

Baseline data on plant demography and performance of Chinese tallow in Louisiana: Preparing for biological control (BC)



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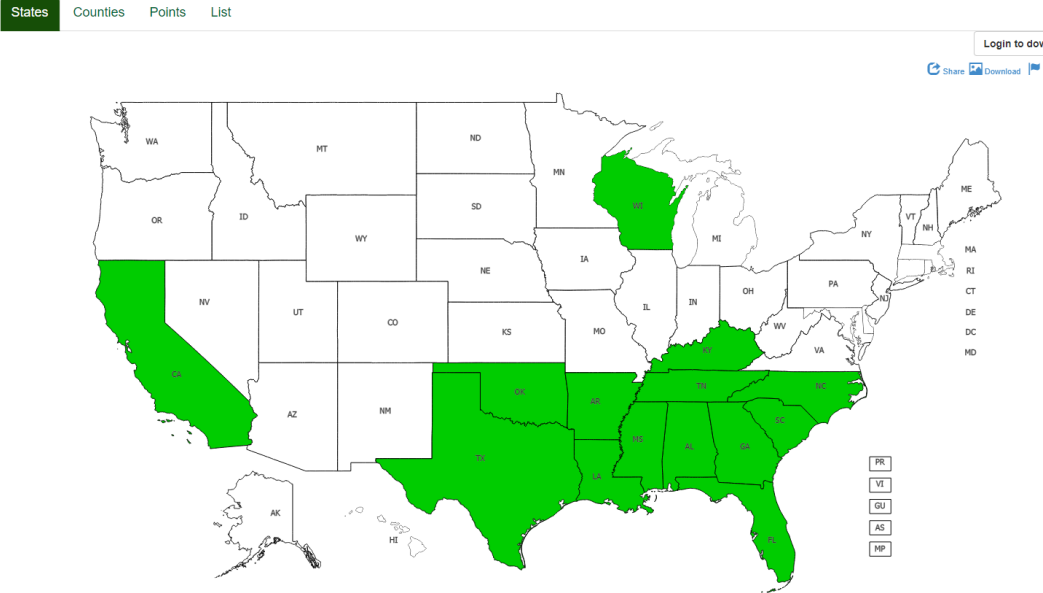
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Background on Chinese tallow

- Chinese tallow, *Triadica sebifera* (L.) Small (Euphorbiaceae)
- Invasive tree native to Asia
- Now present in the SE USA including LA

Chinese tallowtree
Triadica sebifera (L.) Small



Leaves and fruits

Pattison & Mack (2008)

Negative impacts of Chinese tallow

- Displaces native species
- Results in ecosystem modification and biodiversity loss
- Economic impact \$300 million losses over a 20-year period



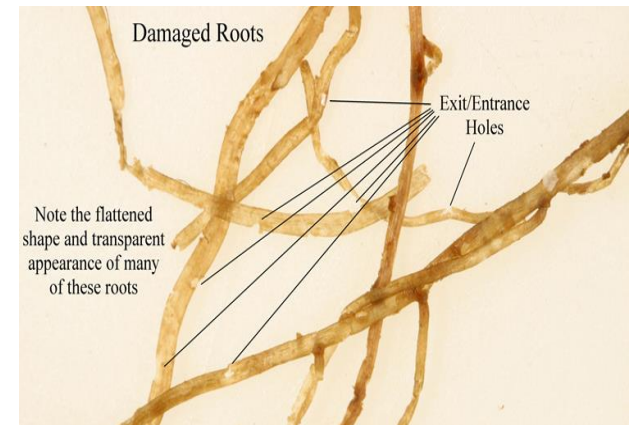
<http://rangeplants.tamu.edu/plant/chinese-tallow-tree>

BC of Chinese tallow

- USDA-ARS FL identified *Bikasha collaris* (Baly) (Coleoptera: Chrysomelidae)
- Host range testing showed the beetle is a specialist
- The petition has been submitted to APHIS-PPQ



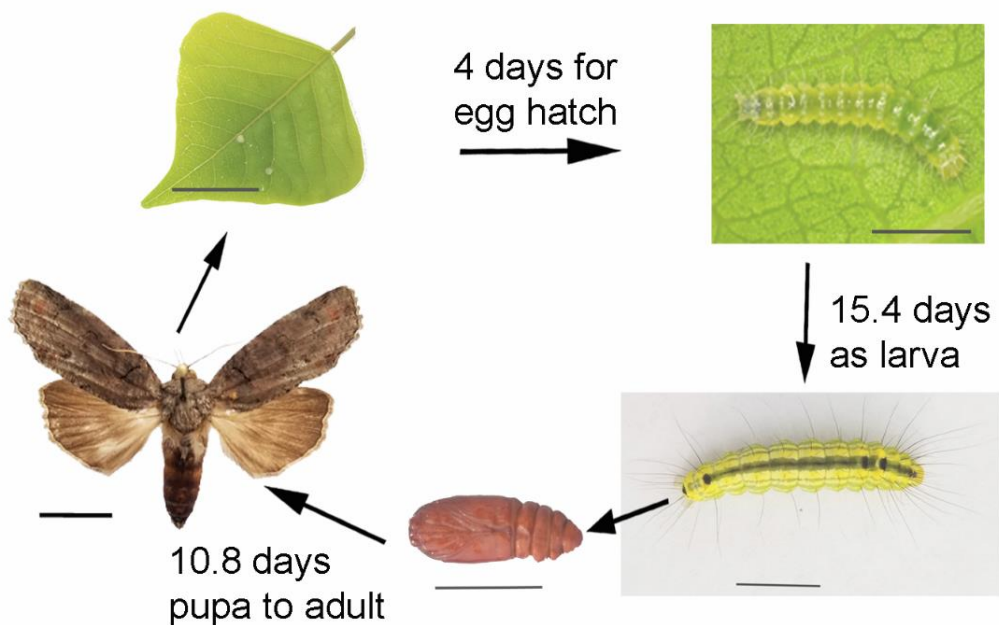
Adults feed on leaves



Larvae feed on roots

BC of Chinese tallow

- USDA-ARS FL identified *Gadirtha fusca* (Lepidoptera: Nolidae)
- Host range testing showed the moth is a specialist
- The petition has been submitted to APHIS-PPQ



