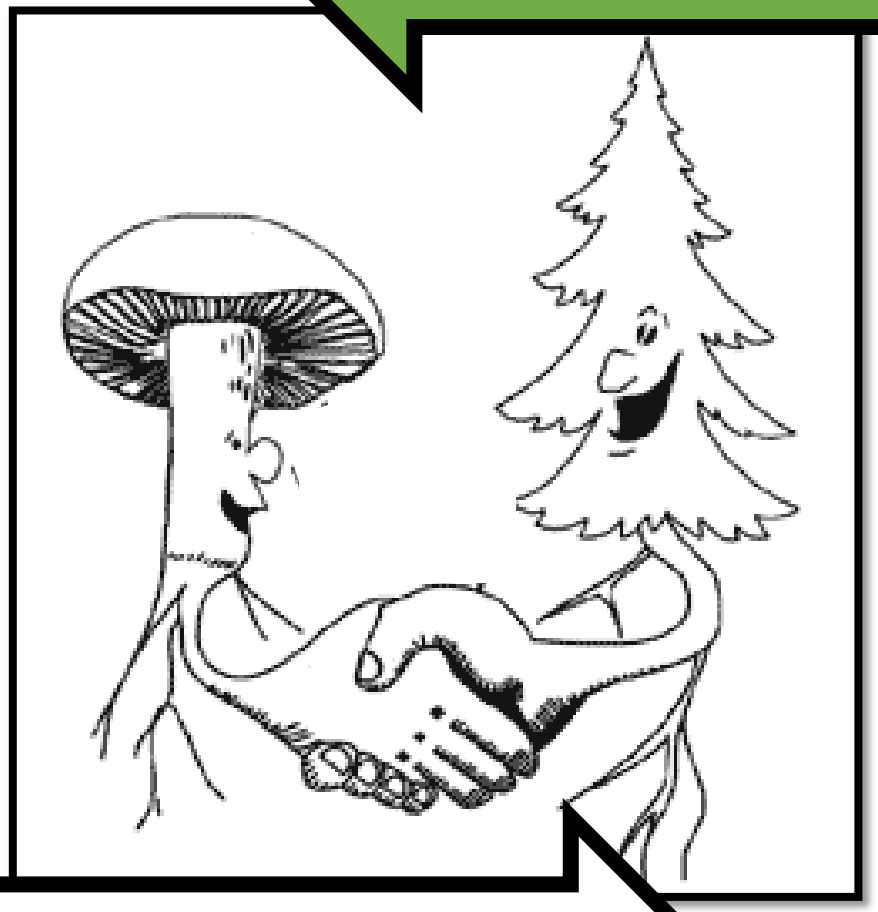
Mycorrhizal fungi mitigate negative effects of invasive species legacy on a foundation tree species.

