TITLE: INT-EM-B-11-03: Monitoring walnut health and decline in response to thousand cankers disease and infestation by the walnut twig beetle, *Pityophthorus juglandis*, in southern California and New Mexico INT-EM-B-11-03

LOCATIONS: Angeles, Apache-Sitgreaves, Carson, Cibola, Cleveland, Coconino, Coronado, Gila, Lincoln, Los Padres, San Bernardino, and Santa Fe National Forests

DATE: September 29, 2011

DURATION: Progress Report on Year 1 of a 2-year project **FUNDING SOURCE:** Base Plan

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PROJECT OBJECTIVES: Our objectives were chosen to answer two questions that are essential to future monitoring programs for the walnut twig beetle (WTB): 1) What is the health status of native walnuts within the native, historic range of WTB? 2) What is the flight periodicity and general attack incidence of WTB throughout its native range, which overlaps with the distributions of *Juglans californica* in California and *J. major* and *J. microcarpa* in Arizona and New Mexico? To answer these we will: 1) Locate and monitor uninfested and infested stands of native *Juglans* spp. and conduct a ground detection survey to determine tree health of *J. californica*, *J. major*, and *J. microcarpa* and 2) Determine the differences in timing of flight and gallery initiation and frequency of tree infection in southern California, Arizona, and New Mexico.

JUSTIFICATION:
Linkage: The walnut twig beetle, *Pityophthorus juglandis* Blackman (WTB), is native to Arizona, California (CA), Mexico, and New Mexico, where its original hosts were indigenous western black walnut trees (e.g., *Juglans californica*, *J. major*, and *J. microcarpa*) (Seybold et al. 2010b, Appendix, Fig. 1). WTB is associated with a newly described fungus, *Geosmithia morbida*, which colonizes and kills the phloem of walnut branches and stems (Graves et al., 2009, 2010; Utley et al., 2009). When populations of WTB are high, numerous feeding and reproductive galleries are colonized by the fungus and resulting cankers coalesce and girdle branches and stems. Based on recent surveys in the USDA ARS National Clonal Germplasm Collection (near Winters, CA), all three of the key native western walnut have shown symptoms of attack by WTB and infection by *Geosmithia* (Appendix, Fig. 2 and 3), but the incidence of infection is unknown in native stands.

Significance: The disease complex first gained notice in the Española Valley of New Mexico in 2001 when eastern black walnut trees (*J. nigra*) declined and died. The beetle-disease complex is associated with widespread mortality of black walnut throughout the western U.S. planted as street or highway trees, and the complex was recently discovered in Knoxville, TN, Richmond,

VA, and Bucks Co., PA (Appendix, Fig. 1, Seybold et al. 2010b). The areas and hosts that we propose to monitor represent a primary natural gateway for this complex to move eastward into the expansive stands of native eastern black walnut, *J. nigra*. However, little is know about the occurrence and incidence of infection in these western hosts.

Biological Impact: WTB attacks both native and planted *Juglans* spp. wherever they occur. In some cases the incidence of TCD following these attacks can be as high as 50-60% of the stand or orchard. Host colonization by WTB can be equated with infection by *Geosmithia* and development of TCD. It is likely that as this complex moves eastward that we can expect to see similar situations developing throughout the range of *Juglans*. In the West, *Juglans* spp. occur primarily in riparian habitats upslope of desert ecosystems, whereas, in the East, *J. nigra* is primarily found in mesic forest ecosystems. WTB and its associated fungus have the potential to significantly and irreversibly alter stands of *Juglans* throughout their range (Seybold et al. 2010a).

Scientific Basis/Feasibility: Survey techniques for WTB will be based on a comparable project with goldspotted oak borer that has been successfully implemented in California (Coleman and Seybold 2008, Coleman et al. 2011).

Priority Issues: This work will influence the development of future surveys for WTB by developing a risk and infection rating system that can be used to more accurately monitor populations of WTB and disease incidence throughout the U.S.