Figures provided by G. Wheeler



Pre-release studies

- Baseline studies on tallow performance in LA are needed prior BC
- Before and after comparisons are used to evaluate the efficacy of BC agents

Evans & Landis 2007, Coupe & Cahill 2003, Morin et al. 2009



Charles Omoyele (MS student)
Graduated Fall 2018



Dora Sevor (MS student)
Graduated Fall 2019

Objectives

1. Establish long-term plots of Chinese tallow in Louisiana
2. Measure performance of Chinese tallow prior BC
 - **Study 1:** Quantify plant demographics in south and central LA
 - **Study 2:** Determine plant growth and impact of local herbivores
3. Assess the impact of herbivory on Chinese tallow growth in LA
 - **Study 3:** Determine the effect of herbivory and soil fertility on tallow growth

Study 1: Demography started Oct 2018

Pineville, central LA

- Private property
- Cattle and horse ranch
- Lower soil nutrients



Chinese tallow plot in Pineville

Marrero, south LA

- Parc des Familles
- Recreation, disc golf course
- 3-4 fold higher soil nutrients



Chinese tallow plot in Marrero

Study 1: Plant measurements every 3 months

- Two-year study: Oct 2018 – Oct 2020
- Plots size: 20 x 20 m
- Plant measurements:
 - Trees were marked and classified in age-classes
 - Seedlings <1 cm BSD, saplings 1-5 cm DBH, mature trees > 5cm DBH
- Seed counts (seed rain, 500 g soil samples)



Plot marked in Pineville



Plant measurements

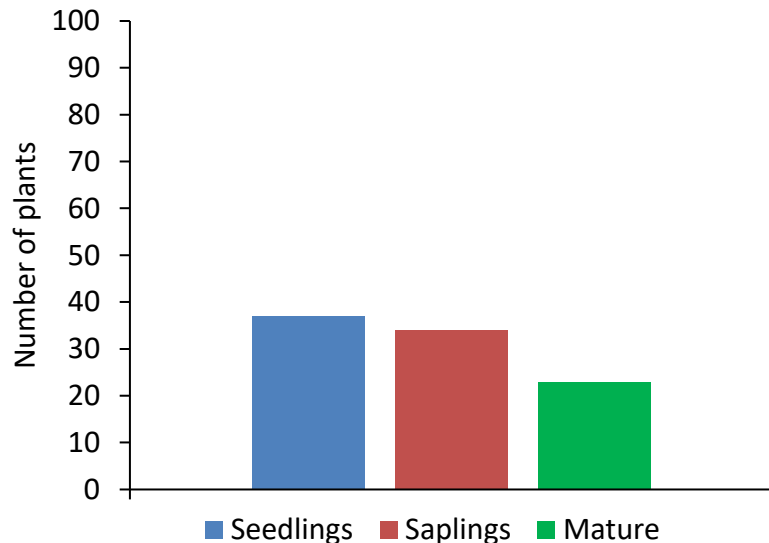


Seed rain trap

Study 1: Age composition in Oct 2018

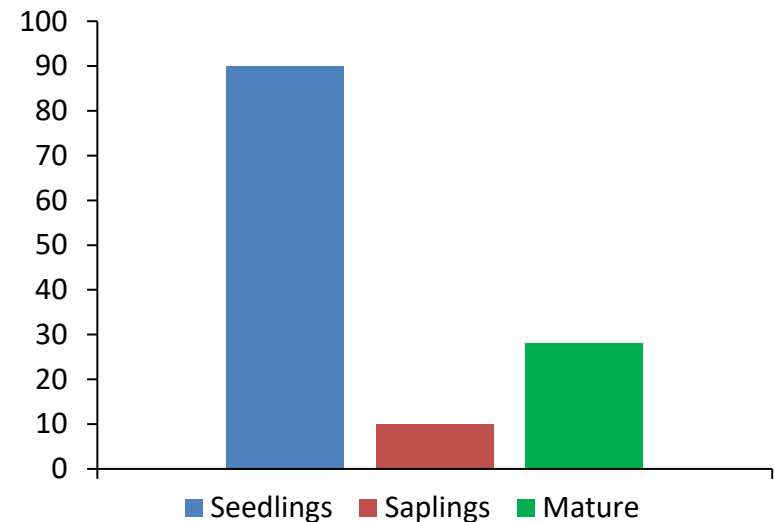
Pineville

- 94 trees tagged
- Population composed of
 - Seedlings (40%)
 - Saplings (36%)
 - Mature trees (24%)



