Thousand Cankers Disease: Overview and Origins

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Thousand Cankers Disease (TCD)

– An Insect/Fungal Disease Complex affecting some *Juglans* spp.

A beetle – **walnut twig beetle**

A fungus – ***Geosmithia morbida***

Jim LaBonte

Walnut Twig Beetle

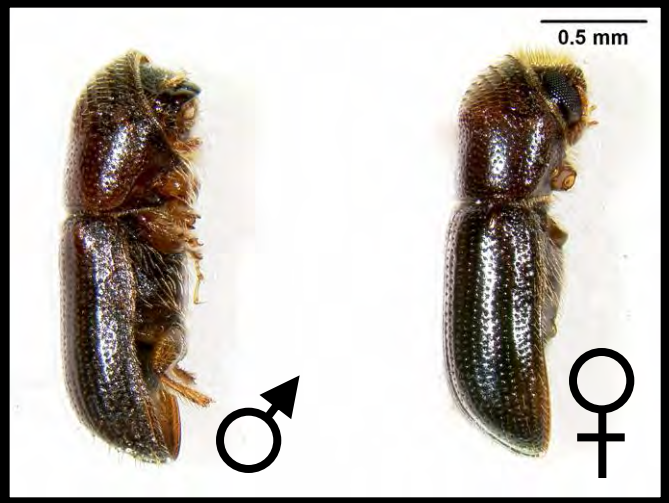
Pityophthorous juglandis

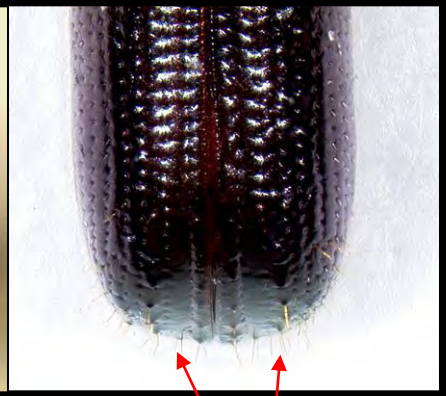
Jim LaBonte


IN GOD WE TRUST
BERTY

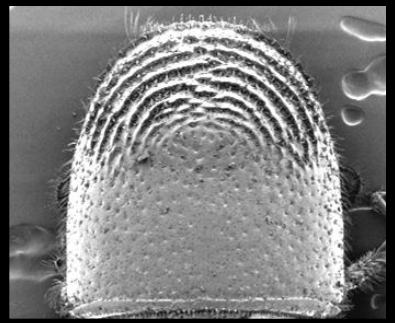
Identification of Walnut Twig Beetle, *Pityophthorus juglandis* Blackman (Coleoptera: Scolytidae) An "Über" Vector of TCD

Slide courtesy
Steve Seybold





Two rows of tubercles



Concentric arcs of asperities

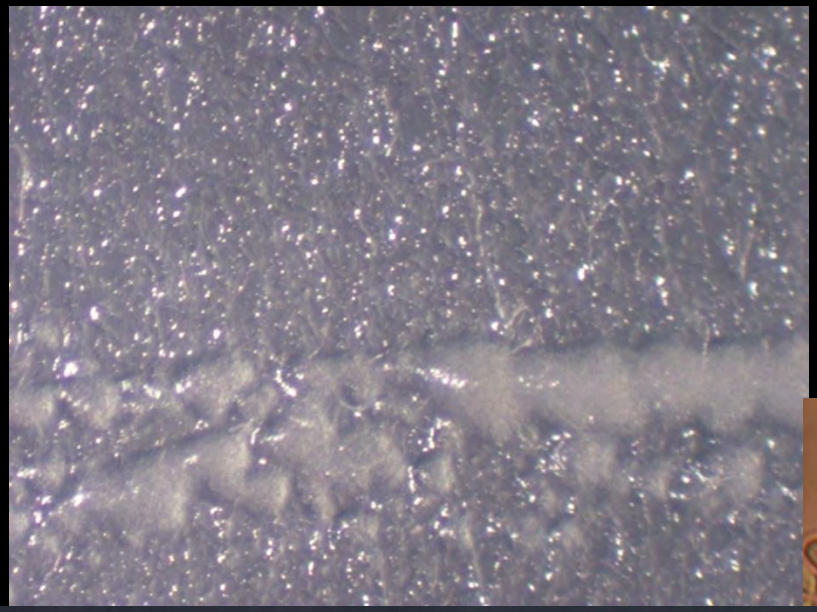
Adults enter trees and excavate galleries

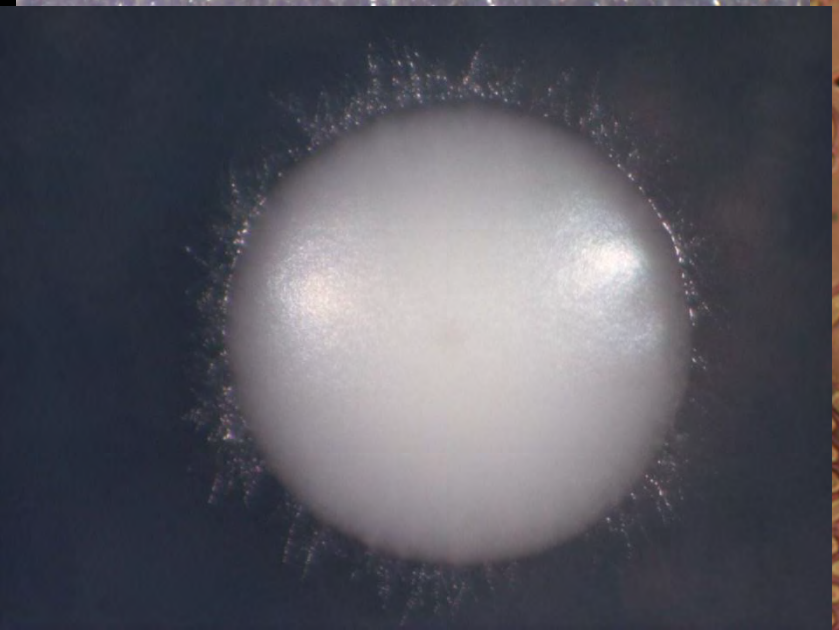
Larval feeding produces a loose network of meandering tunnels in the cambium

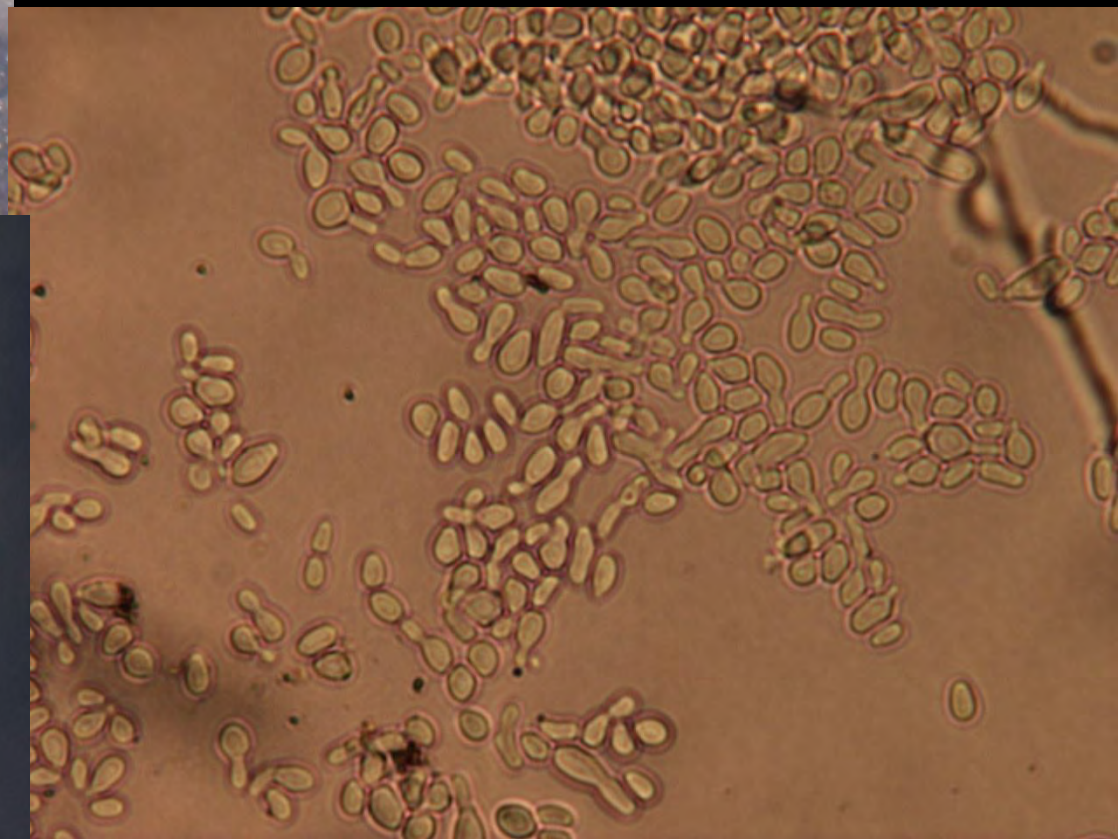
A full grown larva, preparing to pupate.

