

**Rearing Methods of  
*Tamarixia radiata* in  
Gainesville, Florida, and  
information on its biology.**

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**International Workshop on *Tamarixia* Species  
McAllen, Texas - February 2, 2010**



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Division of Plant Industry**



- **1998 – Asian Citrus Psyllids (ACP) first detected in FL**
- **Biological control investigated**
  - Best host plant determined to be orange jasmine due to higher tolerance for large population of psyllid than citrus.
  - Industry donated orange jasmine plants for project.
- **2005, first U.S. detection of citrus greening on samples of pummelo leaves and fruit.**
- **2007 – Orange Jasmine (*Murraya paniculata*) determined to be host of citrus greening**
- **Jan 1, 2008 all orange jasmine must be grown in a screen house structure designed to exclude the Asian citrus psyllid.**

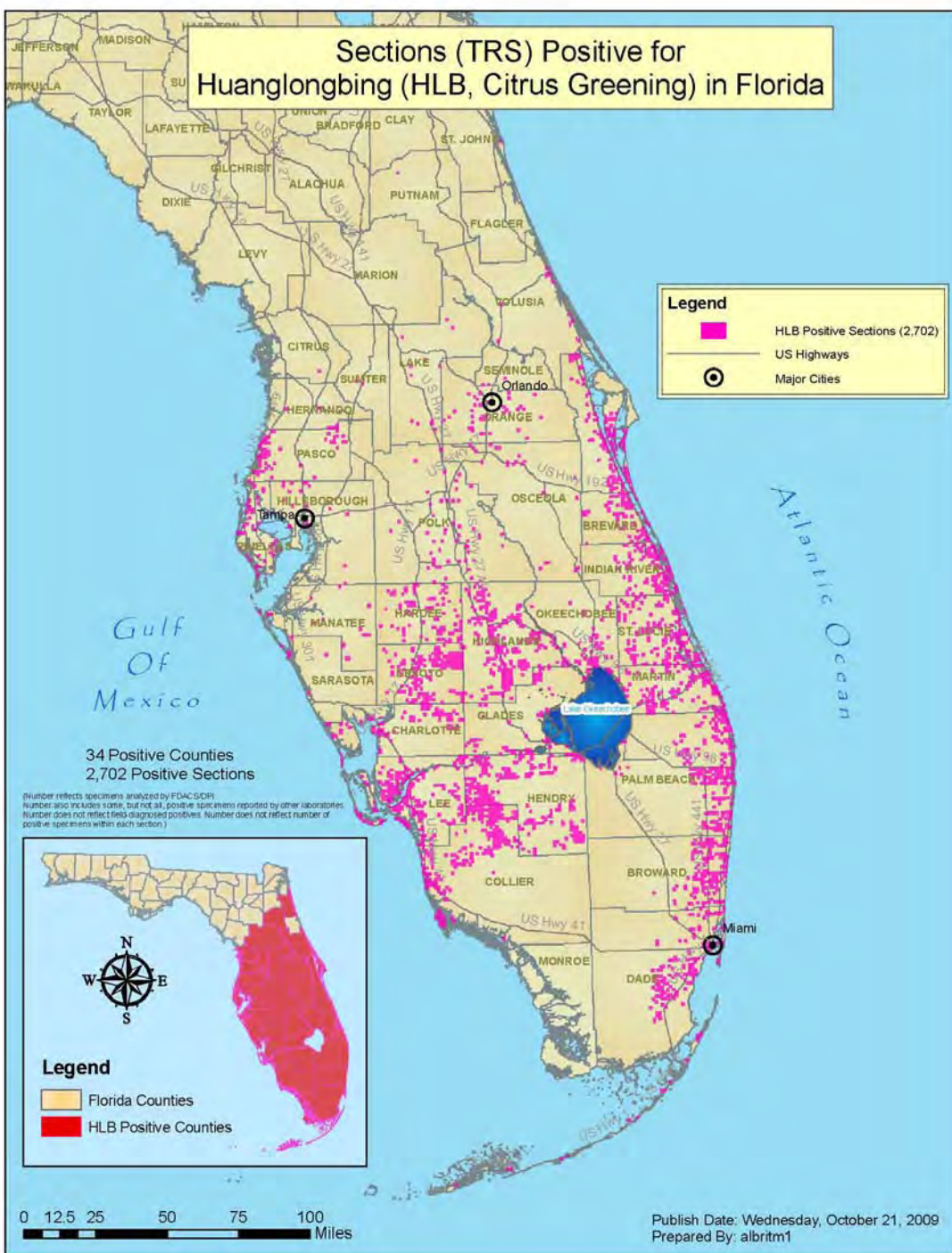


**These screened structures must be approved by the Division of Plant Industry FL Statue 5B-62.**

**Result – no nurseries in FL are growing orange jasmine due to cost of complying with rule.**



# Sections (TRS) Positive for Huanglongbing (HLB, Citrus Greening) in Florida





## Production & Rearing Methods of:

- Orange Jasmine, *Murraya paniculata*
- Asian Citrus Psyllid, *Diaphorina citri*
- *Tamarixia radiata*