Marrero

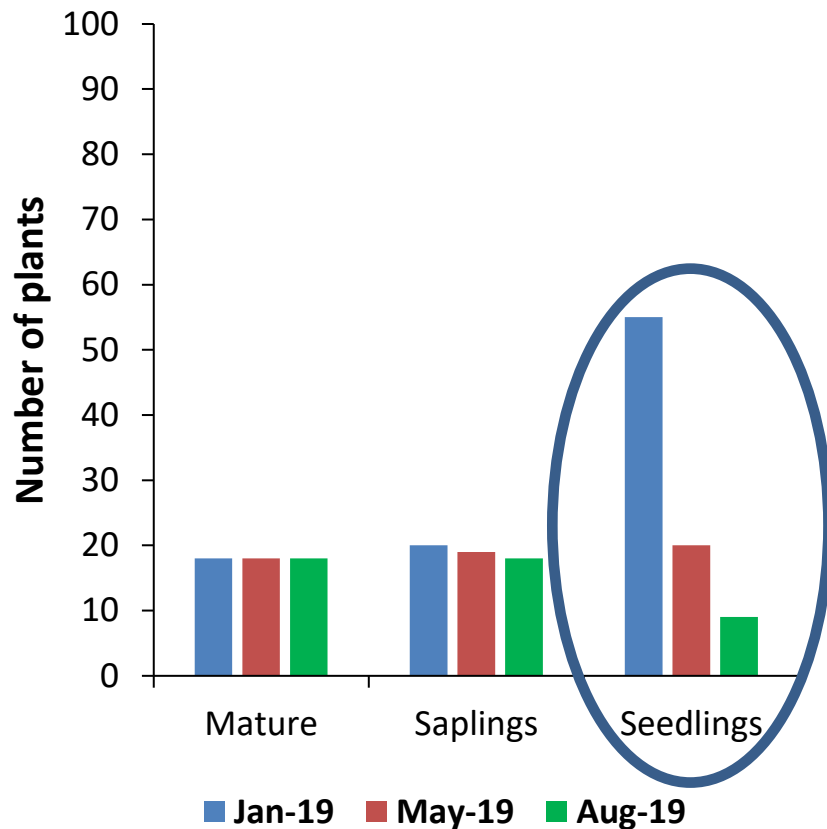
- 128 trees tagged
- Population composed of:
 - seedlings (70%)
 - Saplings (8%)
 - Mature trees (22%)



Study 1: Results in 2019

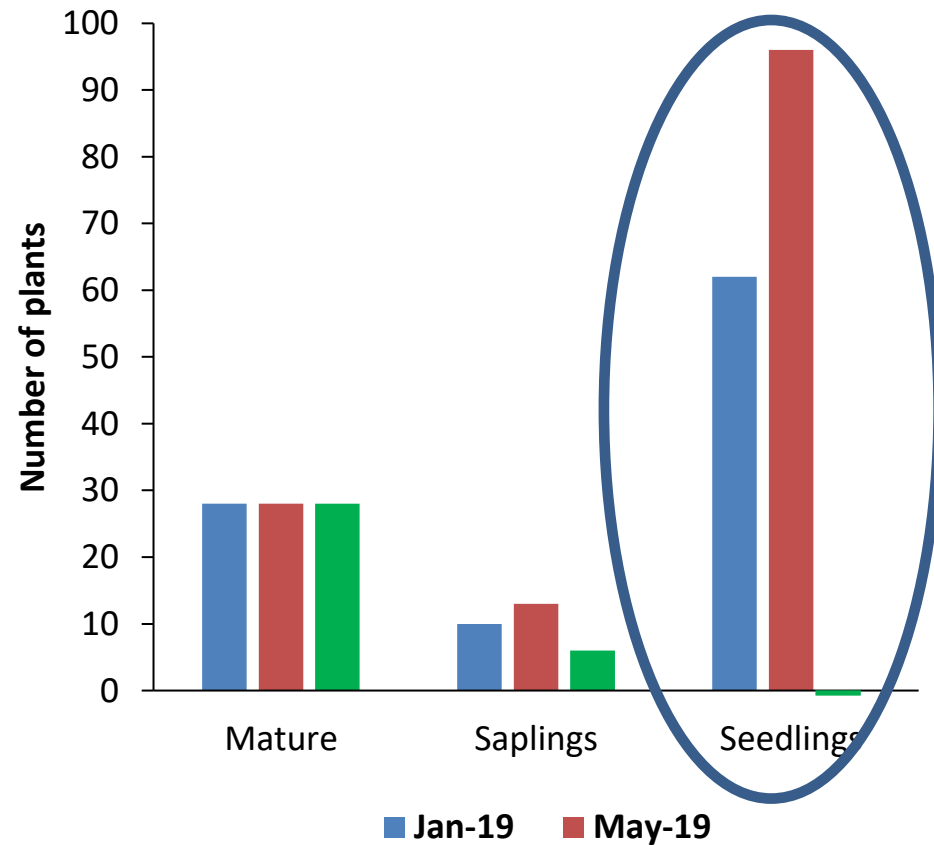
Pineville

- High seedling mortality
- 84% died from Jan to Aug



Marrero

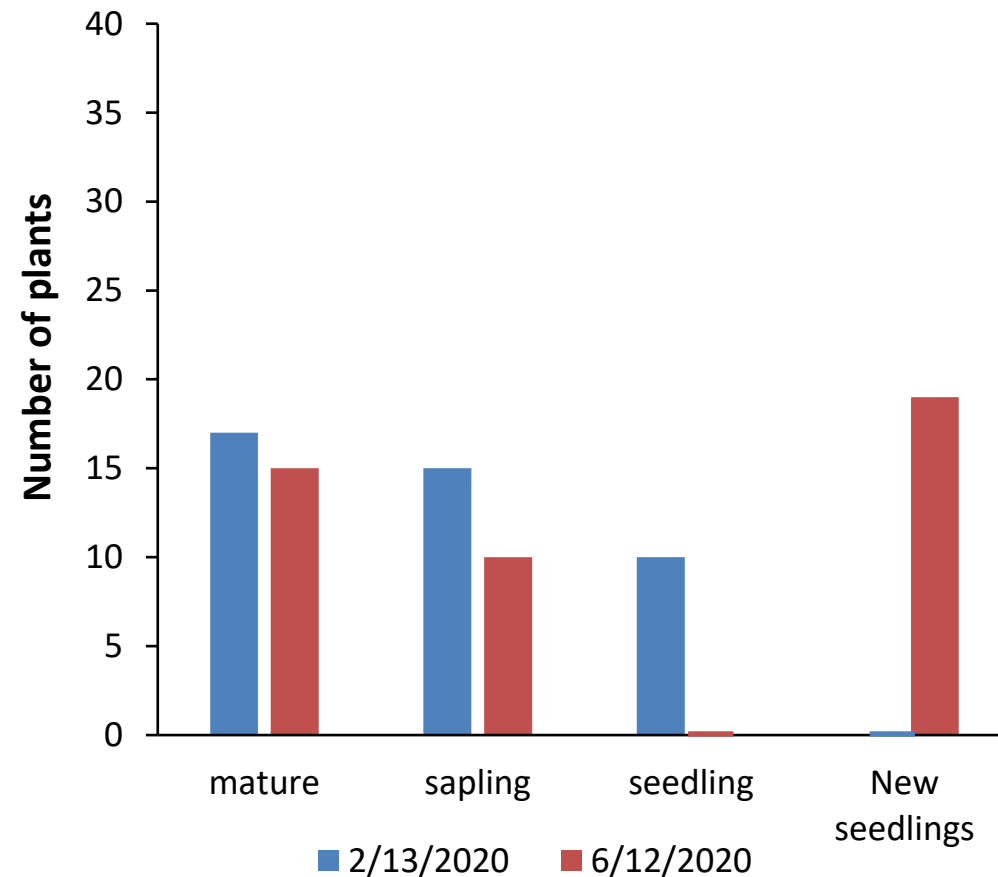
- Seedlings increased Jan to May
- Flooding killed seedlings in Aug



