


Uses of Southern California Black Walnut (*Juglans californica*) in Landscaping, Restoration, and Control of Weedy Plant Species



Restoration, and Control of Weedy Plant Species



Eliza Hernández, Jose M. Marfori, Asma Y. Ayyad, Erin J. Questad, Edward G. Bobich, and Kristin R. Bozak
Biological Sciences Department; California State Polytechnic University, Pomona



Juglans californica
(Southern California black walnut)

- Endemic tree
- Deciduous
- Allelopathic (produces juglone)

Photo: Eliza Hernández

Objective 1

Test how a variety of native and non-native plant species respond to varying concentrations of juglone at seed and seedling stages

Objective 2

Understand the phenology of leaf loss, microclimate conditions, and juglone concentration under existing *J. californica* trees and test how native and weedy invasive species respond to changing conditions beneath these trees

Objective 3

Explore the physiological mechanisms by which juglone interferes with plant growth

Objective 4

Develop a list of potential landscaping plants that can co-occur with *J. californica* similar to lists that can exist for *J. nigra*, the Eastern black walnut

Methods

Greenhouse Experiment (Objective 1):

- 20 seedlings of 4 native shrubs were subject to 3 treatments:
 1. Control (8 seedling replicates per species)
 2. Walnut mulch (6 seedling replicates per species)
 3. 0.5 mM juglone solution (6 seedling replicates per species)
- Plant stress data collection: chlorophyll fluorescence (F_v/F_m)

Field Experiment (Objective 2):

- Lyle Center for Regenerative Studies, Cal Poly Pomona
- 7 native shrubs and 1 native bunch grass were planted in 3 different locations with respect to 8 different *J. californica* trees (Fig. 1):
 1. Underneath the canopy
 2. Along the dripline
 3. Outside of the canopy in the open
- Plant stress data collection: chlorophyll fluorescence (F_v/F_m)
- Microclimate data collection: PAR, soil temperature, soil moisture

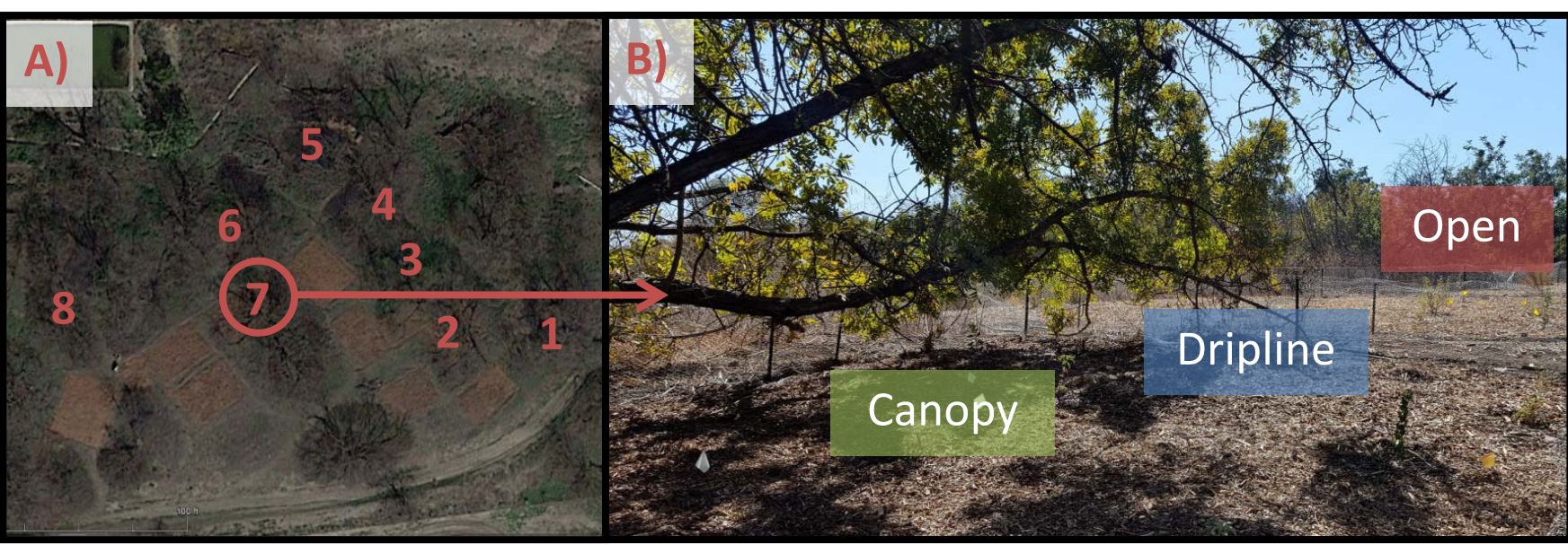


Fig. 1 A) Aerial view of our 8 experimental trees at the Lyle Center
B) Experimental design of planting locations at each tree

Photo: Google Earth; Photo: Sierra Lauman

Plant Stress Results (continued)

