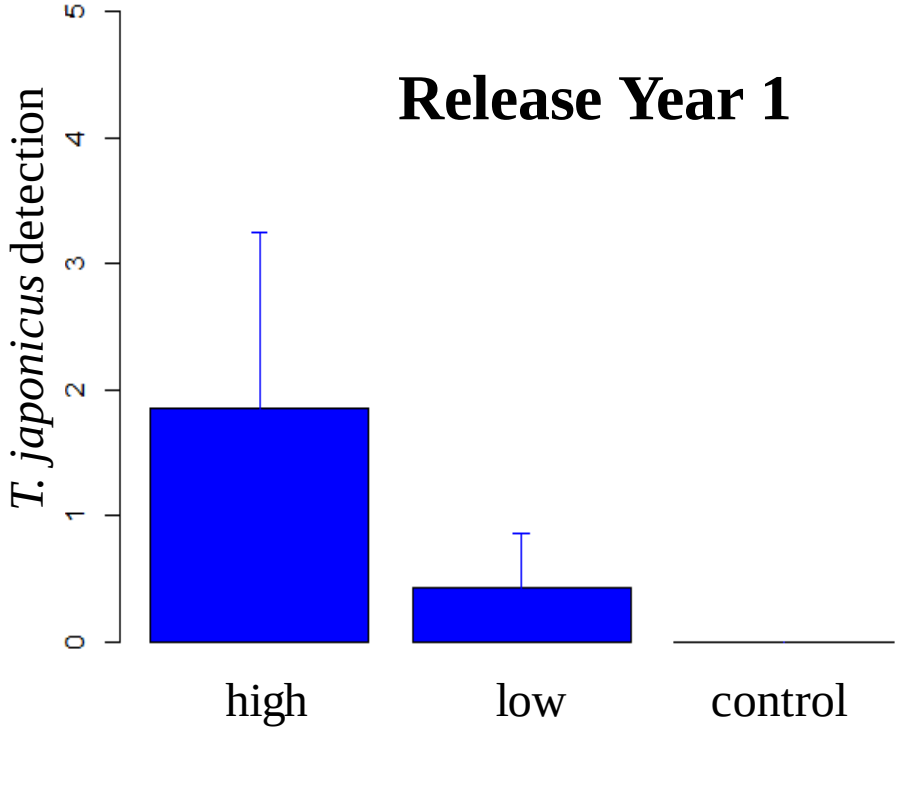
Delaware redistribution

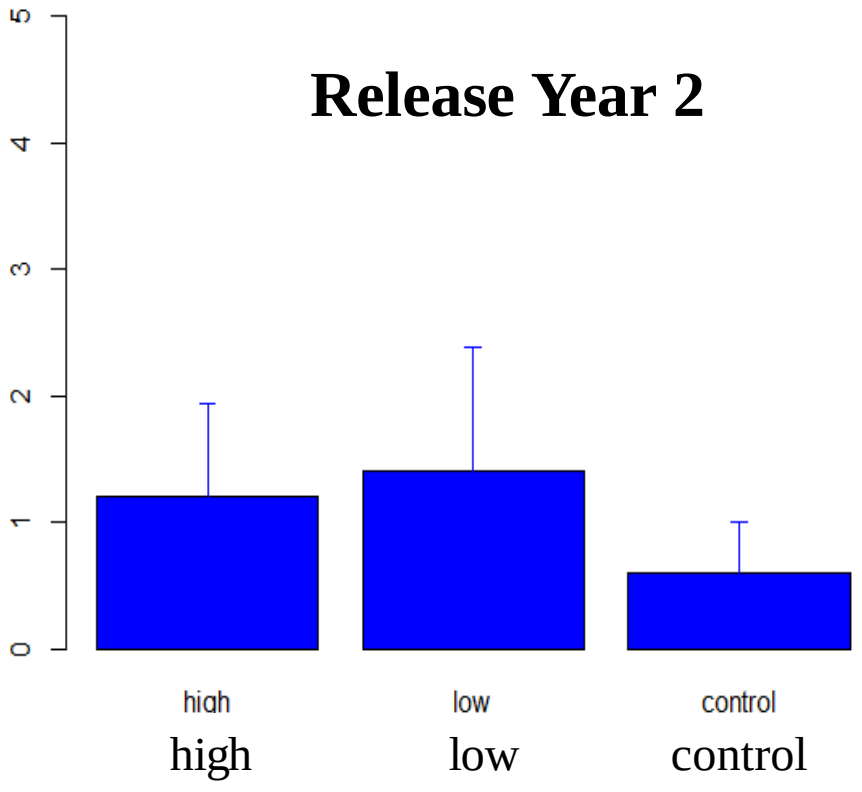
High release: 15-20 parasitized egg masses *per release*, i.e. about 400 female wasps
Low release: 1-2 parasitized egg masses *per release*, i.e. about 40 female wasps
Control: no released wasps