Study 1: Results in 2020

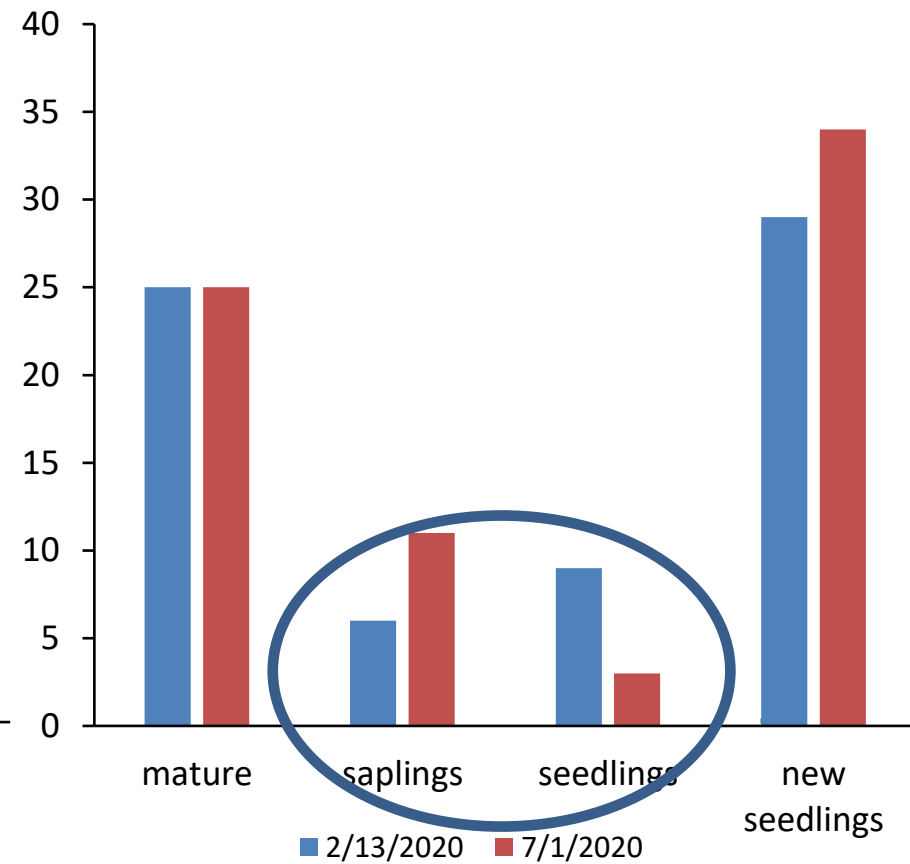
Pineville

- All marked seedlings died in June
- 33% mortality of saplings in June



Marrero

- New seedlings added in Feb -June
- New saplings added to population



Study 1: Higher seeds in Marrero

Soil samples

Month	Marrero	Pineville
Oct 2018	29.0	3.3
Jan 2019	50.5	13
May 2019	49	22.8
Aug 2019	-	21
Feb 2020	47.6	25.3



Seed trap: Mesh was missing, wasps and bird nests, etc.

	Calcium (ppm)	Copper (ppm)	Magnesium (ppm)	pH (1:1 Water)	Phosphorus (ppm)	Potassium (ppm)	Sodium (ppm)	% Organic matter
Pineville	1,347	0.85	140.7	5.36	107.68	71.94	29.66	3.37
Marrero	4,159	2.44	1,114	4.36	20.16	581.24	40.04	8.79

Study 1: What are the implications?

- Chinese tallow has the ability to invade poor and good sites (Gan et al. 2009)
- Higher seeds and seedlings recruitment in Marrero with higher soil nutrients (Siemann & Rogers 2007)
- Chinese tallow seedling recruitment and mortality is highly affected by site conditions (similar results in Florida, G. Wheeler unpublished data)

But, high seedling production provides opportunities for invasion



Closed tallow forests will affect establishment of new plants



Study 2: Impact of local insects on Chinese tallow

- **Field site:** LSU Burden Botanical Gardens, Baton Rouge, LA
 - 80 Chinese tallow (1-year old) planted in June 2018
 - Two-year study (2018 – 2019)

- **Treatment:**

- Insecticide applications (Acephate Bonide®)
- Water (control)



- **Plant measurements:**

- Number of leaves, branches
- Basal stem diameter, plant height
- Insect damage (%)