The Pathogen - *Geosmithia morbida*

Geosmithia morbida has a yeast phase







Geosmithia morbida – **Discovered by Ned Tisserat and subsequently described in 2009**

Geosmithia are associated with numerous bark beetles in Europe. None have previously been reported as a plant pathogen

Geosmithia species	Insect	Host
G. fassatiae	*Scolytus intricatus*	*Quercus*
	Scolytus rugulosus	*Malus*
G. langdonii	*Scolytus intricatus*	*Quercus*
	Scolytus rugulosus	*Malus*
	Ernoporicus fagi	*Fagus*
	Scolytus multistriatus	*Ulmus*
G. obscura	*Scolytus intricatus*	*Quercus*
	Scolytus carpini	*Carpinus*
Geosmithia OTU's	*Ernoporus tiliae*	*Tilia*
	Hylesinus orni	*Fraxinus*
	Ips typographus	*Picea*
	Scolytus schevyrewi	*Ulmus*
	Trypophloeus	*Populus*
	Xyloborinus saxeseni	*Ulmus*

Teneral adults and pupa, covered with *Geosmithia* spores

Geosmithia **is introduced into wounds made by walnut twig beetles**

Growth of the fungus beyond the inoculation site creates a dead region (canker) in the cambium.

TCD results in pockets of dead phloem – gives bark a marbled appearance

Multiple cankers produce girdling that seriously restricts movement of nutrients.

Flagging symptoms emerge in end stages of 1000 cankers on black walnut

Foliage wilting may occur rapidly on TCD-compromised limbs

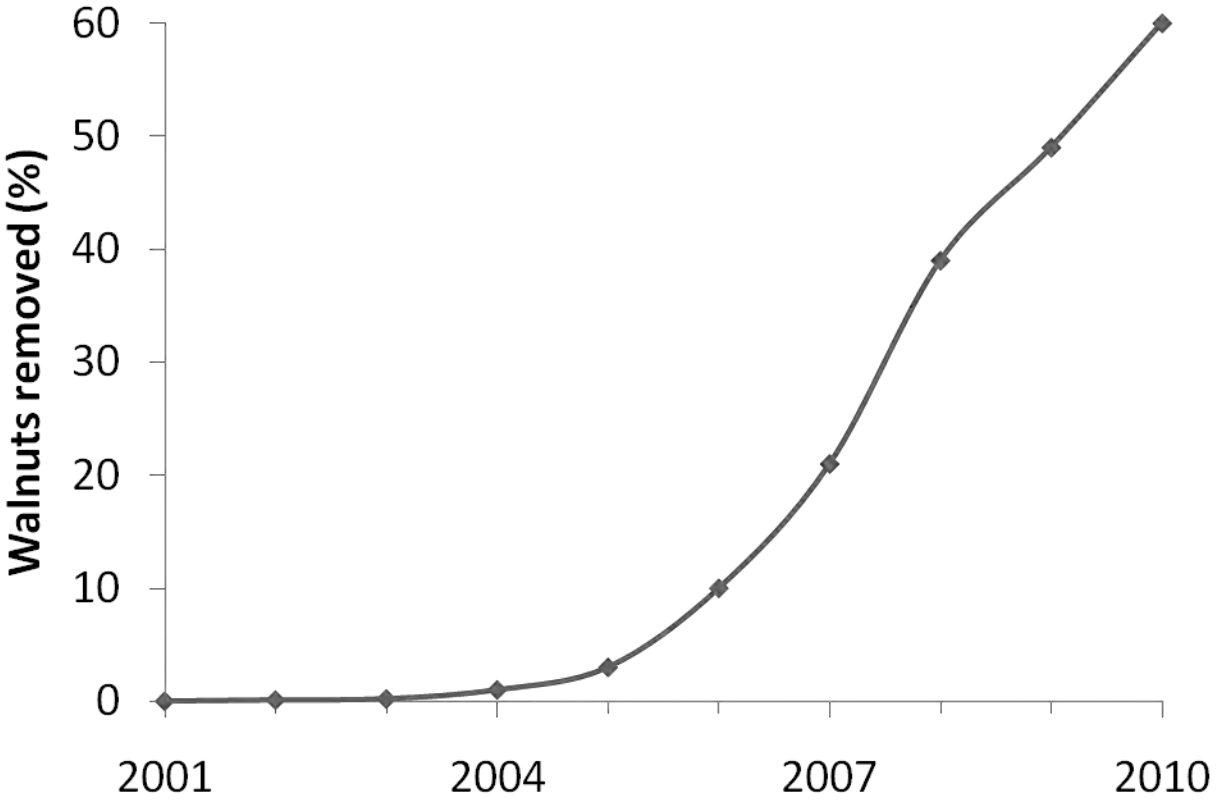
Crown symptoms July 2009 – Tree died in 2010


June 2008

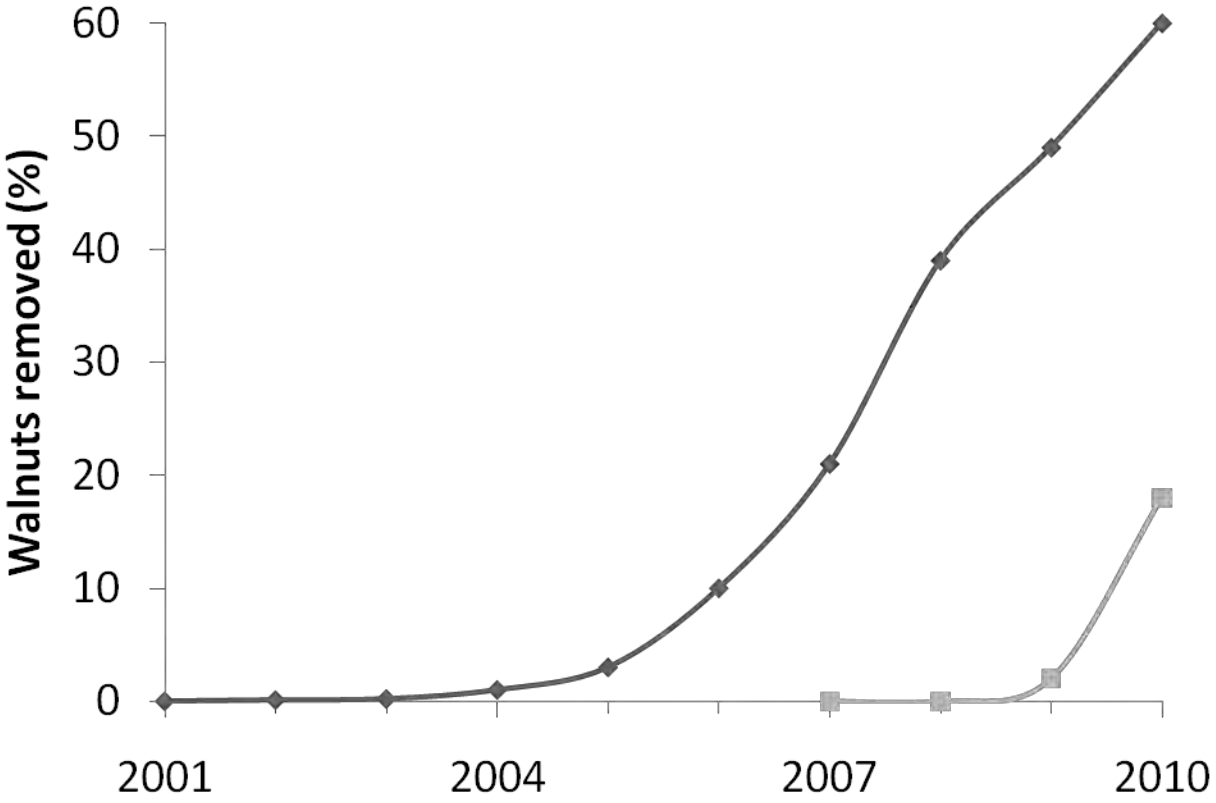

September 2008


June 2009

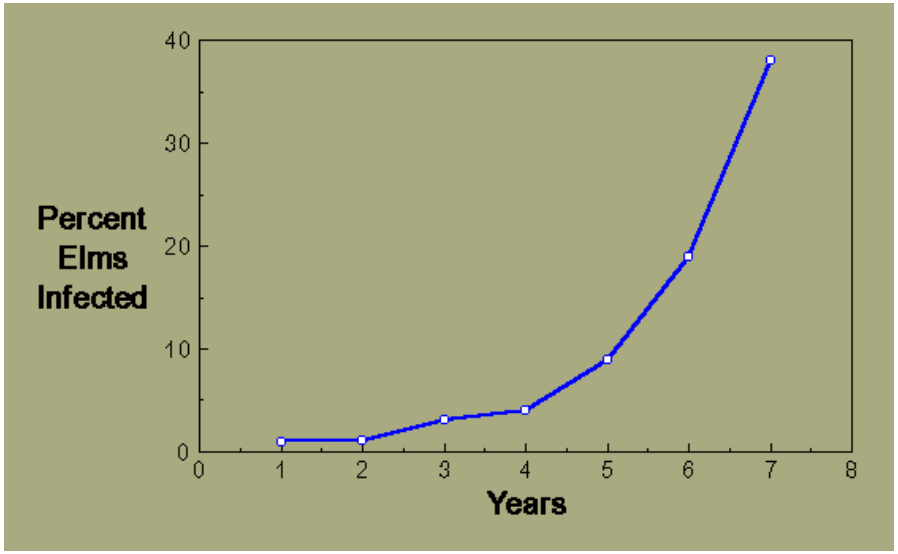
Black Walnut Removals in Boulder, Colorado