DESCRIPTION:

a. Background: Understanding the distribution and levels of incidence of this relatively understudied insect-disease complex is critical because it continues to cause high levels of injury and mortality and the effects of its spread are yet to be fully realized. Drought was considered to be the sole cause of this mortality for many years, but now that the complex is clearly the primary mortality agent. Monitoring the health of uninfested and infested walnuts will allow us better understand the link between this complex and its host species. Additionally, we will be able to offer better monitoring tools for early detection of this complex as it inevitably spreads eastward from its native population.

b. Methods:

Objective 1. To assess walnut health, WTB-infested and uninfested walnuts will be monitored in permanent plots that span its current native in southern California (Angeles, Cleveland, Los Padres, and San Bernardino NF's) and throughout New Mexico (Carson, Cibola, Coronado, Gila, Lincoln, Santa Fe NF). Decline ratings will be determined by the degree of crown die back (rating 1-5), adult exit hole density (0-3), and bark staining from fungal inoculation (0-4). A similar rating system has been used for another hardwood attacking beetle (goldspotted oak borer) (Coleman and Seybold 2008, Coleman et al. 2011). Assessments will occur four times throughout the summers of 2011 and 2012.

Objective 2. A series of monitoring traps (4-unit funnel traps, Seybold et al. 2010a) will be placed throughout study plots to asses the differences in flight timing between southern California and New Mexico. Walnuts will also be tagged and monitored in these to assess the time and location of attack. Infested and uninfested trees will be tagged in areas where disease

incidence is high in southern California and lower throughout New Mexico. Tagged trees will incorporate the same health class ratings as Obj. 1. Replicates will be partitioned into 4 crown classes (1-healthy, 2-minor twig die back, 3-moderate die back, and 4-severe die back). Each health rating class will contain at least 30 trees (*N*=120). Tree tagging and health ratings will begin 2011 and be re-assessed in the fall of 2011 and again, throughout 2012.

c. Products: The results of this monitoring work will assist land managers by providing information on timing and location of monitoring techniques for WTB. Developing a walnut health rating system will facilitate monitoring efforts and increase our understanding of the background levels of this complex within its native range (Obj. 1). This monitoring work will assist with future surveying and trapping for WTB by determining timing and location of flight and attack on trees. This work will validate previously developed health rating systems and determine the average time trees (Obj. 2). Findings from this effort will be transferred to land managers at local and regional meetings. This work will also produce a technical report, peer-reviewed manuscript, and contribute to a planned Forest Insect and Disease Leaflet and to a future updated version of the Pest Alert, on which two of the project leaders are co-authors.

d. Schedule of Activities:

Years One and Two	
Objective 1	Plot establishment and initial tree health assessment (Spring-Summer 2011)
	Monitor uninfested and infested trees within plots (Summer 2011 and 2012)
Objective 2	Tag additional trees in (Fall 2011)
	Re-evaluate tagged trees (Fall 2011 and 2012)
	Install and monitor funnel traps (Spring and Summer 2012)
	Determine timing of gallery initiation at all sites (Spring 2012)

e. Progress/Accomplishments Year 1:
Objective 1: A total of 23 survey plots were installed during the spring and summer of 2011. All plots were established on national forests with 14 plots in California [Angeles (3), Cleveland (1), Los Padres (6), and San Bernardino NF's (4)], four in Arizona [Apache-Sitgreaves (1) and Coconino NF's (3)] and five in New Mexico [Gila (4) and Lincoln NF's (1)] (Fig.1). A total of 335 trees were assessed across all plots. Assessment included measuring the DBH (diameter at breast height, 1.47 m), assigning a crown health rating (1-5), determining the presence of WTB, and noting the presence of cankers and abnormal growth due to disease progression on each of the trees. The mean DBH on the plots was 9.24" (6.64" for *J. californica* in CA to 13.78" for *J. major* in southeastern NM) (Fig. 2). Crown health, in general, was worse in *J. major* than in *J. californica* with the most severely affected trees (*J. major*) observed on the Apache-Sitgreaves and Lincoln National Forests (Fig. 3). An additional 27 locations were searched for indication of the beetle and/or disease symptoms and samples were collected, but plots were not established (Fig.1). For the permanent plot locations, only areas with either *Juglans californica* (in CA) or *J. major* (in AZ and NM) were chosen. We have found no evidence that WTB feeds on *J. micorcarpa* in southeastern NM and western TX. Plots were only established where the presence of the beetle or disease-like symptoms were noted. There was very little evidence for the WTB or disease symptoms on the Cleveland NF; the native distribution of *J. californica* only occurs on the Trabucco Ranger District on the northern half of the forest. Relatively low trap catches in two of five monitoring traps indicate that location may represent the southern distribution of the beetle and disease in CA.