## *T. radiata* in quarantine

The four *T. radiata* biotypes are: Florida (a genetic mix from southern Vietnam and Taiwan); Pakistan; Northern Vietnam and China.



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- **Orange Jasmine: Seed Germination**  
Vermiculite in incubator @ 90°F for 2 weeks



# Orange Jasmine

- Separate individual plants from the root ball
- Place in new pot and add soil





## ■ Orange Jasmine inside the greenhouse

- water every other day, fertilize 1X month with milorganite (1 tsp) + 20-20-20 fertilizer solution



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# Orange Jasmine



**Vegetative propagation?**

**Three months old - three years old**



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# ■ Major pests of Orange Jasmine in the greenhouse in Gainesville

1. Two spotted spider mite (*Tetranychus urticae*)
2. Cowpea aphid (*Aphis craccivora*)
3. Whitefly (*Aleuroclava jasmini*)

Control – once infested spray with soap/water 5% (3 X / week)





# Rearing Methods for Asian Citrus Psyllid



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## Orange Jasmine with new sprouts.

Prune terminal growth, fertilize and put in greenhouse (2wks) to promote new growth.



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## Rearing cages for psyllid oviposition.

**(80°F + 40-70%RH, 18 hr photoperiod)**

- **25-30 plants are put into cage & infested with adult psyllids.**  
(infest w/3-5k psyllid for 3-4d. 50-70 eggs per sprout)
- **Transferred to holding cage for nymph development -30-40 pots /cage)**





- **Young sprouts of Orange Jasmines with ACP eggs (yellow)**





- **Young nymphs of ACP**





# Life Stages of Asian Citrus Psyllid



Eggs



14 days total developmental time from egg hatch



Female life span 6-8 months and can lay 800 eggs/2 months.





# Biology of *Tamarixia radiata*



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When psyllid nymphs reach 3-4<sup>th</sup> instar, colonized plants are transferred into parasite rearing cage + inoculated with 60-80 males/females of *Tamarixia*.

Females prefer to lay eggs on 4-5<sup>th</sup> instars, but will attack younger nymphs.





**Egg is Light  
yellow and  
elongate oval**

**Egg of *T. radidata* deposited  
between thorax & abdomen**



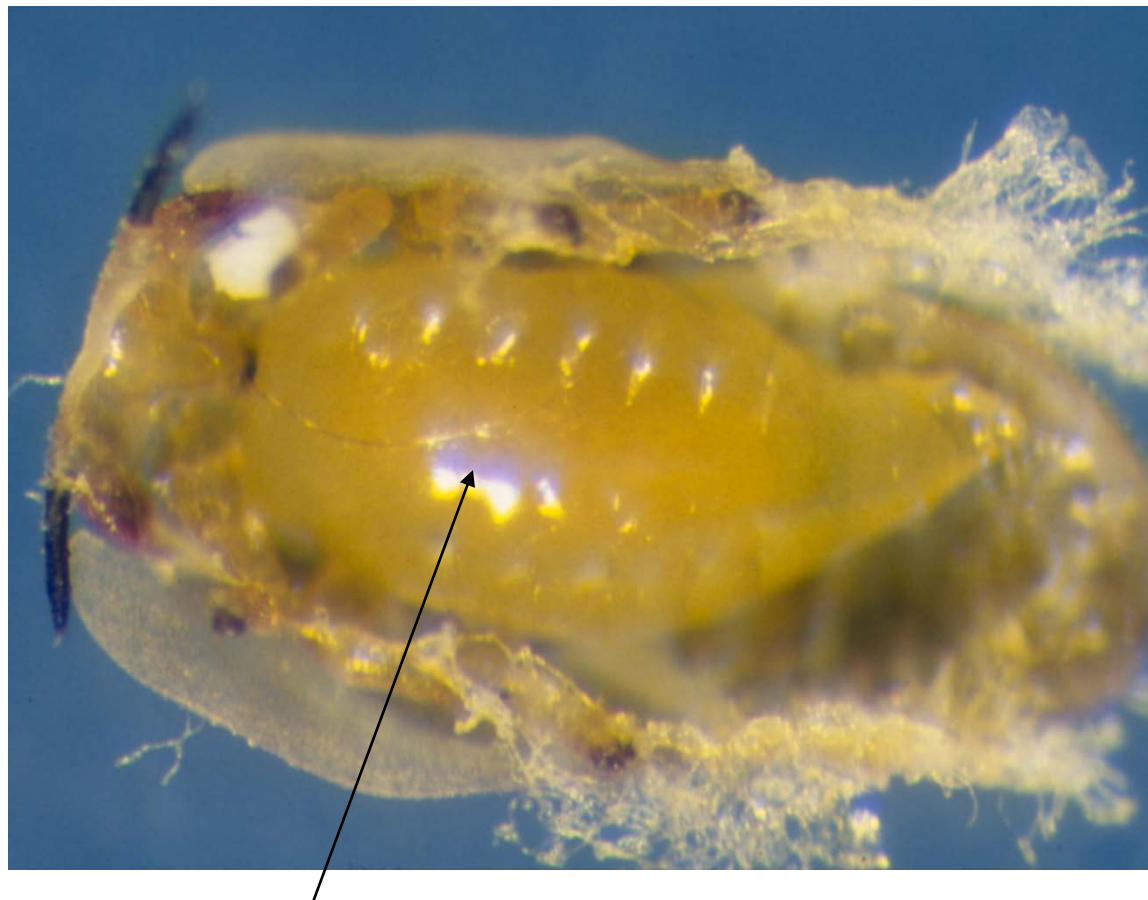
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**Young larva of *Tamarixia radiata* on ACP nymph**