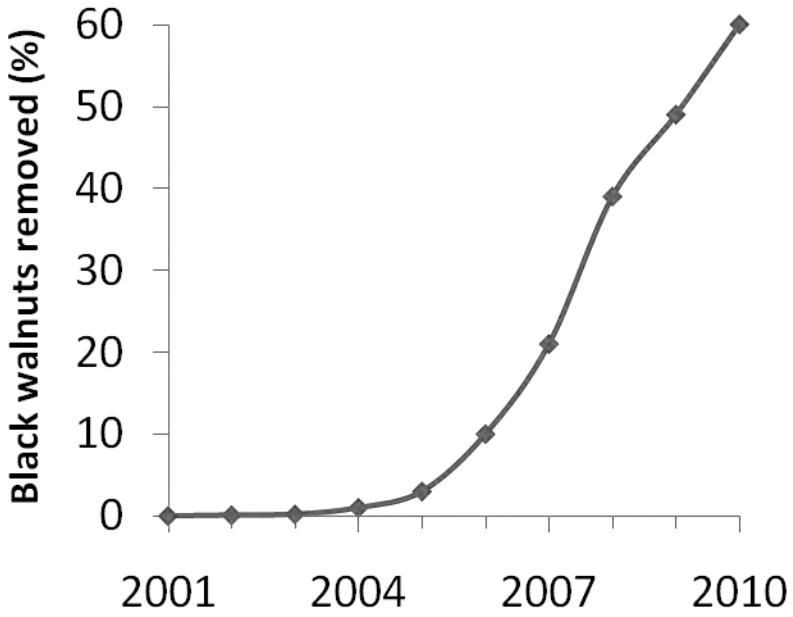


Black Walnut Removals in Boulder and Denver



Comparison of Epidemics of Dutch Elm Disease (historical) and TCD in Boulder





Death by TCD – Working Hypothesis

- Girdling from cankers (and bark beetle tunneling) restricts movement of nutrients.
  - Photosynthetic efficiency possibly impacted
- Trees weaken as stored energy reserves become depleted.
  - External symptoms develop in end stages of infestations
- Trees ultimately die from energy depletion.

Thousand Cankers is produced by the combined effects of *two* species

Geosmithia morbida

Walnut twig beetle

Symptoms of Thousand Cankers Disease develop following *sustained introductions* of *Geosmithia* by walnut twig beetles in susceptible hosts.

Good News: **It takes a long time (Decade? More? A bit less?) for a tree to die following initial colonization by walnut twig beetles.**

Factors Affecting Course of Thousand Cankers Disease

- **Resistance of host**
  - Species, cultivar differences
- **Vigor of host**
  - Available energy reserves
- **Amount of local inoculum**
- **Natural controls**
  - Biological controls
  - Abiotic controls (e.g., temperature)

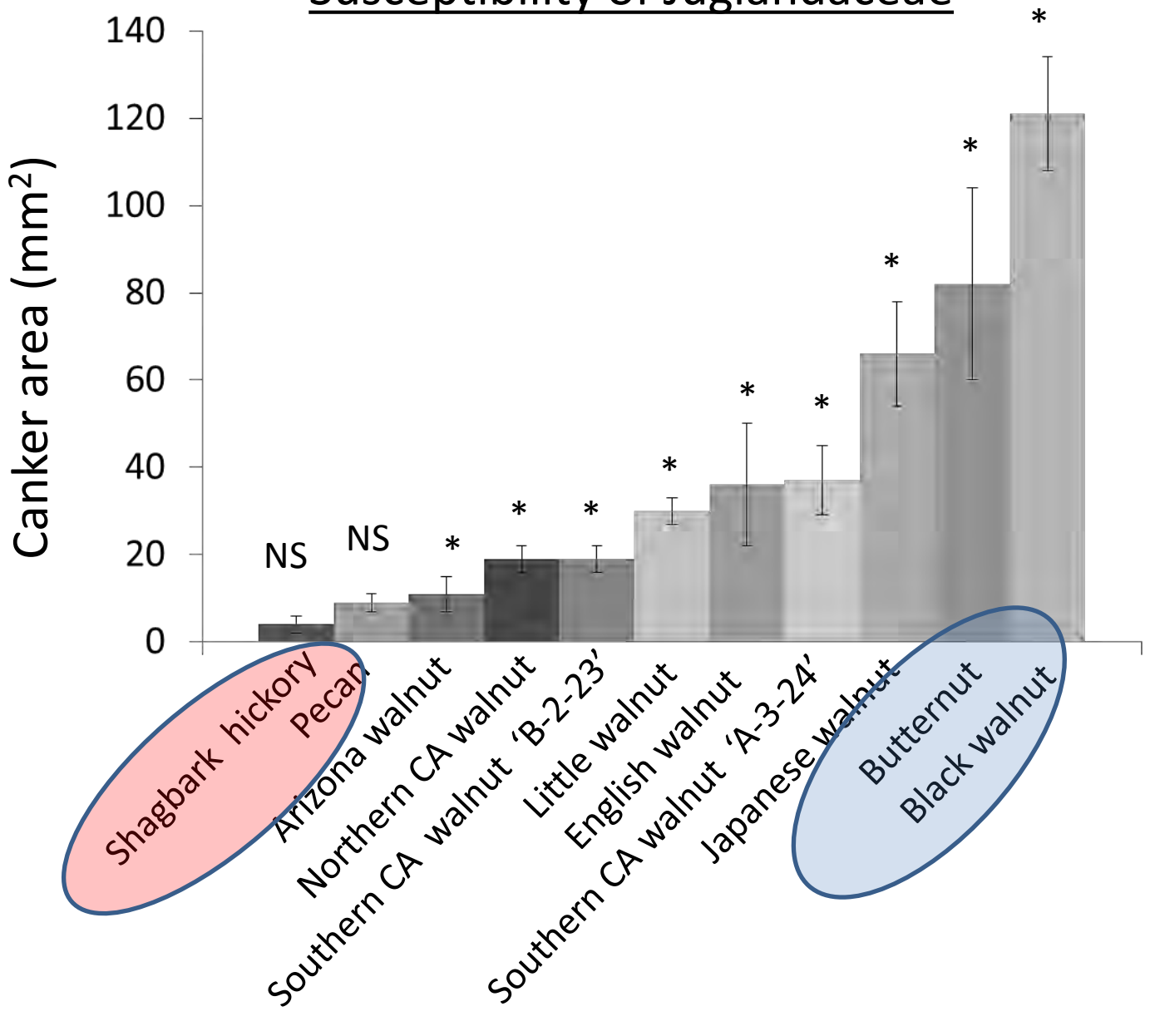
Native Walnuts (*Juglans* spp.) in North America

- **Black walnut (*J. nigra*)**
- **Butternut (*J. cinerea*)**
- **Northern California walnut (*J. hindsii*)**
- **Southern California walnut (*J. californica*)**
- **Arizona walnut (*J. major*)**
- **Little walnut (*J. microcarpa*)**

Resistance to Thousand Cankers Disease may often result from differences in susceptibility to *Geosmithia morbida*

Canker formation in black walnut

Canker formation in Southern California walnut

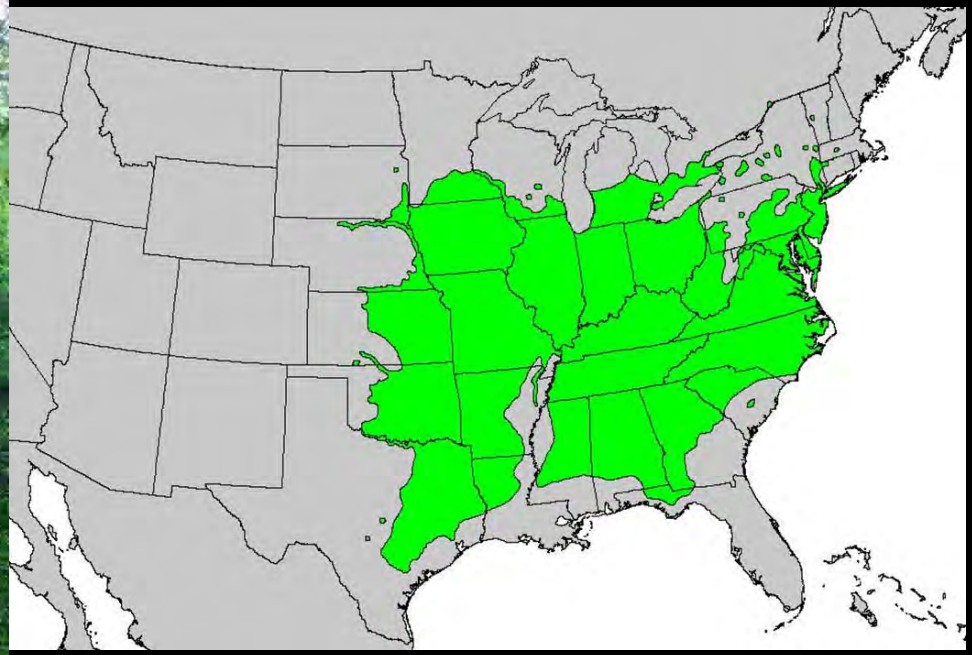

Susceptibility of Juglandaceae
Canker area (mm2)
140
120
100
80
60
40
20
0
NS
NS
*
*
*
*
*
*
*
*
Shagbark hickory
Pecan
Arizona walnut
Northern CA walnut
Southern CA walnut 'B-2-23'
Little walnut
English walnut
Southern CA walnut 'A-3-24'
Japanese walnut
Butternut
Black walnut