- **Initial and final biomass (dry weight)**



Study 2: Leaf miner was major insect on tallow

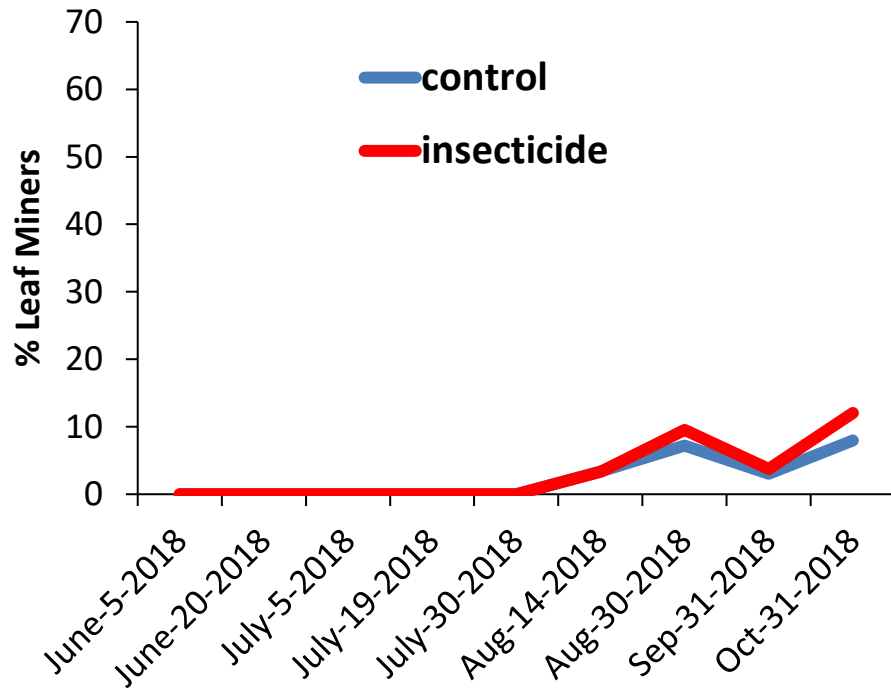
- *Caloptilia triadicae* (Lepidoptera: Gracillariidae)
- Leaf miner reported throughout Chinese tallow invaded areas in the USA
- Native to China



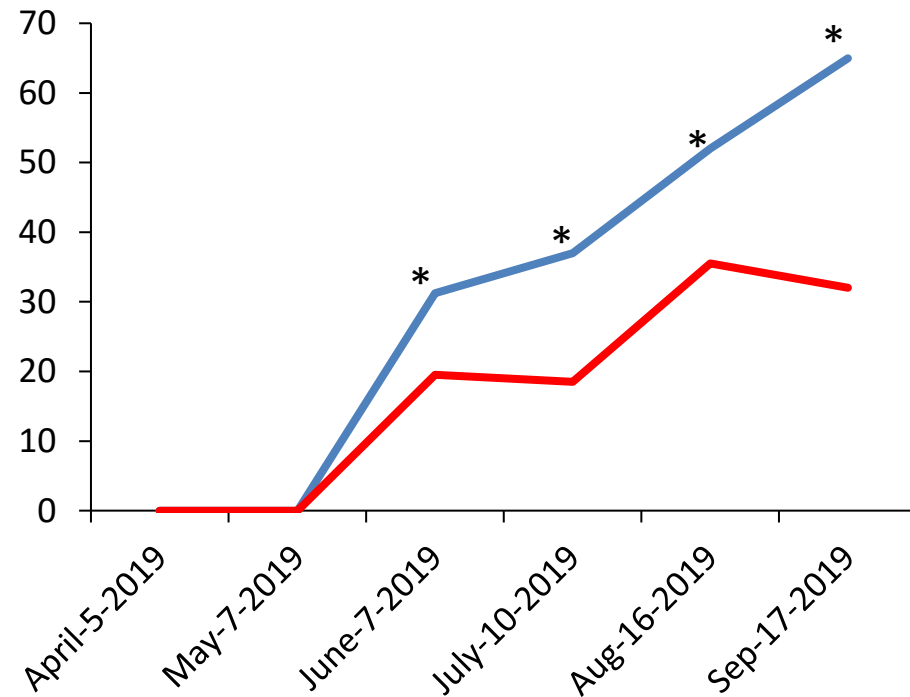
Leaf miners and damage observed on tallow leaves