Objective 2: Traps (40) were placed in seven locations in southern CA (Angeles, Cleveland, Los Padres, and San Bernardino NF's) to determine the feasibility of detecting WTB in areas with low to intermediate population densities. This trapping will be expanded to AZ and NM in FY2012. We will also determine the timing of gallery initiation at all sites in FY2012.

Figure 1. Locations of monitoring plots and collection sites.

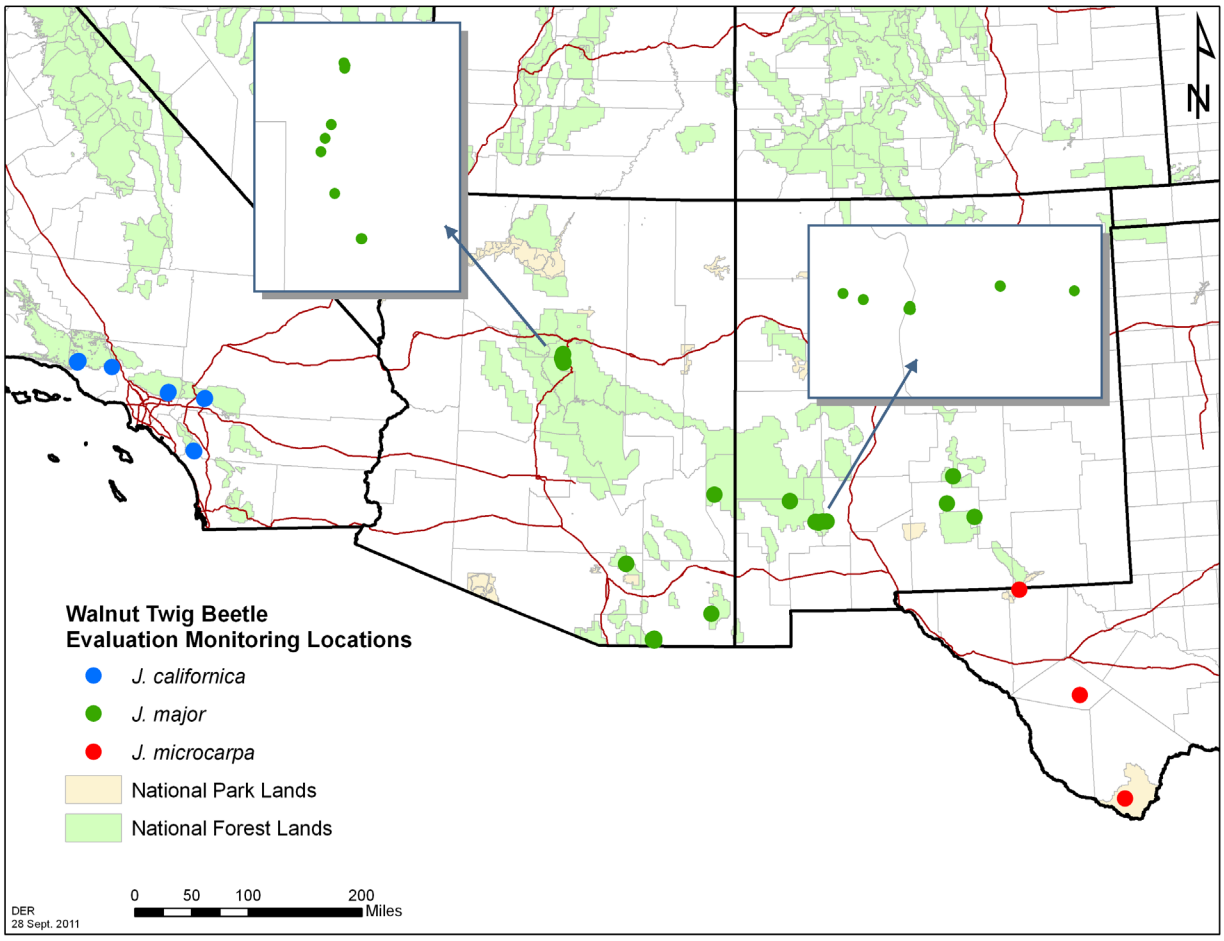


Figure 2. Diameter [DBH (inches)] of walnut trees at national forest sites throughout the Southwest.