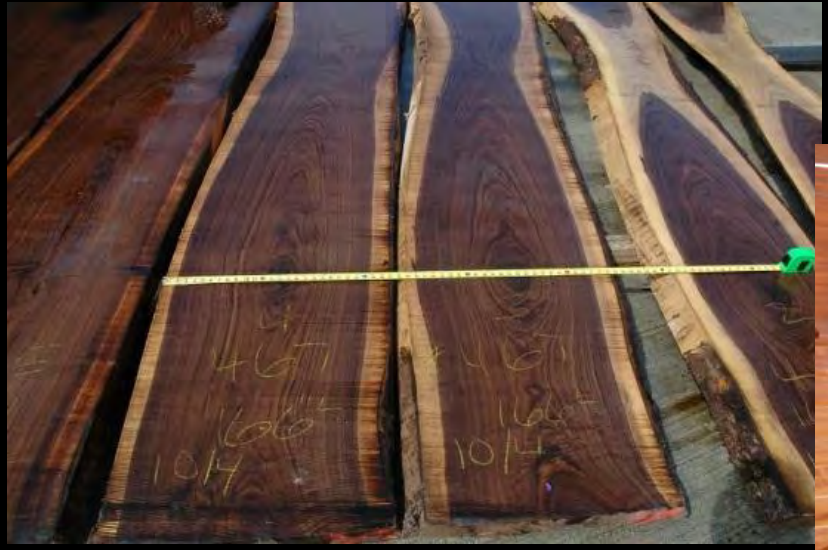
Relative Resistance of *Juglans* to *Geosmithia morbida* – *Preliminary Observations*

- **Highly Susceptible**
  - Black walnut (*Juglans nigra*)
- **Varying Intermediate Resistance**
  - Northern California walnut (*J. hindsii*)
  - Southern California walnut (*J. californica*)
  - Persian/English walnut (*J. regia*)
  - Little walnut (*J. microcarpa*)
- **Highly Resistant**
  - Arizona walnut (*J. major*)

Good News: Other *Juglans* species are not as susceptible to TCD as is *Juglans nigra* (black walnut). Pecan and other *Carya* are apparently TCD resistant and non-hosts for walnut twig beetle.

Juglans nigra
Black walnut/
Eastern black walnut





What is Thousand Cankers Disease?

Black walnut

Arizona walnut

A canker producing fungus (with vector)

+

A susceptible host (black walnut)

=

A canker producing fungus (with vector)

+

A nonsusceptible host (Arizona walnut)

=

Thousand Cankers is a different disease in different *Juglans* hosts

Origins of Thousand Cankers Disease

Walnut twig beetle originally collected (1896) in Grant County New Mexico

Original description of species by Blackman - 1928

Great picture by Jim LaBonte, OR Dept. Agriculture!

Native host of the originally collected beetle was Arizona walnut, *Juglans major*.

Arizona walnut (*Juglans major*) – Host associated with original descriptions of the walnut twig beetle

Arizona walnut is a common species found in canyons and along riverways

In 2008-2011 surveys, walnut twig beetle has been foung regularly in Arizona walnut at several sites in NM and AZ

Walnut twig beetle in Arizona walnut functions as a “typical” *Pityophthorus* species of twig beetle. Attacks are normally limited to small diameter branches and function as a form of natural pruning.

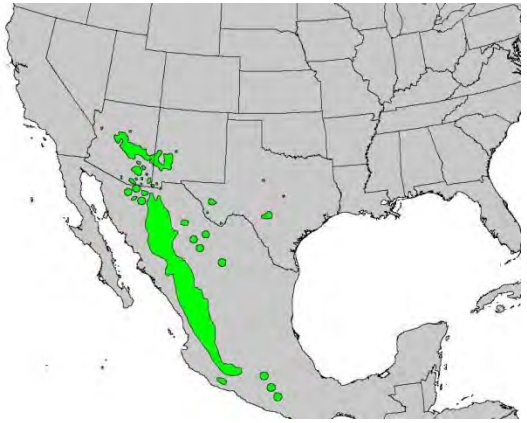
Progression to full-blown Thousand Cankers Disease *has not* been observed in Arizona walnut.

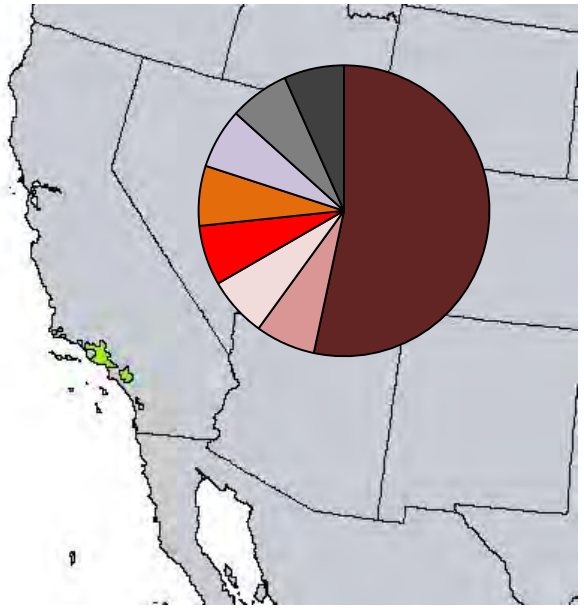
Juglans californica – An original host for walnut twig beetle?

The *Geosmithia* fungus is has been found consistently associated with the tunnels and frass of walnut twig beetles – regardless of *Juglans* spp. or site of collection.

So where did *G. morbida* come from?

- From Arizona walnut in Mexico?
- From southern California walnut?
  - Intermediate in susceptibility to fungus
  - Why wasn't it observed more frequently in CA?
- What about WTB populations?
  - Story similar (S. Seybold – USFS)





***Geosmithia morbida* is also likely to be a native fungus.**

Why did TCD become a problem in black walnut? - **Somehow the beetle (with *Geosmithia*) jumped hosts.**

Colorado Potato Beetle

(Jumped from buffalobur to cultivated *Solanum* – *then moved across US and into Europe*)

Apple Maggot

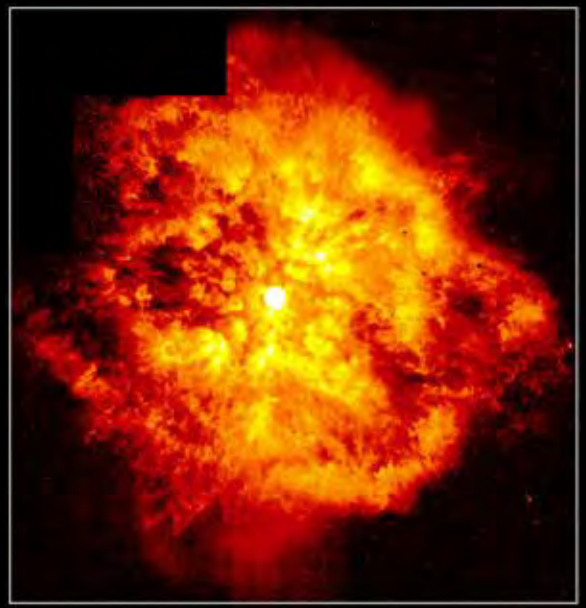
Jumped from hawthorn (*Cratageus*) to apple (*Malus*)

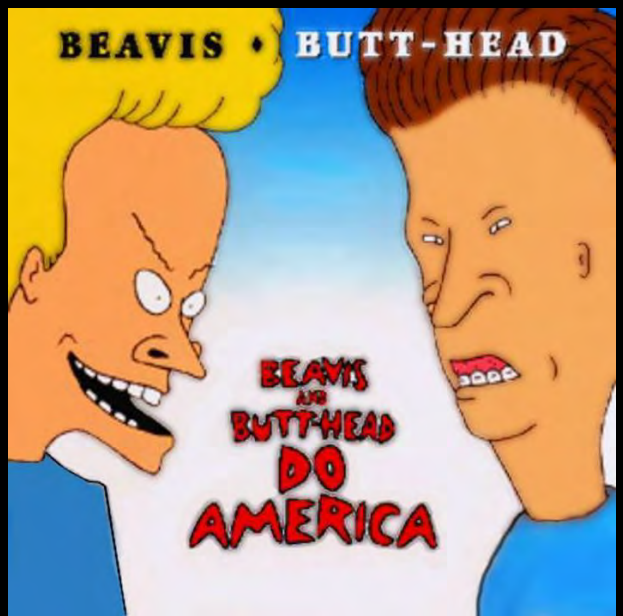
Boll Weevil

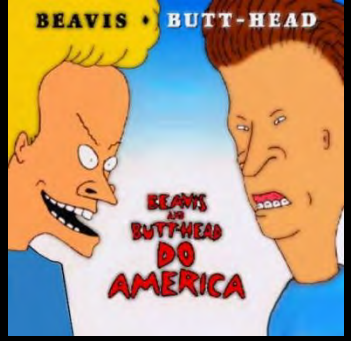
Jumped from wild cotton in Mexico to cultivated cotton – and spread throughout the US Cotton Belt.