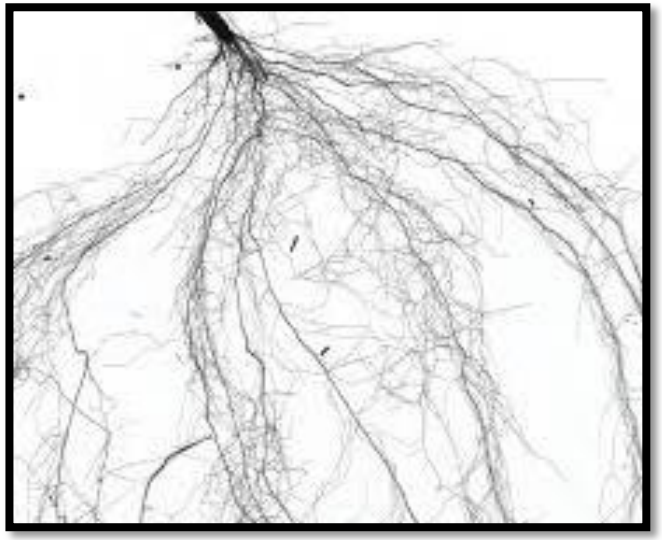
myco = fungus

rrhiza = root

mycorrhiza = fungus root

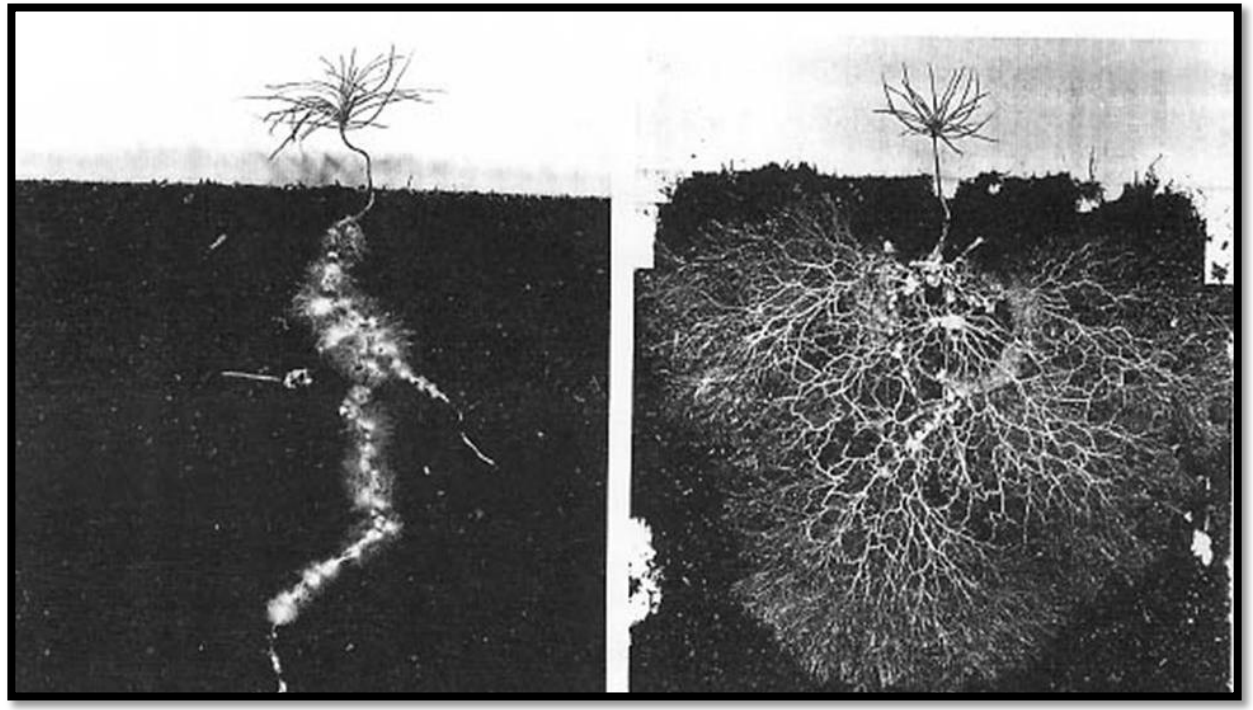
Sugars



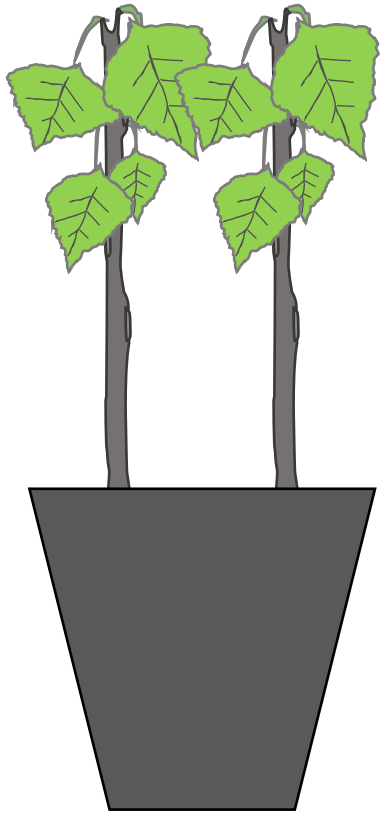


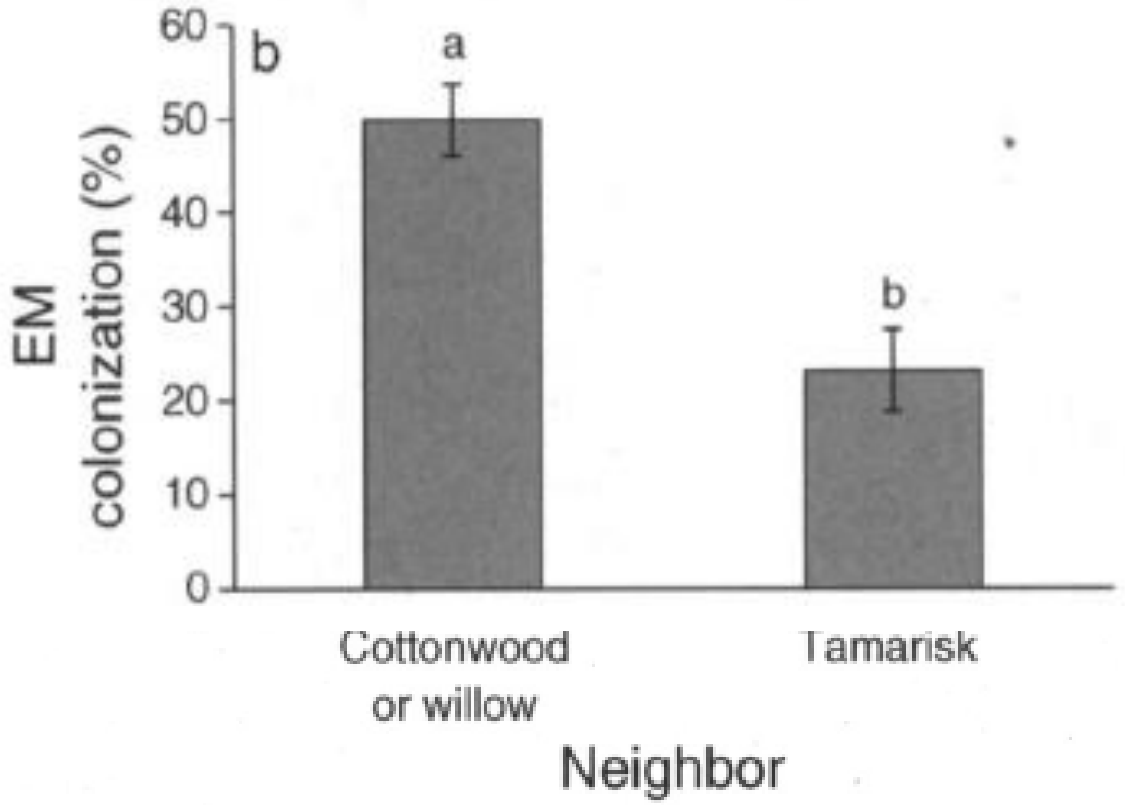
Water & soil nutrients

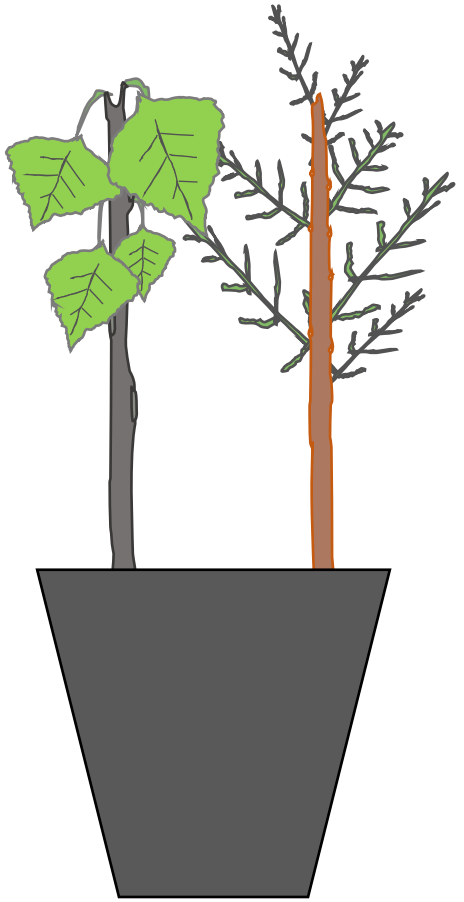
Mycorrhiza = Fungus Root



Tamarisk reduce the abundance and diversity of mycorrhizas







From Meinhardt & Gehring 2012

Tamarisk alters soil properties

Legacy can last for years

Before arrival of tamarisk leaf beetle

Two weeks after the arrival of tamarisk leaf beetle

How can we improve outcomes when restoring in tamarisk invaded soils?

Greenhouse study to identify potential methods to increase restoration success

EXPERIENCED

NAÏVE

Agricultural legacy soil

Tamarisk legacy soil

How can we improve outcomes when restoring in tamarisk invaded soils?