- Use mouthpart to attach to psyllids integument and feed on the fluid of psyllid.

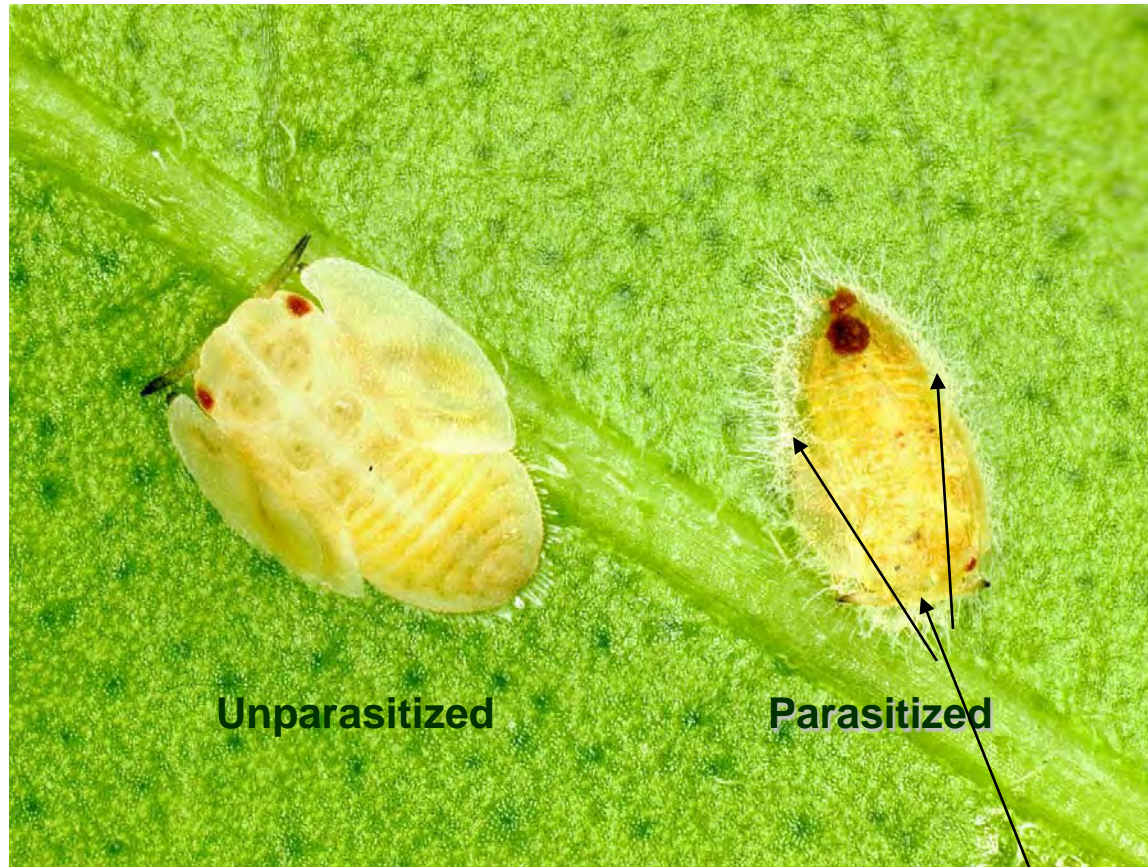




**Mature larva of *T. radiata***

**When they become mature (larvae) , excrete white filament**





## Psyllid nymphs: (5<sup>th</sup> instar)

Filament fuses the psyllid host to plant. Can't move or fall off.