Walnut Twig Beetle Range Expansion

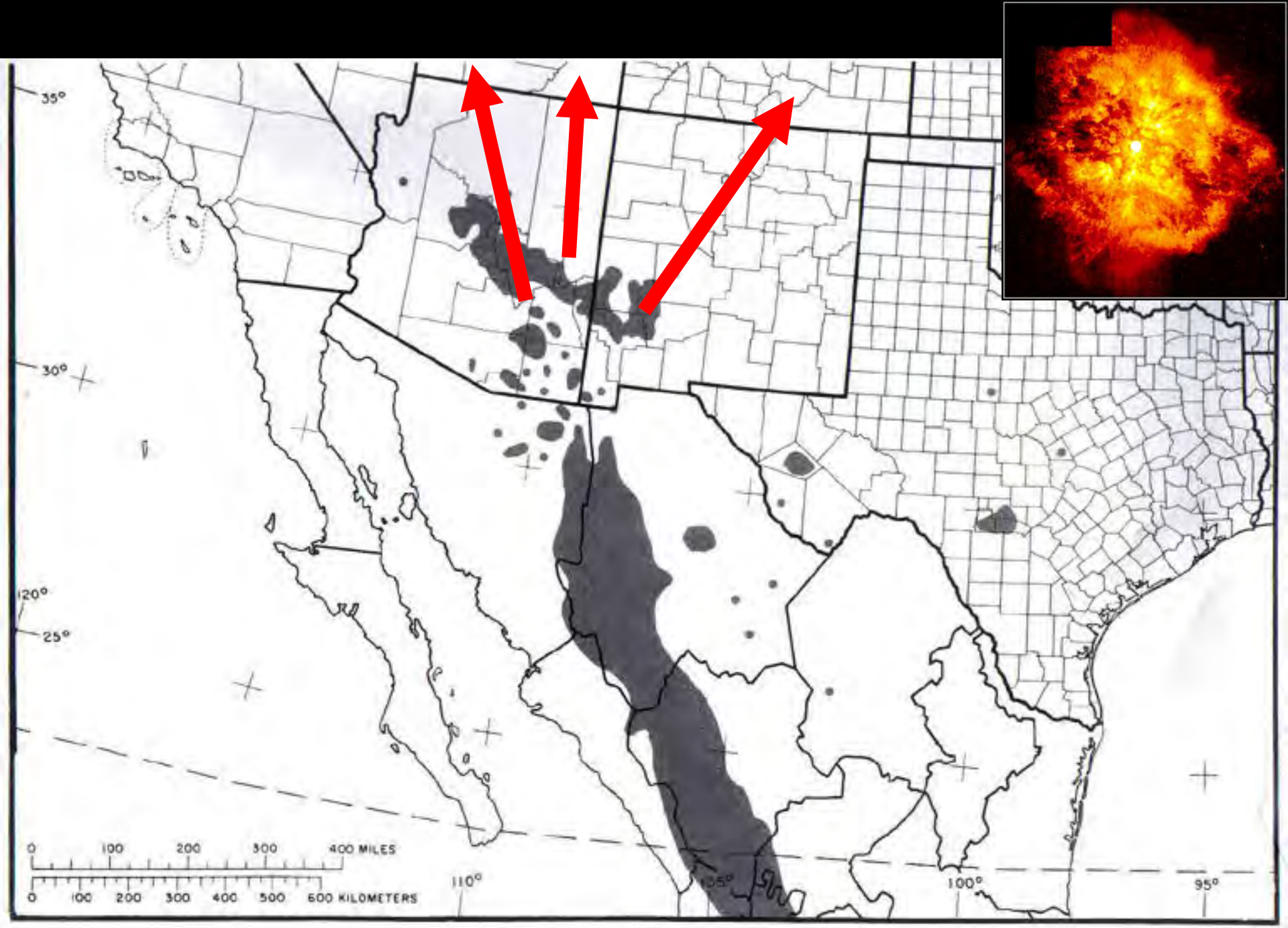
“Big Bang” or “Buttheads”





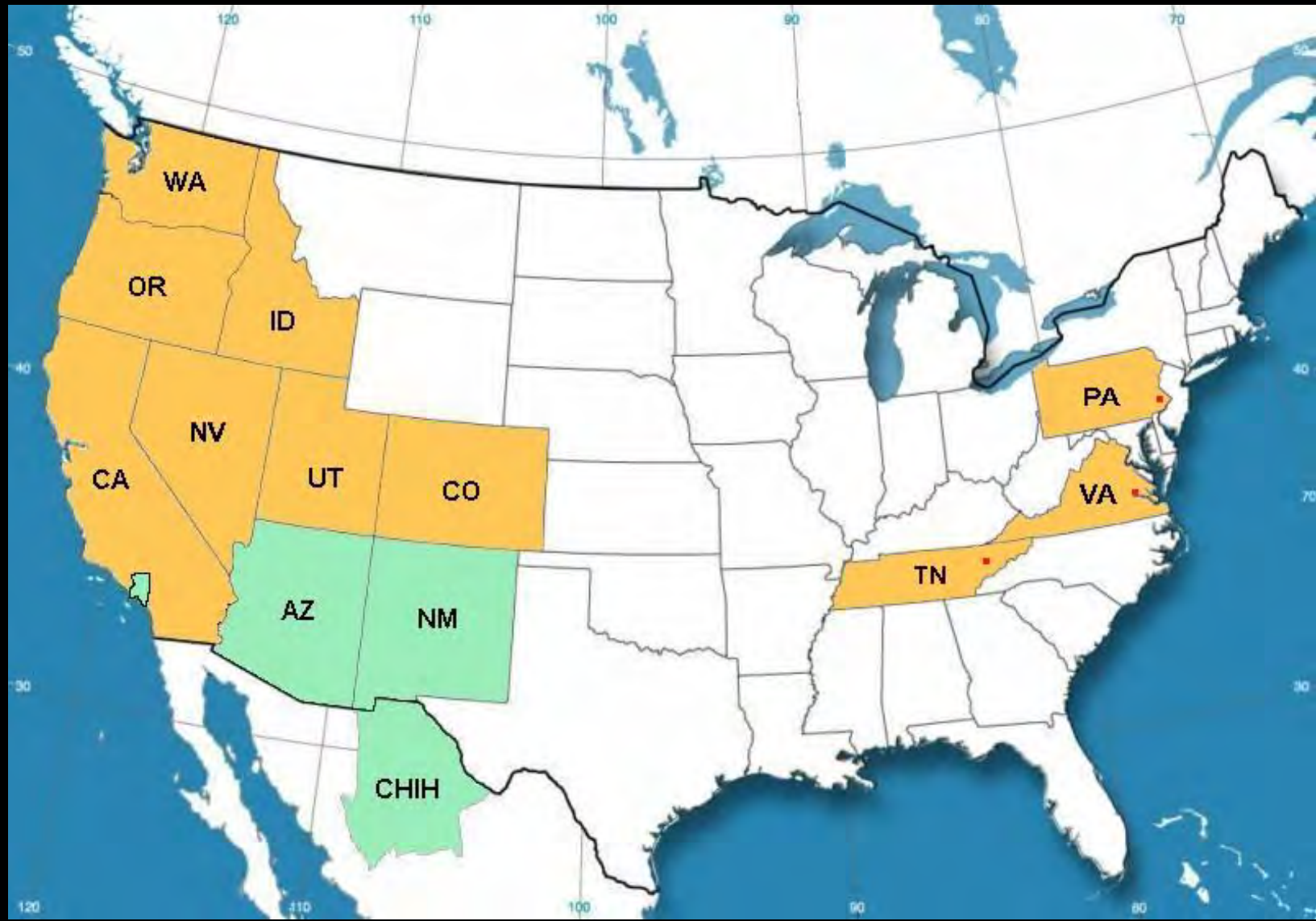


Spread of walnut twig beetle through the western states involved human transport of infested wood products



Map 92-SW. *Juglans major* (Torr.) Heller, Arizona walnut.

Current distribution of Thousand Cankers Disease/ Walnut Twig Beetle



Is thousand cankers disease an exotic pest?

Management Issues Related to Thousand Cankers Disease

Bad News: Prospects for effective chemical control of walnut twig beetle are poor.

Drenching branch sprays for walnut twig beetle

Treatments have failed to slow progress of thousand cankers in trees showing symptoms

Systemic insecticide soil drenches/ trunk injections?

The fungus grows ahead of the beetle.
Cankered areas may prevent movement of insecticide to the beetle feeding site.

Thousand Cankers Management & Pesticides

What kind of crop is black walnut?

Pesticides Used on Black Walnut Must be Consistent with Labels for Nut-bearing Crops

- **Probably legal**
  - Imidacloprid (0.05 ppm residue tolerance)
  - Clothianidin (0.01 ppm residue tolerance)
  - Abamectin (0.01 ppm residue tolerance)
  - Bifenthrin (0.05 ppm residue tolerance)
- **Not apparently legal for use on black walnut**
  - Dinotefuran
  - Enamectin benzoate

Bad News: Prospects for effective control of walnut twig beetle are poor. Insecticides *may* slightly slow, but *will not* stop the progress of TCD.

Good News: **It takes a long time (Decade? More? A bit less?) for a tree to die following initial colonization by walnut twig beetles.**

Bad News: **By the time symptoms appear it can be assumed that the walnut twig beetle is generally distributed in the area.**

Survey for thousand cankers disease is often based on identifying symptomatic trees

Good News: A newly available attractant lure can be used to help detect walnut twig beetle presence

Bad News: **Walnut in TCD end stages and cut wood with bark intact is extremely infectious.**

Two logs, ca 14 cm diameter, 45-cm length

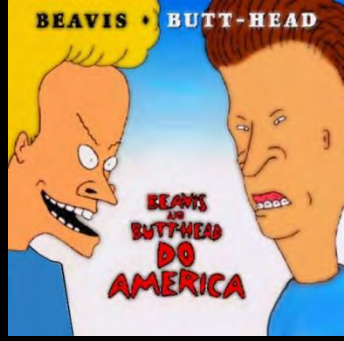
23,040 Beetles/2 logs

= ca. 6 beetles/cm^2

Bad News: **Salvage of black walnut wood and subsequent human transport is going to be a huge issue.**

A walnut log in Denver waiting for Uncle Benny from Chicago

Beetle infested black walnut from Boulder area with bark attached as advertised on the internet



Bad News: Long distance movement of walnut wood killed by 1000 cankers disease will always be a *huge* issue due to the high value of the saw logs and wood turning pieces.