1. Does the addition of mycorrhizas and other soil microbes from cottonwood stands without tamarisk increase the growth and survival of cottonwoods in tamarisk legacy soil?

27% increase in shoot biomass

60% increase in root biomass

Inoculated plants were 38% larger

TOTAL: **$p=5.68^{-13}$**

SHOOT: **$p=1.08^{-12}$**

ROOT: **$p=2.83^{-6}$**

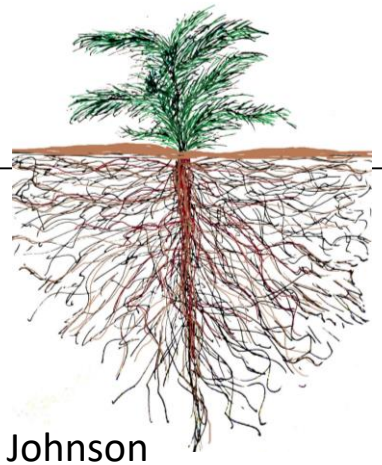


Image yoinked from Emily Johnson

Dry biomass (g)

3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
(0.5)
(1.0)
(1.5)
(2.0)

live sterile

Inoculation type

ROOT:SHOOT: **$p=2.12^{-8}$**

How can we improve outcomes when restoring in tamarisk invaded soils?

1. Does the addition of mycorrhizas and other soil microbes increase the survival and growth of cottonwoods in tamarisk legacy soil?

YES!!!

How can we improve outcomes when restoring in tamarisk invaded soils?

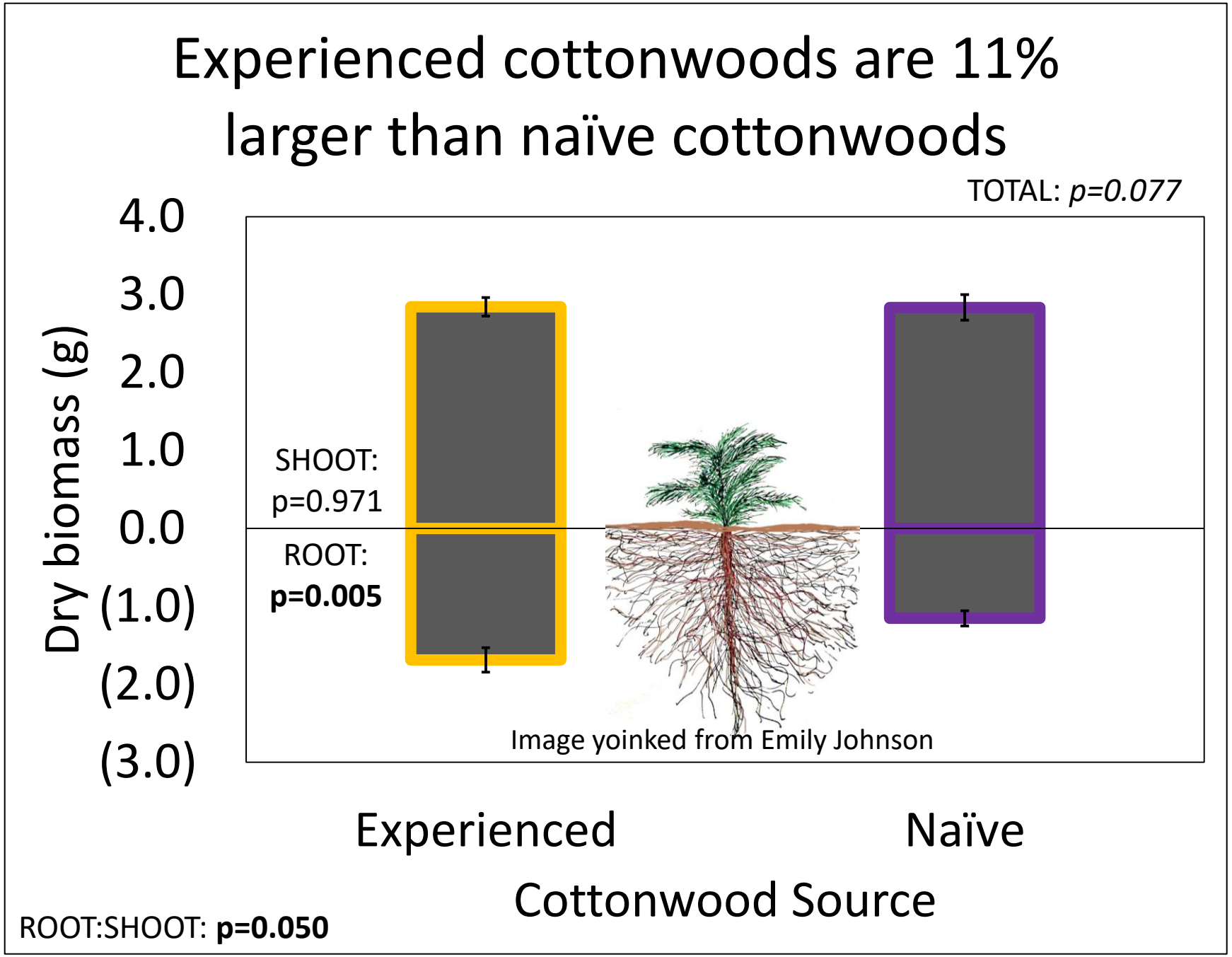
2. Do experienced cottonwoods perform better in tamarisk legacy soil than naïve cottonwoods?