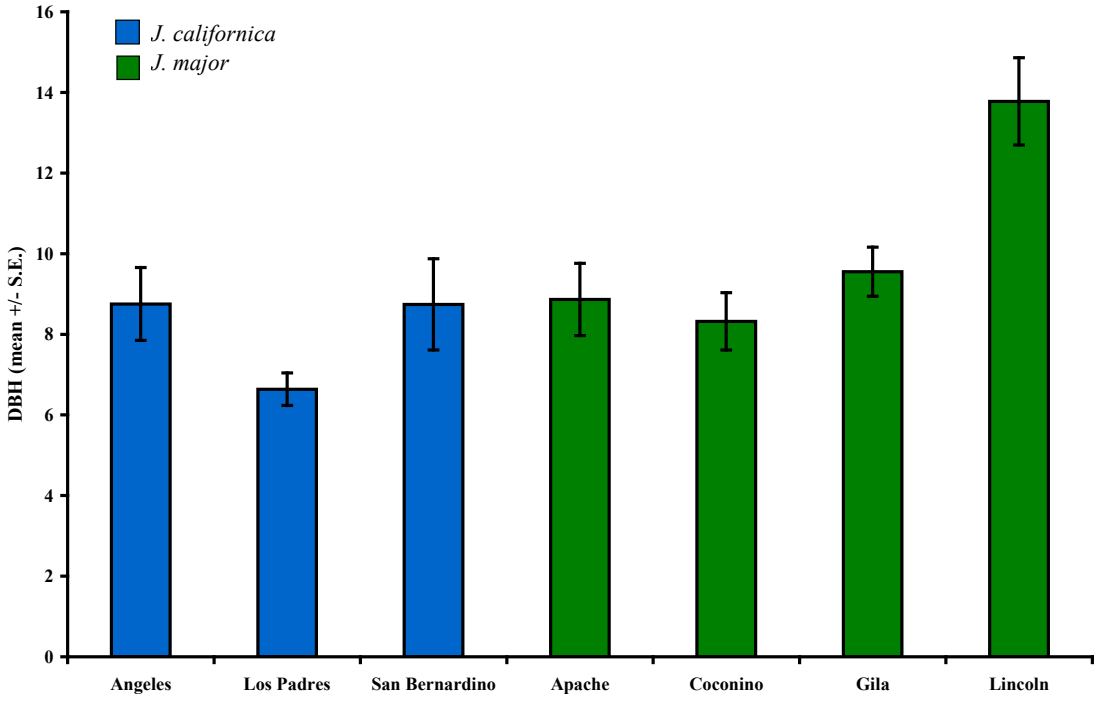
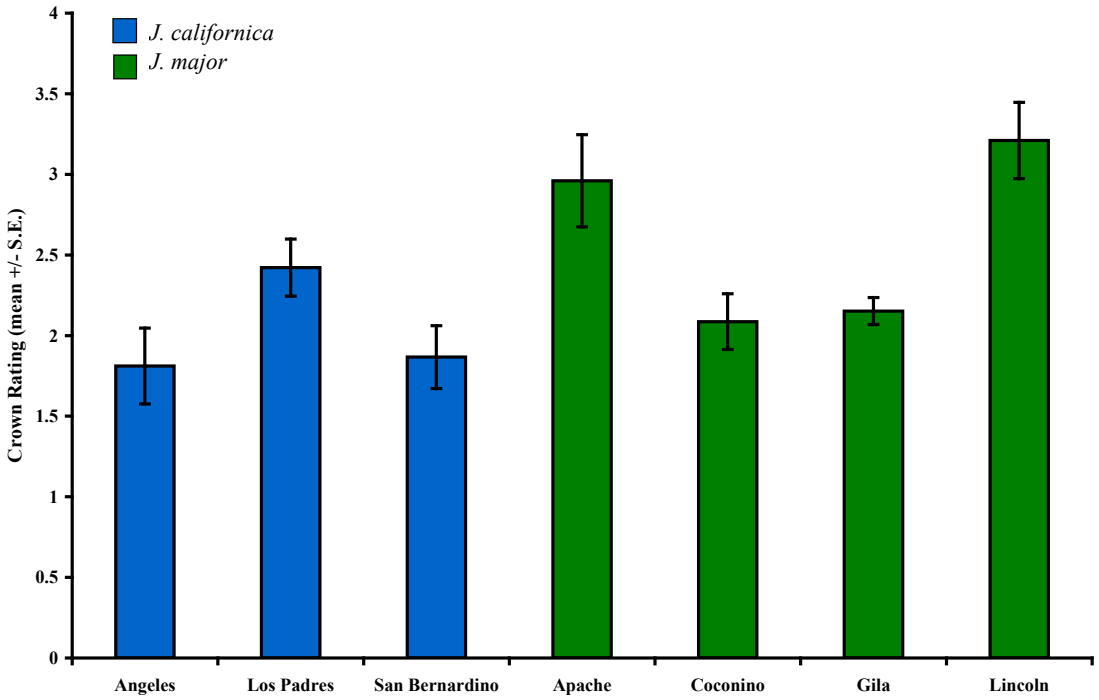