Study 2: Exclusion treatment was successful in 2019

2018



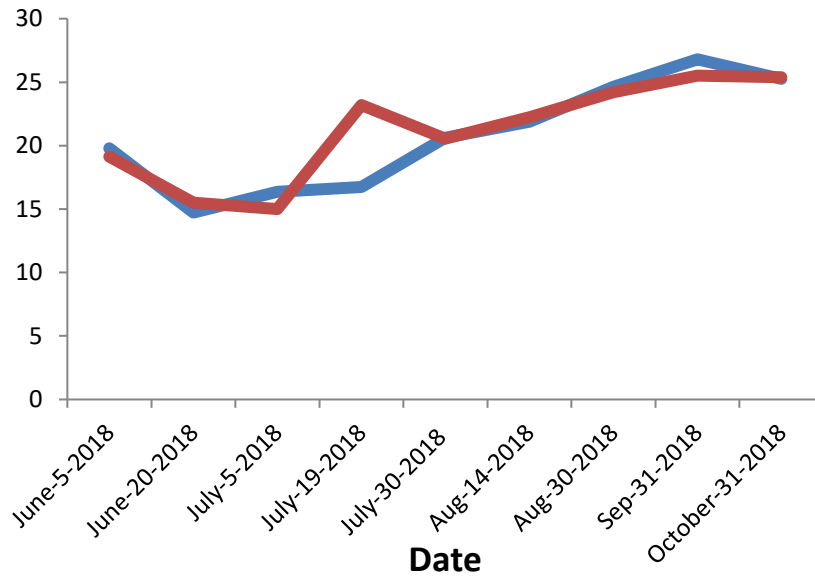
2019



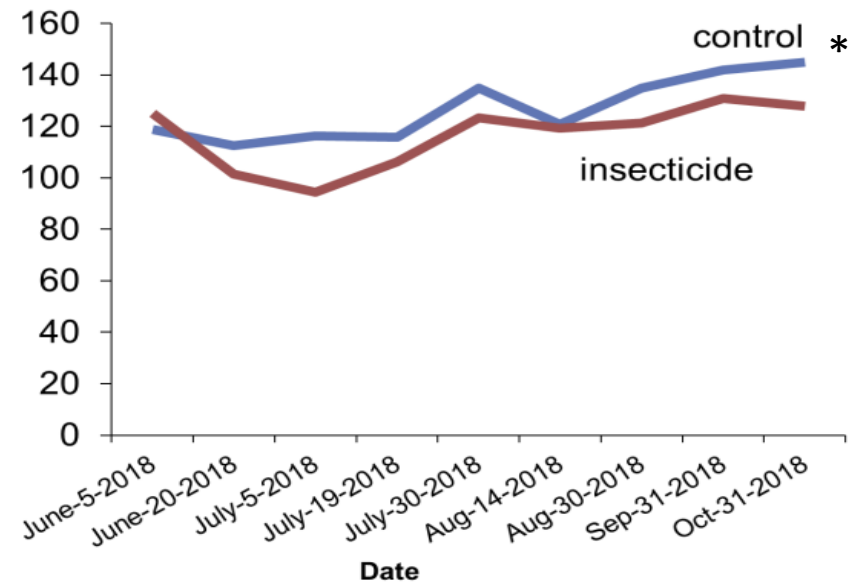
Are these levels of leaf miners detrimental to Chinese tallow?

Study 2: Mostly no differences (2018)

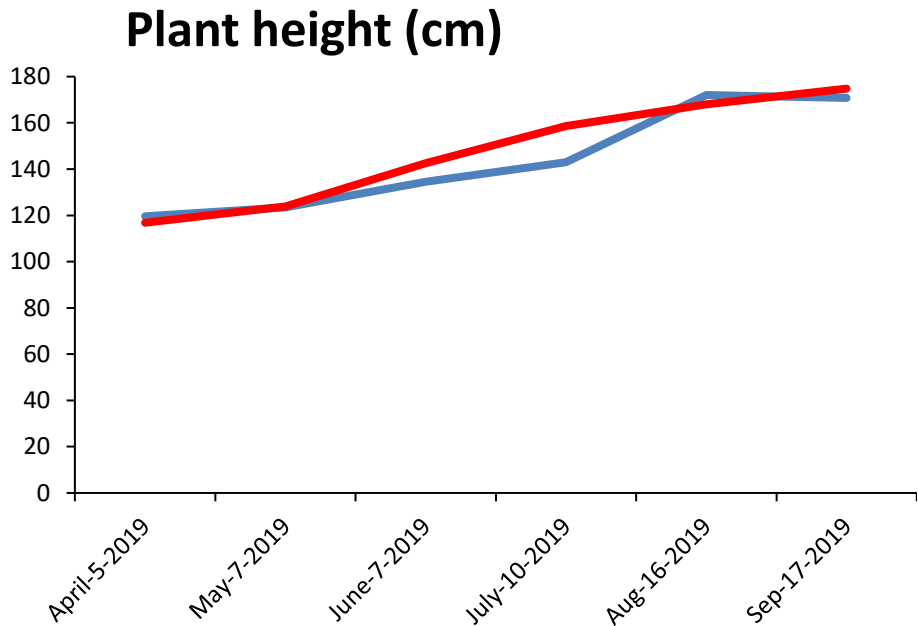
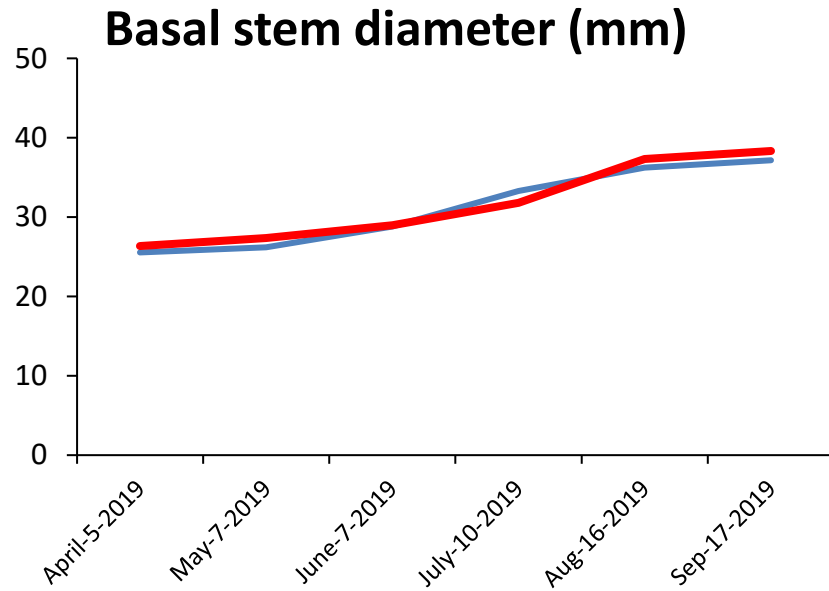
Basal stem diameter (mm)



Plant height (cm)



Study 2: No differences between treatments (2019)