- Minimum separation of 2 km between release locations
- Randomized complete block design
- All release sites were forested habitat edges



Delaware redistribution

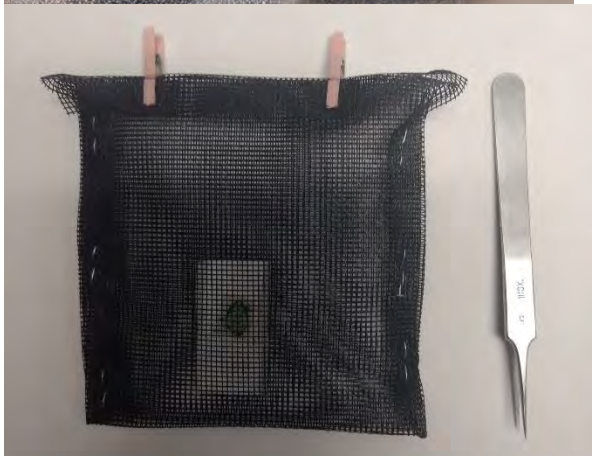




Multistate redistribution efforts

***Trissolcus japonicus* redistribution is ongoing in…**

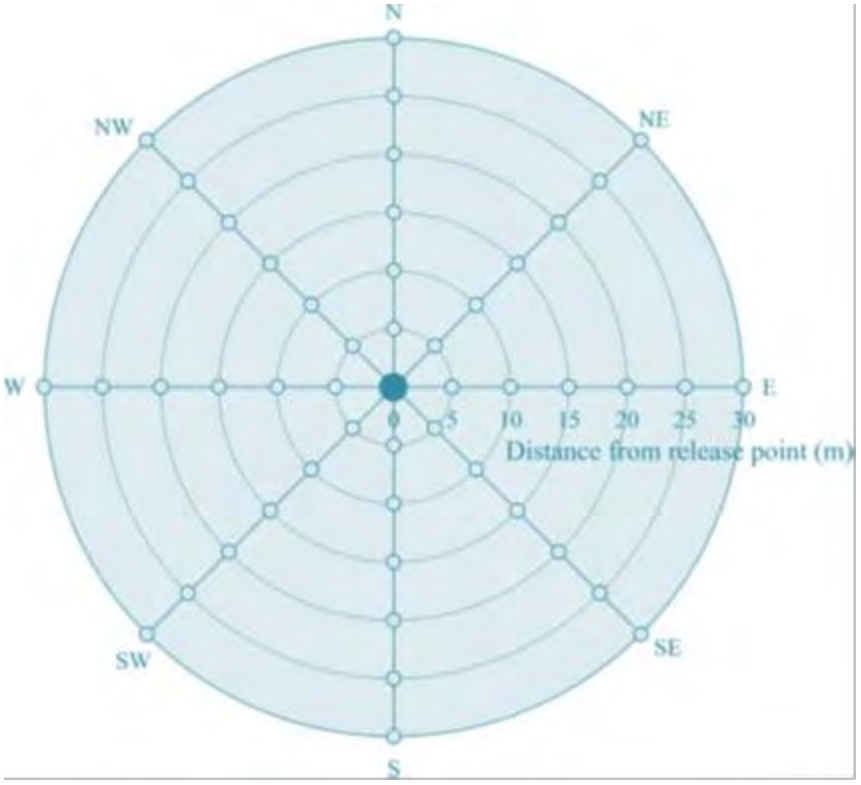
Delaware – Kaser, Tatman, Owens & Hoelmer
Maryland – Shrewsbury & Potter
New Jersey – Girod, Hamilton & Nielsen
New York – Jentsch & Agnello
Michigan – Pote & Szucs
Ohio – Welty
Oregon – Wiman & Lowenstein
Virginia – Bergh & Quinn
Washington – Beers & Milnes
Others?



Why such low growth?