Bad News: **Walnut in TCD end stages and cut wood with bark intact is extremely infectious.**

What about chipping?

Walnut twig beetles were able to complete development in larger pieces following chipping

Chipping will kill many beetles and hasten the period that wood will become non-infectious

How do we handle TCD-killed trees?

Key Research Need: How can one completely and permanaently disinfest TCD-affected walnut wood?

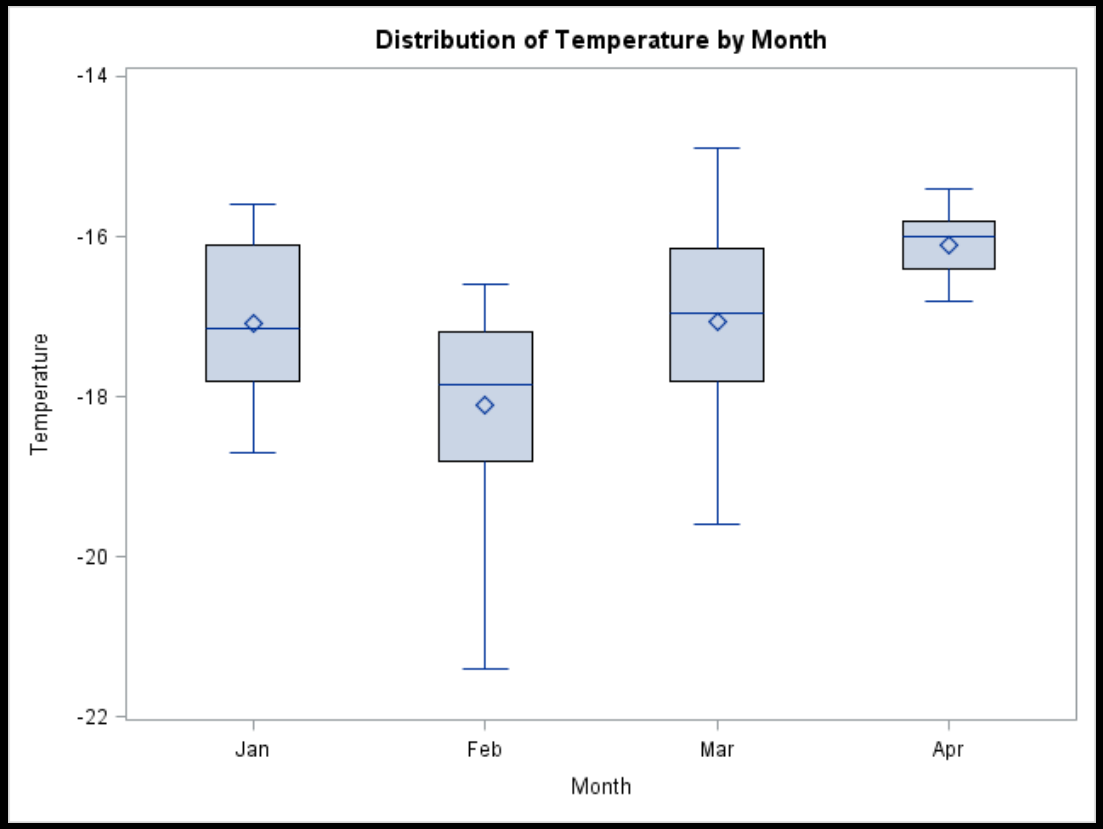
- Debarking?
- Chipping?
- Heat?
- Cold?
- Insecticides?
- Submergence treatments?

Debarking:
Difficult to practice, destroys wood quality (checking), incompletely disinfests

Chipping: Destroys wood, incompletely disinfests, but greatly reduces period of beetle suitability

Heat Treatment: High temperature (ca. 130-140F/30 minutes will destroy beetles, unknown likelihood of reinfestation potential

Cold Treatment: Abrupt deep freezing can kill walnut twig beetles, unknown likelihood of reinfestation potential, susceptibility may vary seasonally



Insecticides: Bifenthrin is only treatment that may have potential in disinfesting logs, studies in progress