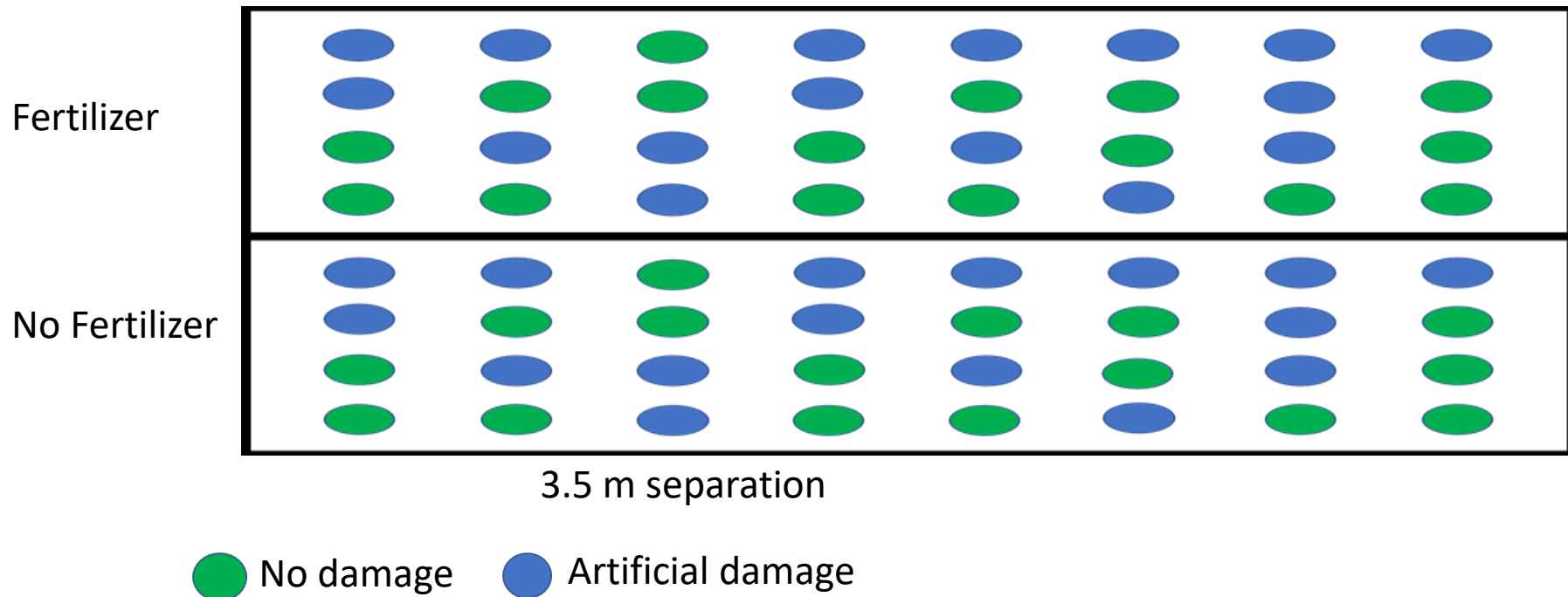


Study 2: What are the implications?

- We found low herbivory pressure in Baton Rouge, LA
- Few herbivores found on Chinese tallow in USA (Duncan et al 2006)
- Damage by leaf miner was not sufficient to reduce tree growth
- The introduction of specialist BC agents may help manage this invasive tree in LA

Study 3: Herbivory and soil fertility on tallow growth

- **Field site:** Southern University, Baton Rouge, Louisiana
 - 64 Chinese tallow (1-year old) planted in June 2018
 - Two-year study (2018 – 2019)
- **Treatments:**
 - Fertilizer (Osmocote NPK 15-9-12)
 - Artificial herbivory



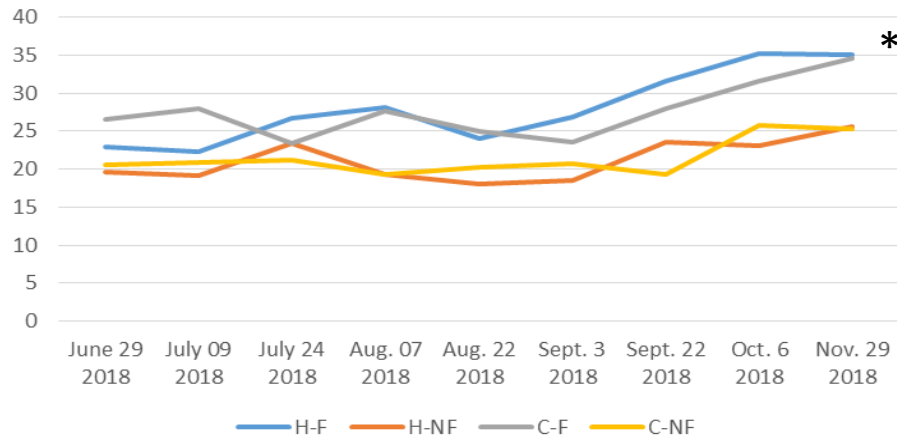
Study 3: Artificial herbivory to simulate *B. collaris*

- 20% leaf removal using clippers (based on Huang et al. 2011)
- Root damage using the root assassin shovel (10% estimation)
- 3 artificial damage events were conducted each year (July - September)