Population growth = birth - death + immigration - emigration

T. japonicus Dispersal



~1700 female adult wasps released
Half of trees exposed to BMSB adults (contact kairomone)

T. japonicus Dispersal

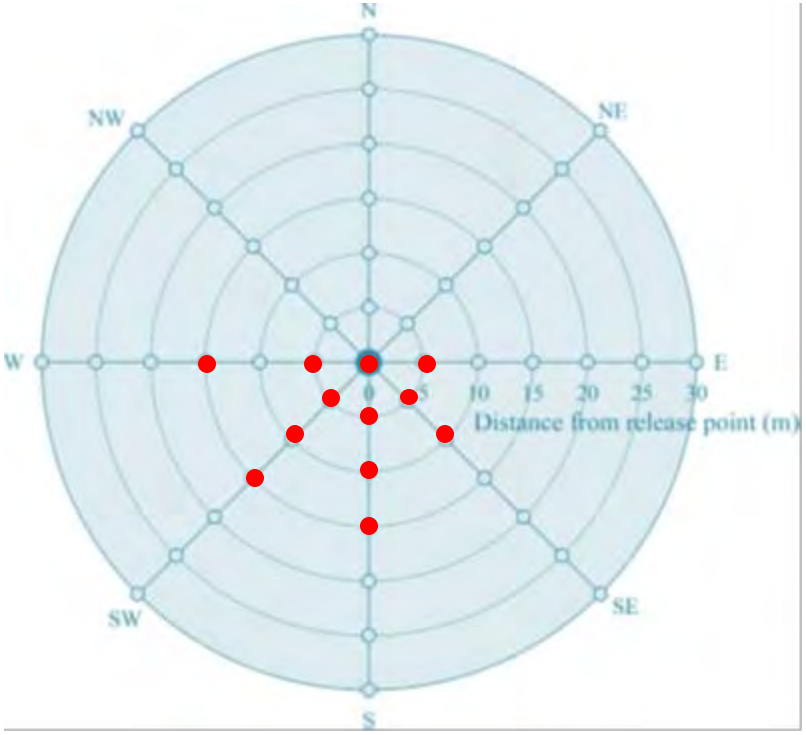
Logistic regression: Parasitism~Distance+Treatment+ Distance*Treatment

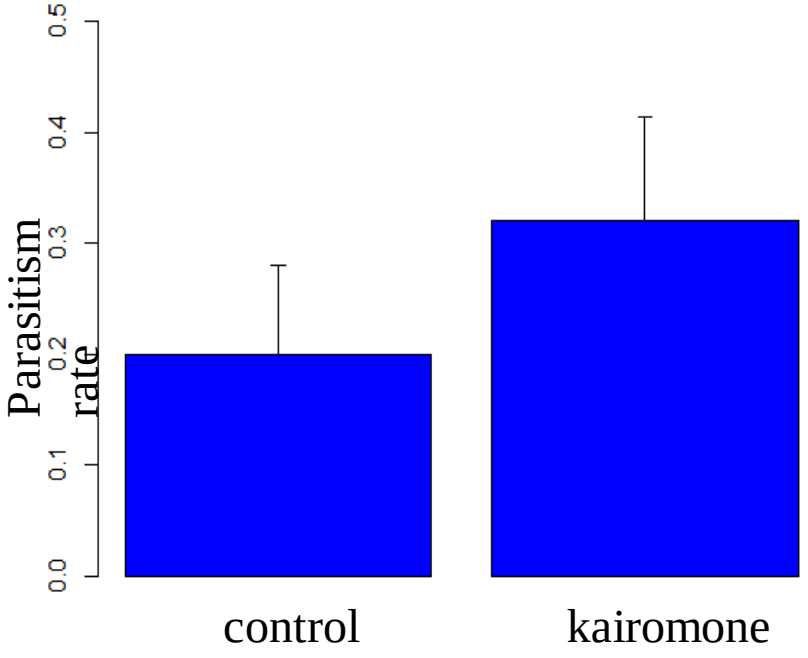
Distance: ***P* = 0.035**

Treatment: *P* = 0.47

Distance x Treatment: *P* = 0.89

26% parasitism
By 0.7% of females





Summary

- Parasitoids can be long-lived
- High reproductive output
- Sperm limitation might limit population growth under certain conditions (like low population density)
- Low *detected* population growth at release sites, thus far
- But *T. japonicus* is continuing to increase its geographic range
- High rates of dispersal may create a lag before local populations increase dramatically; though we can only speculate at this stage
- In China, parasitism is very high, and BMSB density is lower
- Should we continue to release and wait, or is there something different about the U.S. context that limits biological control capability?

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