Tamarisk **EXPERIENCED** cottonwood populations

Tamarisk **NAÏVE** cottonwood populations

Experienced cottonwoods have 32% more root biomass

Experienced cottonwoods are 11% larger than naïve cottonwoods



How can we improve outcomes when restoring in tamarisk invaded soils?

2. Do experienced cottonwoods perform better in tamarisk legacy soil than naïve cottonwoods?

YES!!!

How can we improve outcomes when restoring in tamarisk invaded soils?

3. Do experienced cottonwoods respond differently to mycorrhizas than naïve cottonwoods?

Experienced cottonwoods responded MORE to soil microbes!

How can we improve outcomes when restoring in tamarisk invaded soils?

3. Do experienced cottonwoods respond differently to mycorrhizas than naïve cottonwoods?

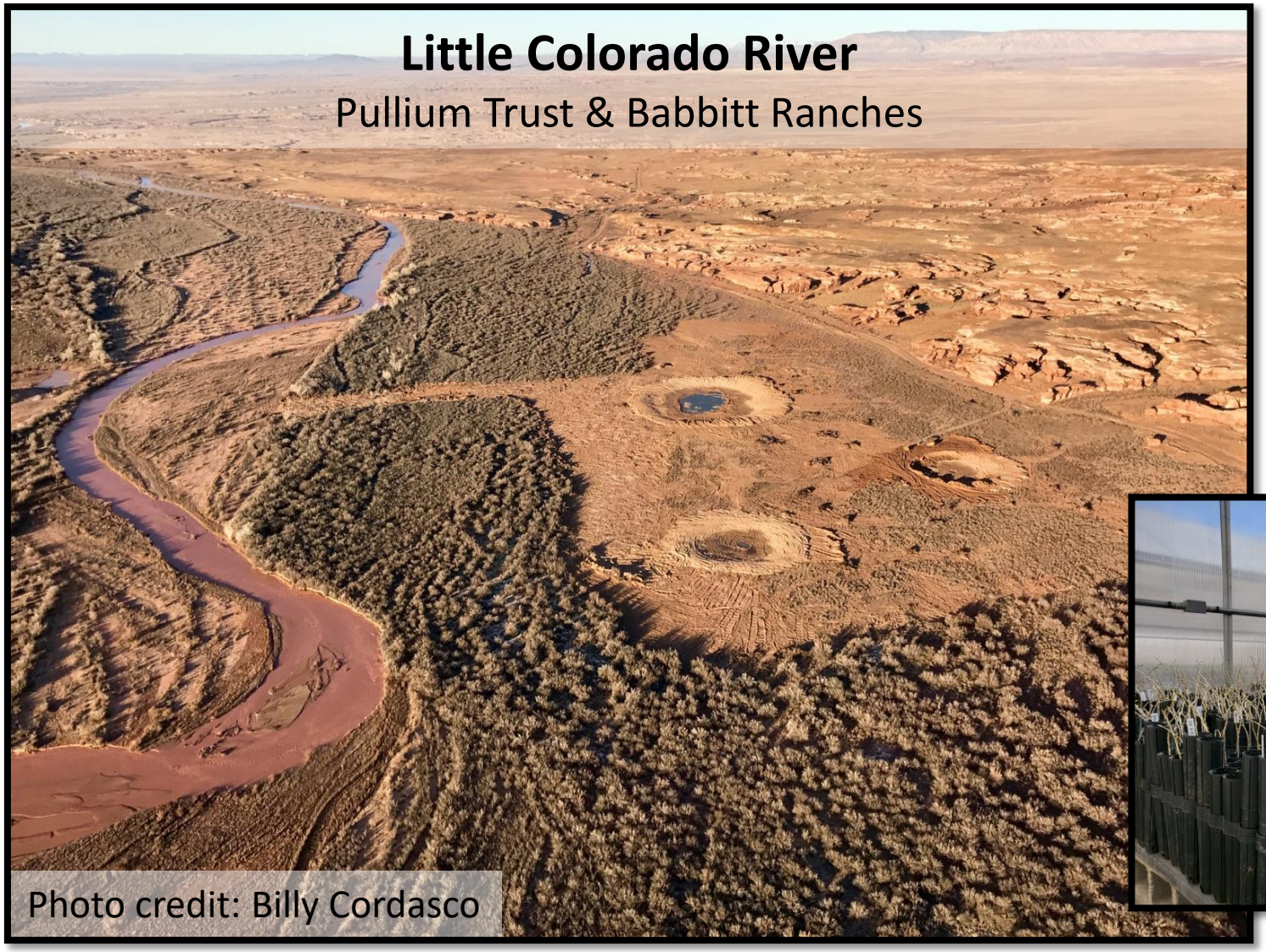
YES!!!