Study 3: Plant growth in 2018

Number of Branches



- Higher plant growth under high fertility independently of herbivory

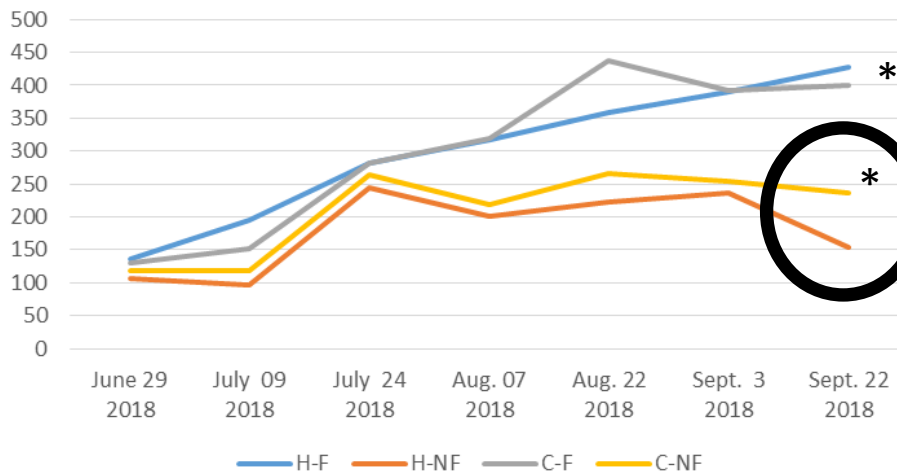
H-F = Herbivory, fertility

H-NF = Herbivory, no fertilizer

C-F = Control, fertilizer

C-NF = Control, no fertilizer

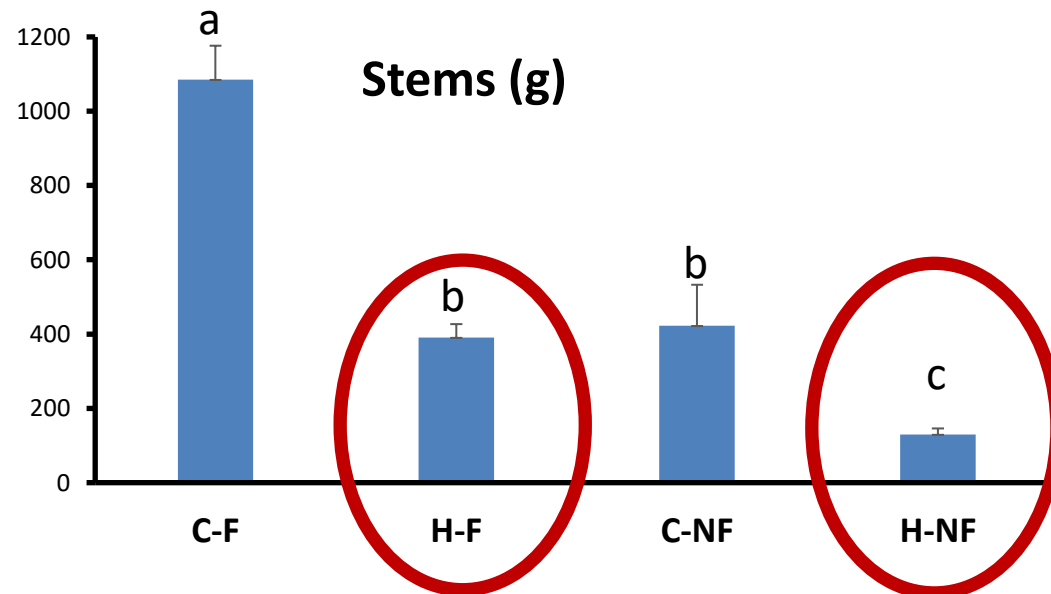
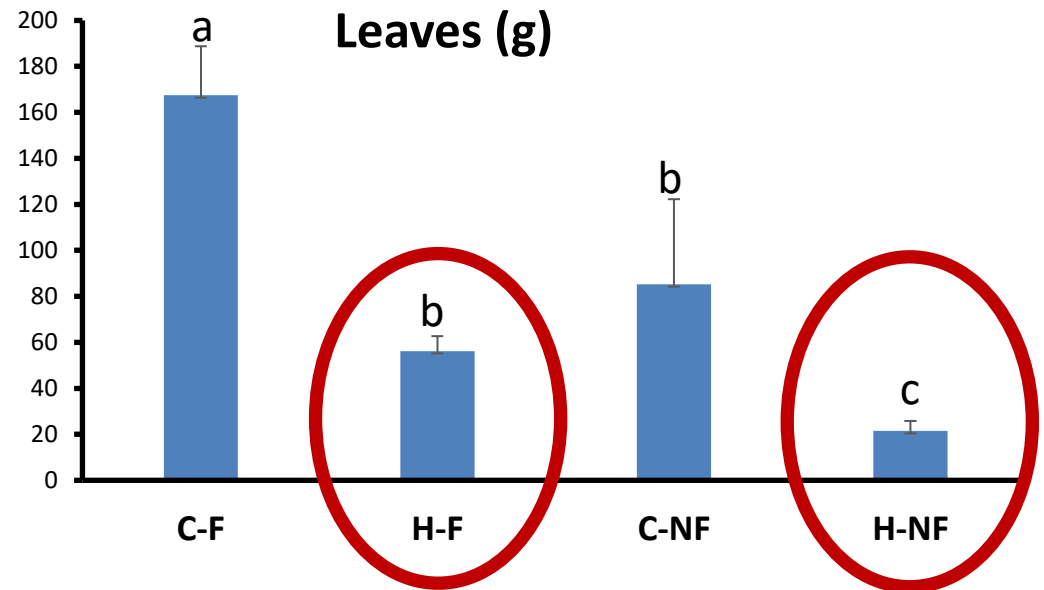
Number of leaves



- Less number of leaves for plants under low fertility and herbivory

Study 3: Final biomass 2019

- Multiple herbivory events over two-year period significantly reduced plant growth



H-F = Herbivory, fertilizer
H-NF = Herbivory, no fertilizer
C-F = Control, fertilizer
C-NF = Control, no fertilizer

Study 3: Herbivory reduced tallow growth



Fertilizer – No herbivory



Fertilizer – Herbivory



No fertilizer – No herbivory



No fertilizer – Herbivory

Study 3: What are the implications?

- Chinese tallow plants growing under high soil nutrients may compensate for herbivory by BC agents during the first year following releases
- More releases of BC agents or other management may be needed in those sites
- However, multiple herbivory events over several years will significantly reduce growth of Chinese tallow at sites under low or high soil nutrients

Final conclusions

- Field sites with tallow infestations have been identified in central and south LA, the demographics characterized, and will serve as future release sites
- The leaf miner *Caloptilia triadicae* is the main herbivore attacking tallow plants in Baton Rouge, LA
- Exclusion studies determined that damage by local herbivores are not sufficient to reduce growth of tallow tree

Final conclusions

- If release permits are obtained, BC agents may help manage this invasive tree
- Multiple herbivory events over several years may reduce tallow growth and reproduction at sites under low or high soil nutrients
- Post-release studies are critical to determine establishment of BC agents, quantify damage and assess efficacy of BC program in LA

Thanks you!

- Collaborative project between SU and LSU (LA), USDA-ARS (FL)
- Graduate students involved in these projects: Charles and Dora!
- Funding agencies:
 - Barataria-Terrebonne National Estuary Program
 - Louisiana USDA Forest Service