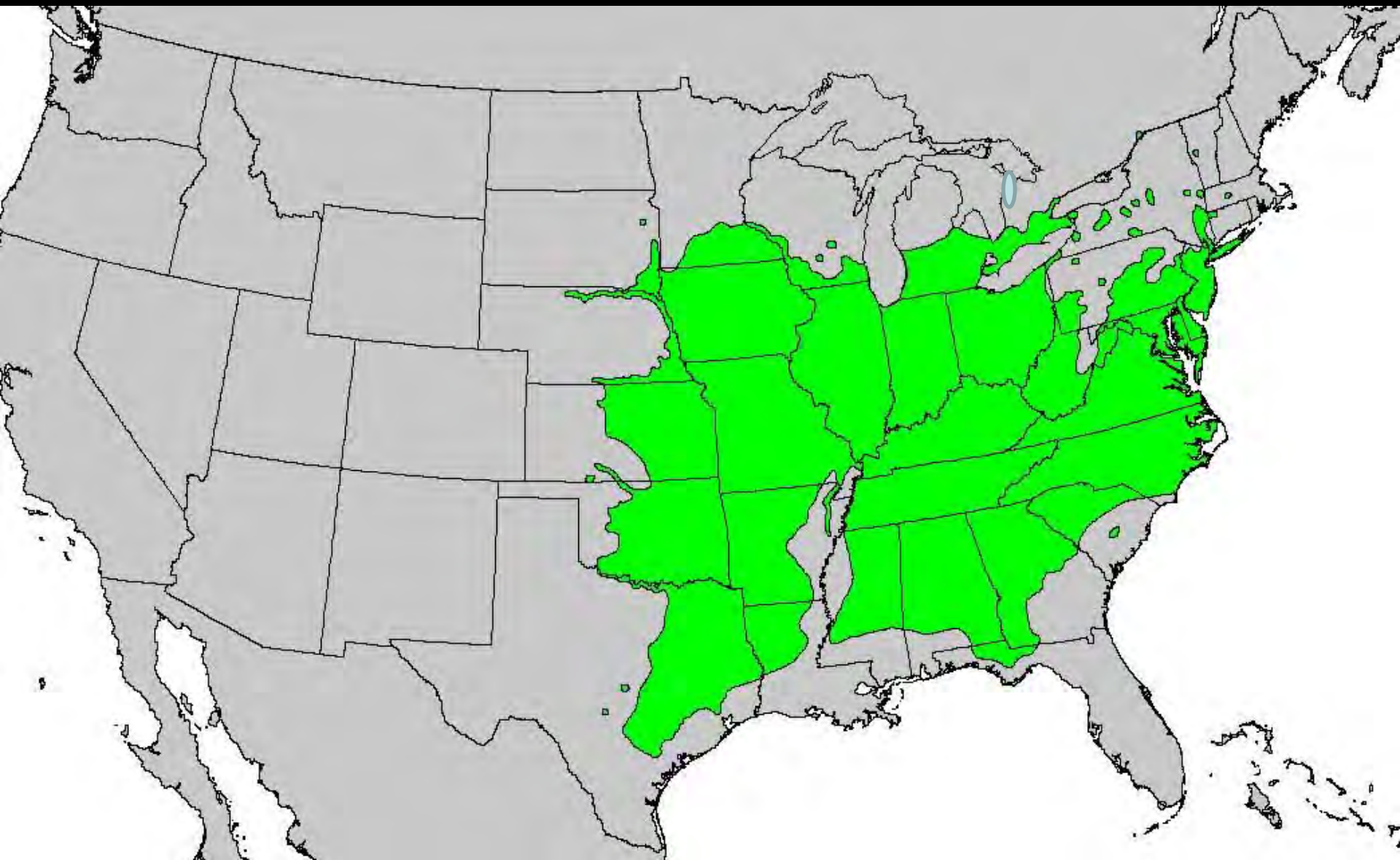
Submergence treatments

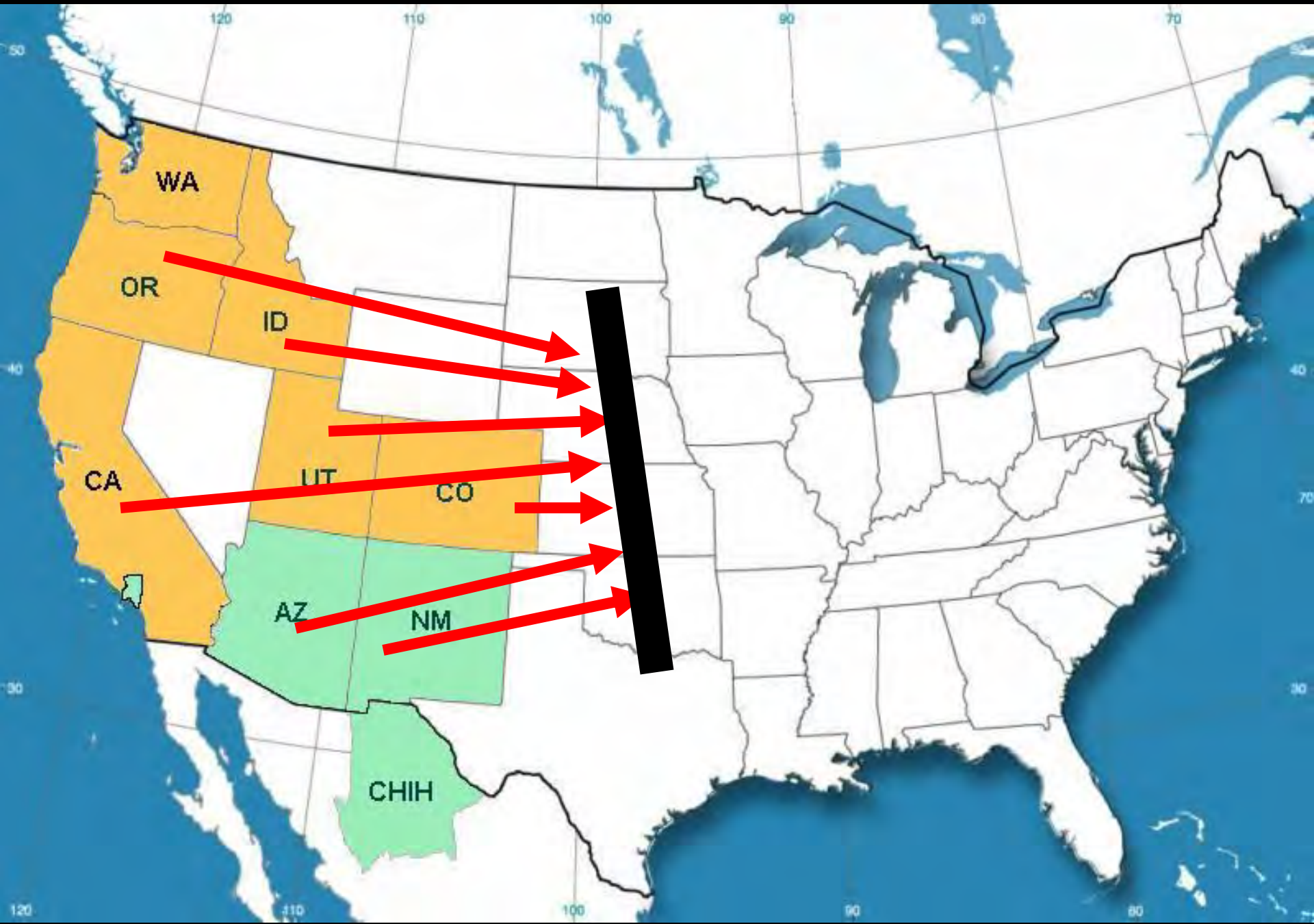
- Ethanol – looks promising
- Water – Incomplete disinfestation at one week
  - Reevaluation with surfactant

Ineffective disinfestation treatments include:

- Most insecticides
  - Carbaryl
  - Permethrin
  - Imidacloprid
- Biodiesel
- Solarization

Native Distribution of Black Walnut, *Juglans nigra*

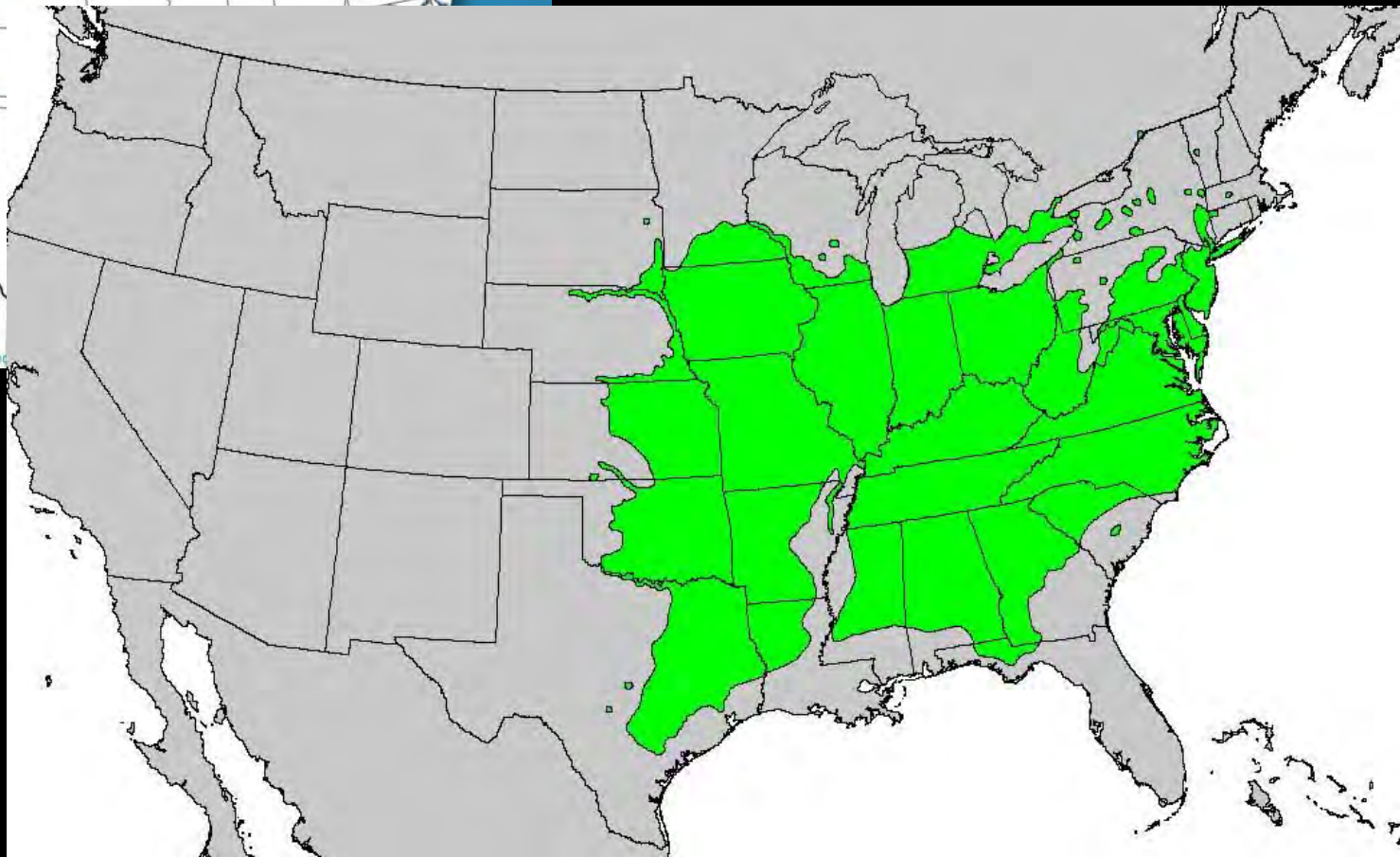



WA
OR
ID
CA
UT
CO
AZ
NM
CHIH

Typical appearance of the High Plains found across eastern Colorado and adjacent states

What I said, until recently…….

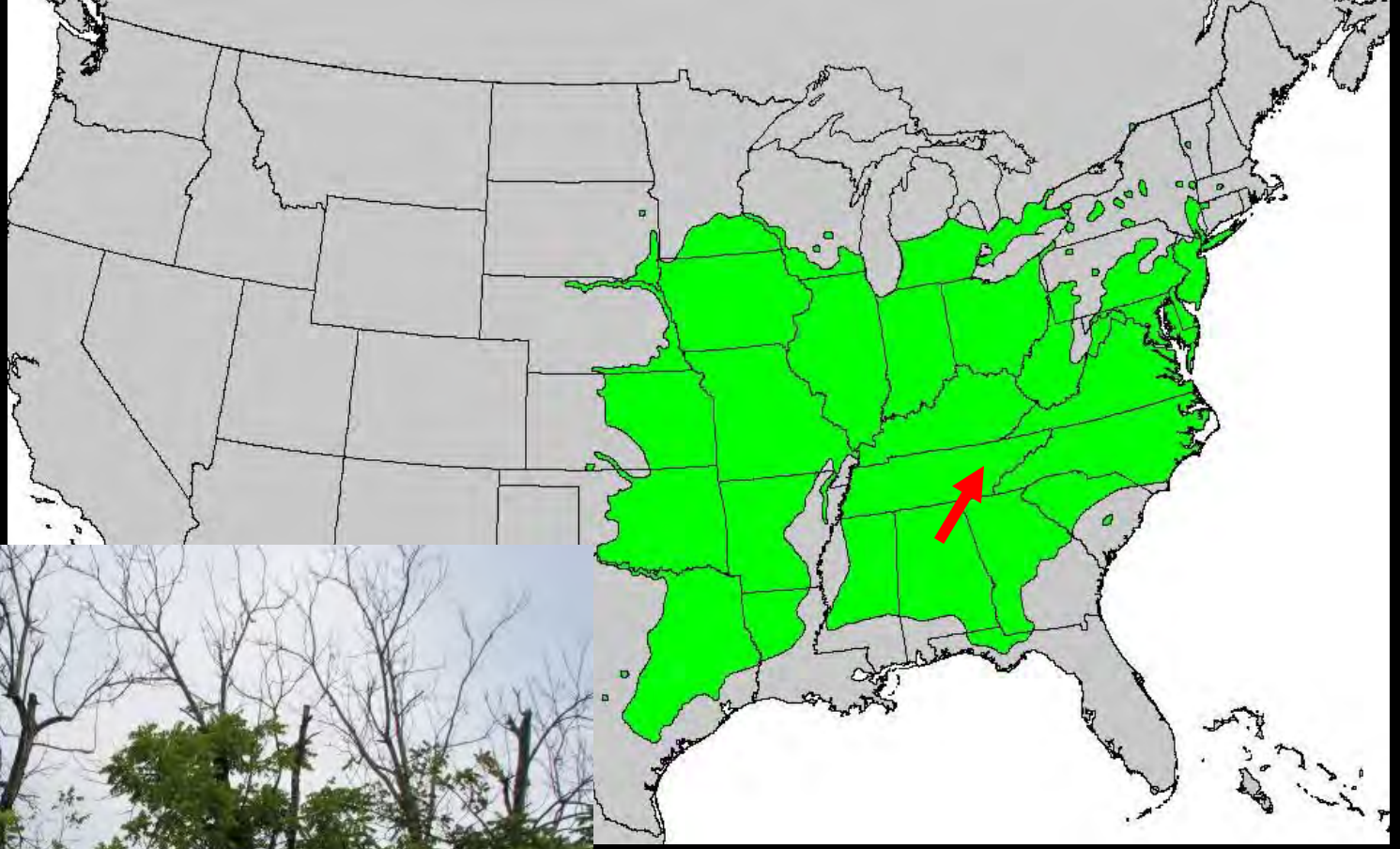
Good News: Walnut twig beetle has likely not yet reached the native range of *Juglans nigra* (we think).