Figure 3. Crown ratings of walnut trees at national forest sites throughout the Southwest. A crown rating of one is considered healthy, whereas a crown rating of 4 is considered severely injured.



COSTS:

	Item	Requested Funding
FY11		
Administration	2 Biological technicians (6 mo.)	20,000
	Travel-Mileage/per diem	10,000
Procurements	Supplies (traps, field equipment for plots)	5,000
	Pass through overhead (PSW/UC Davis, 2%)	700
FY11 Total		**35, 700**
FY12		
Administration	2 Biological technicians (6 mo.)	20,000
	Travel-Mileage/per diem	10,000
Procurements	Supplies (traps, field equipment for plots)	5,000
	Pass through overhead (PSW/UC Davis, 2%)	700
FY12 Total		**35, 700**
Project Total		**71,400**

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Appendix

Figure 1 Distribution of Thousand Cankers Disease in the U.S (inset highlights the project area).

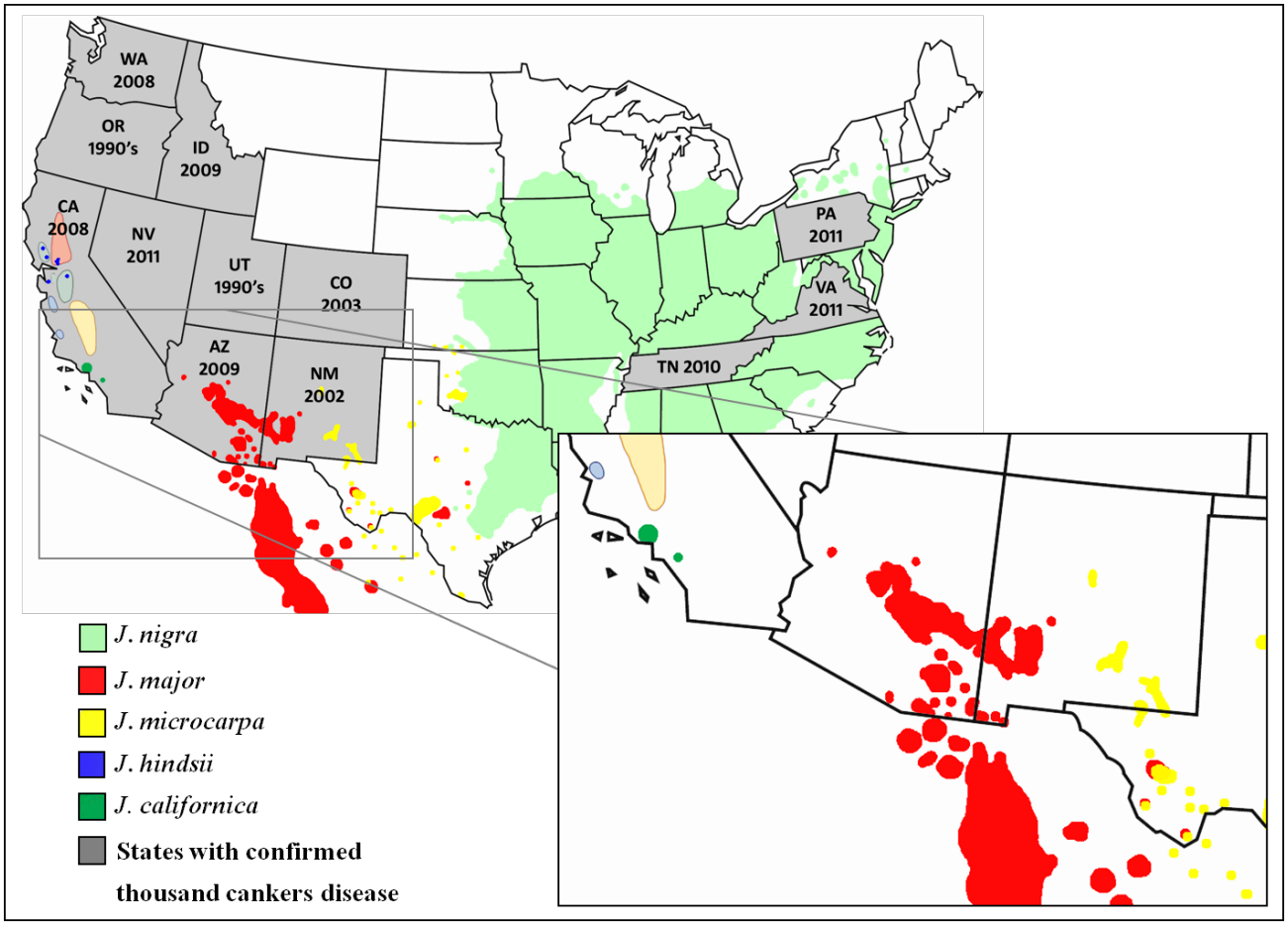

Figure 2

Survey of *Juglans* Germplasm Collection for TCD, Solano Co., California, Sept., 2009

"Species"	*N*	Percentage Infected (mean ± S.E.)
J. ailantifolia	124	0
*J. californica**	208	58.2 ± 3.4%
J. cathayensis	4	0
J. hindsii	180	75.0 ± 3.3%
J. major	133	9.8 ± 2.6%
J. mandshurica	17	5.9 ± 5.7%

* 31 of 87 non-symptomatic trees were already dead

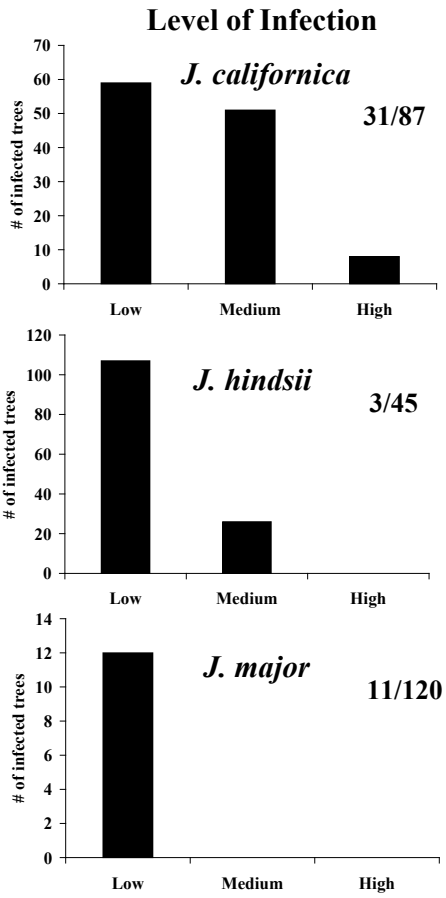

Figure 3

Survey of *Juglans* Germplasm Collection for TCD, Solano Co., California, Sept., 2009

"Species"	*N*	Percentage Infected (mean ± S.E.)
J. microcarpa	33	21.2 ± 7.1%
J. mollis	4	75.0 ± 21.7%
J. nigra	7	42.9 ± 18.7%
Paradox or hybrid	20	10.0 ± 6.7%
J. regia	188	11.7 ± 2.3%
J. sinensis	3	0