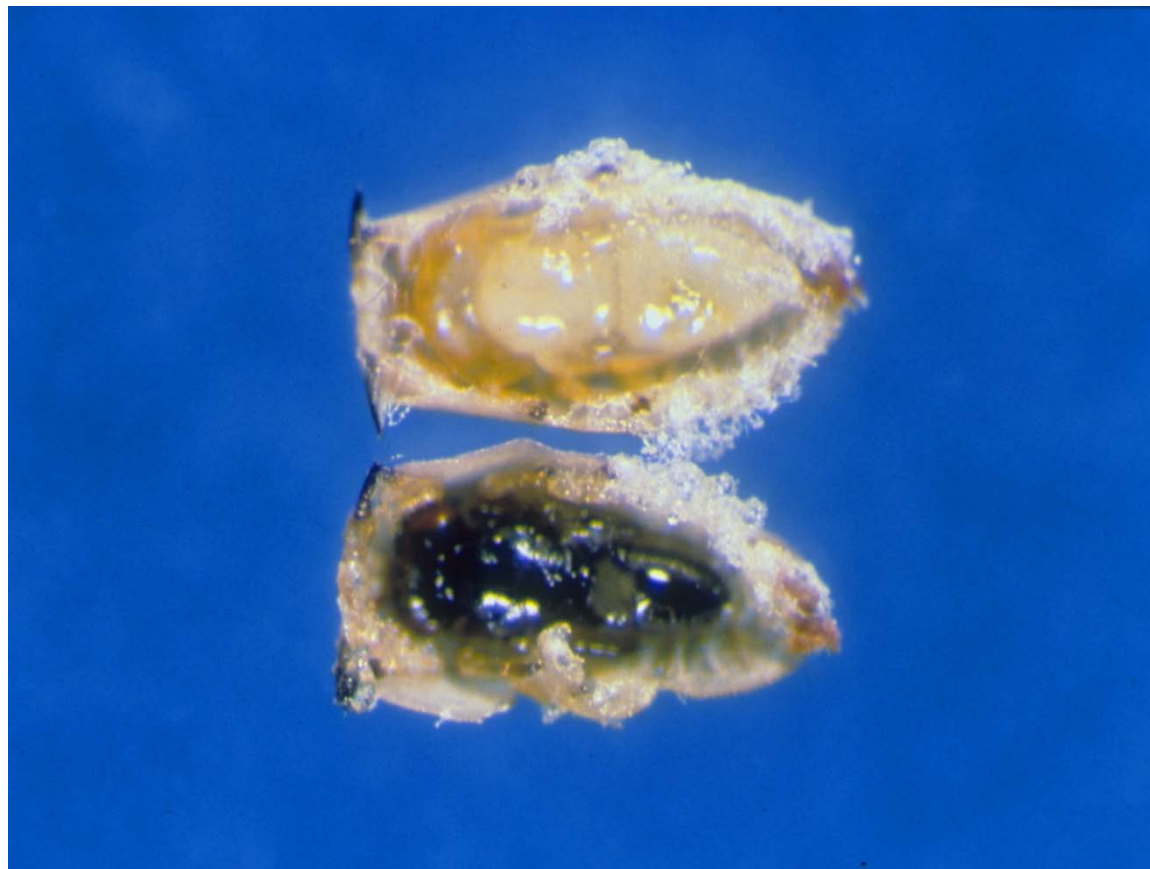




## Mummified nymphs of ACP



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**Pre-pupa (top) and pupa (bottom) of *T. radiata***





**Exit hole of *T.radiata* (closer to head)**





*T. Radiata* adult (female)



# *Tamarixia radiata*



- Egg to adult – (80 F) 10-11 days
- A female may lay 160-300 eggs during her life span of 14-24 days.
- A female may kill more than 500 psyllid nymphs by combination of host feeding (60%) and parasitism (40%).
- Sex ratio varied (4 male: 6 female)
- In rearing conditions, female emerges first
- Life span of parasites fed with honey 25-30 days, unfed lasts 1-2 days.