July 20, 2010 – Very, very bad news:
Thousand cankers and walnut twig beetles found in the center of the native range of *Juglans nigra*

Knoxville, Tennessee

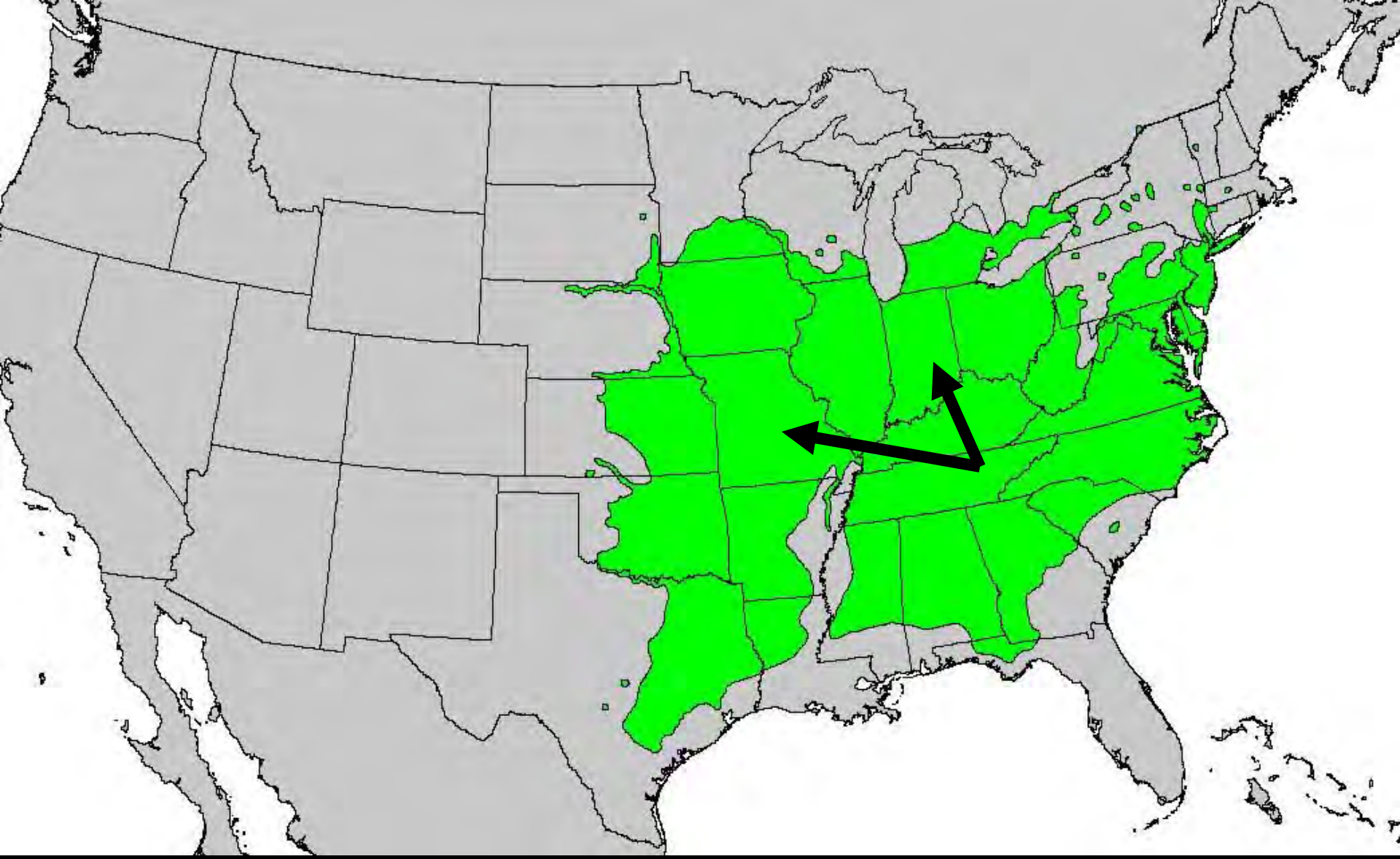
Note: The local foresters thought that the trees were suffering from drought stresses



Thousand Cankers has now breached the geographic barrier of the Great Plains!!!!

Implications of TCD Finding in Native Range

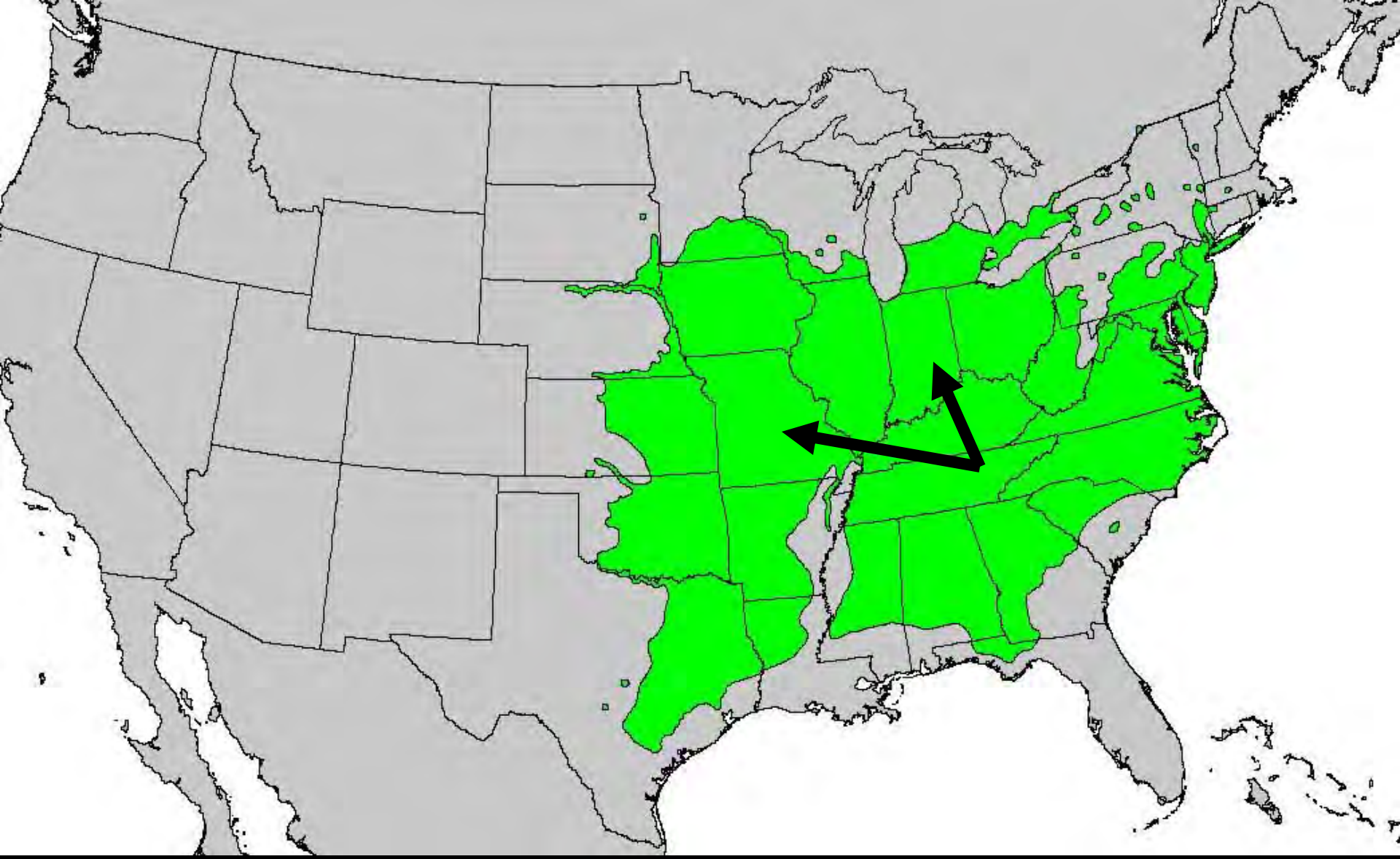
- There are now no ecological or geographic barriers that will prevent TCD spread throughout the entire range of *Juglans nigra*
  - Natural spread will likely slow, but inexorable
- Containment through restrictions on movement of walnut wood products may slow spread
- Aggressive management at edges of infestation may slow spread



Slow the Spread of Thousand Cankers Disease!

What Needs to Be Done

- Strong public education on the threat of Thousand Cankers Disease to black walnut in its native range
- Immediate restriction, aided by national quarantine, of all *Juglans* material that may further spread walnut twig beetle native range of black walnut.



Slow the Spread of Thousand Cankers Disease!

An Interim Web Site for TCD information

Department of Bioagricultural Sciences and Pest Management

Colorado State University

Search "BSPM CSU"

Click on "Extension and Outreach"

Also check out the Insect Information page!