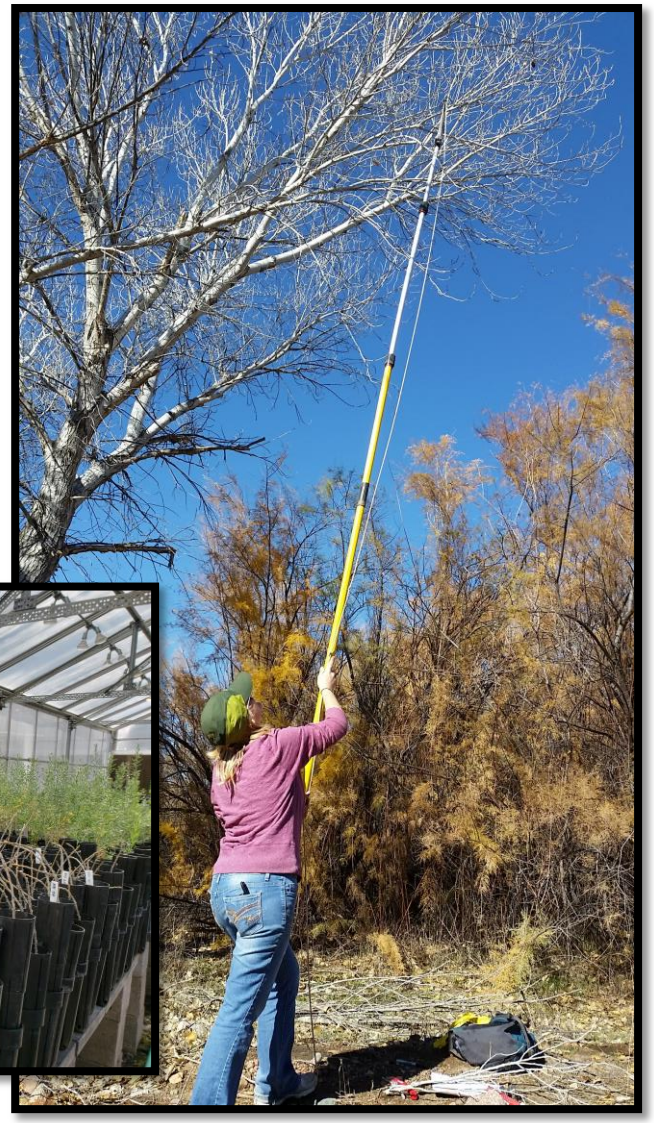
To improve restoration outcomes:

Experienced cottonwoods as restoration stock

Add soil from sites without tamarisk

Field trials of logistics is underway





6000+ cottonwoods & willows

Native soil full of mycorrhizas and other microbes is being bulked up to inoculate trees at the time of planting.

Flagstaff High School students monitoring water quality