# Parasitoid Collection



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- ***T. radita* collected by vacuum pump**

Have to collect insects singularly with vacuum pump and aspirator. Suitable for small operation, but not mass production.



## *T. radiata* collection box (experiment)



Painted black inside



One day before emergence:

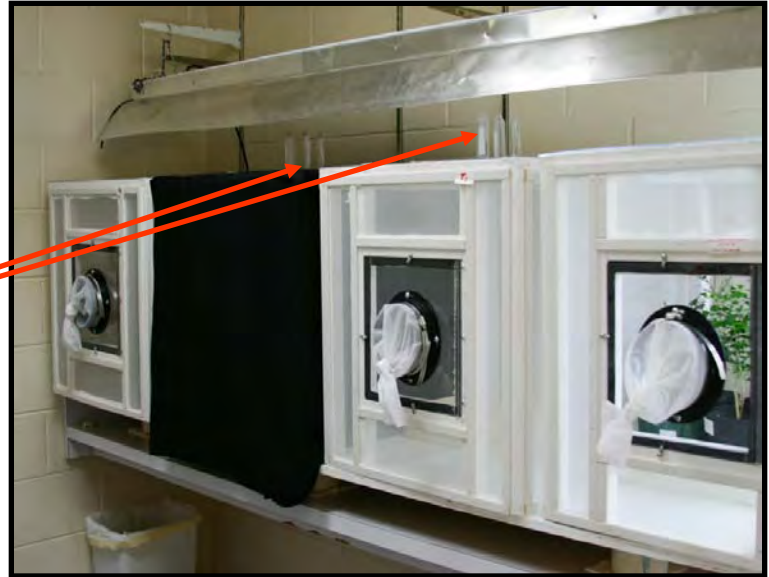
A stem of Orange Jasmine / parasitized psyllid and put in box.  
When parasitoid emerge are attracted to light.

Only collect ~50% of parasitoids.





- Rearing cage covered with black cloth to collect *T. radita*



Collection vials

- 2d post emergence, cover with black cloth, place vials on tops. 90% of parasites collected.
- 20 plants (+80 parasite) can yield 2,000 – 2,300 parasites.





- **Hyper parasitism of *T. radiata***
- **Host range study of *T. radiata***





# Hyperparasitoids of *Tamarixia radiata* reported in Taiwan

- Aphelinidae: *Eacarsia* near *shafeei*  
*Marietta leoparchina*
- Eulophidae: *Tetrastichus* sp.
- Encyrtidae: *Syrphophagus taiwanus*
- Signiphoridae: *Chatocerus walkeri*
- Pteromaridae: *Pachyneron concolor*

Important - These have been reported in Taiwan, but we have not seen any of these in the state of FL.





**Host range of *Tamarixia radiata***  
*Tamarixia radiata* is a host specific parasitoid.

It has only one reported host: *Diaphorina citri*.

However, these following psyllids were listed as hosts in the literature:

-*Psylla hyaline* - **India Walnut Psyllid**

(listed by Peter et al. 1990- checked voucher specimen by LaSalle. 1999)

-*Trioza erytreae* - **African psyllid**

(listed by Annecke & Cilliers 1963 - voucher specimen checked by Daniel and Moran 1972)

It was determined these weren't *radiata*, but another *Tamarixia sp.*

*Tamarixia* has about 30-40 sp.



A branch of an orange tree with several ripe oranges hanging from it, positioned in the top right corner of the slide.

# *Tamarixia radiata* host range test on indigenous psyllids in Florida 2009

APHIS PPQ requested host range tests before granting permit for release:  
China, Pakistan, Vietnam

5 species of psyllids were collected in FL from field:

- *Ceropsylla sideroxyli*
- *Hyteropsylla cubana*
- *Glycaspis brimblecombei*
- *Trioza magnobia*
- *Pachypsylla* sp.

**\*\*\* In no choice test, no *T. radiata* emerged\*\*\***



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# *Ceropsylla sideroxyli*



Unparasitized psyllid



Parasitized psyllid



This parasite collected in Indian River (Hall/Hibbard)

Exit hole on  
right  
parasitized.



*T. Radiata* (male & female)



*Tamarixia* spp. (male & female)

Parasite of *Ceropsylla sideroxyli*



Verified (by Greg Evans, Mike Gate) as *Tamarixia* sp. of *Ceropsylla Sideroxyli*



# Biocontrol Program for Asian Citrus Psyllid



From lab production to mass-rearing insectory

- 1) Orange Jasmine production in 7,000 sq ft. screen house
- 2) Psyllid rearing in additional greenhouse
- 3) Parasites reared in walk-in environmental chambers



# Acknowledgements



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**THANK YOU**



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