***Frangula californica* (California coffeeberry)**
-Native shrub-

F. californica is least stressed by conditions underneath the canopy/dripline of *J. californica* and tolerates juglone

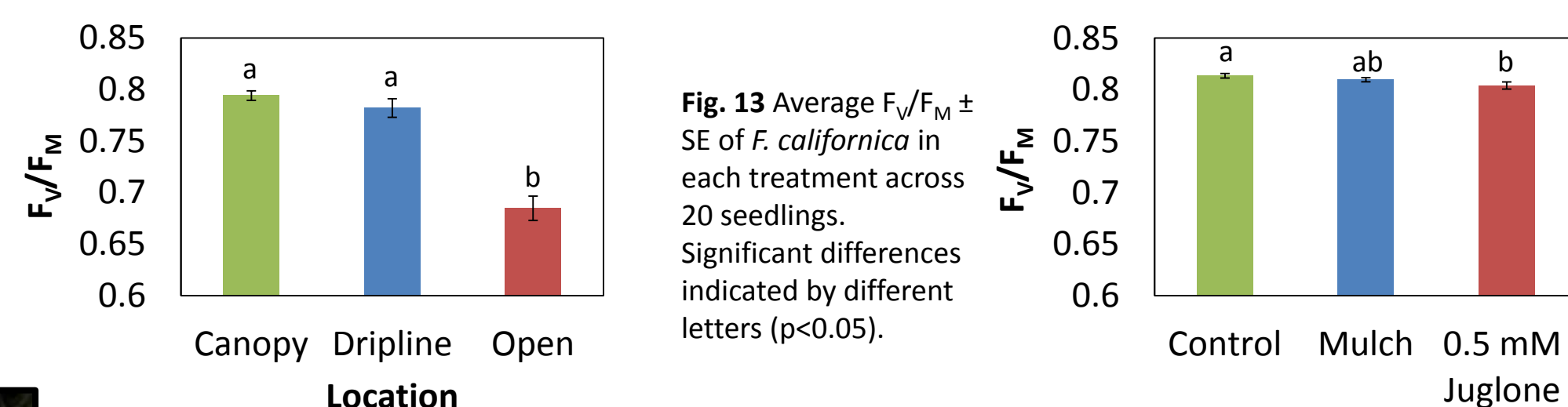


Fig. 12 Average $F_v/F_m \pm$ SE of *F. californica* in each location across eight trees. Significant differences indicated by different letters ($p < 0.05$).

Fig. 13 Average $F_v/F_m \pm$ SE of *F. californica* in each treatment across 20 seedlings. Significant differences indicated by different letters ($p < 0.05$).

***Artemisia californica* (California sagebrush)**
-Native shrub-

A. californica is least stressed by conditions underneath the canopy of *J. californica* and tolerates juglone

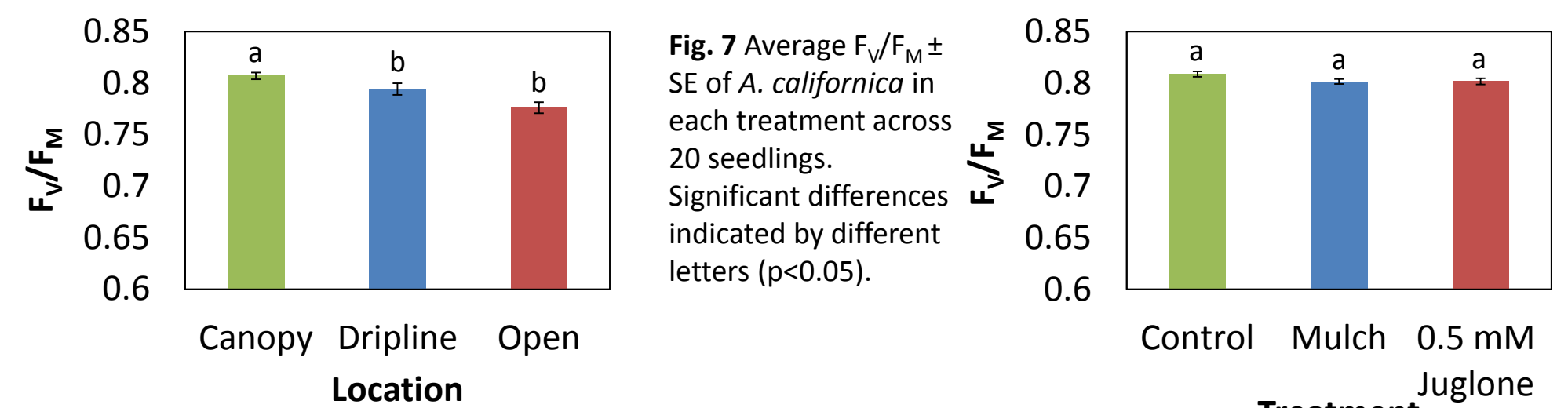


Fig. 6 Average $F_v/F_m \pm$ SE of *A. californica* in each location across eight trees. Significant differences indicated by different letters ($p < 0.05$).

Fig. 7 Average $F_v/F_m \pm$ SE of *A. californica* in each treatment across 20 seedlings. Significant differences indicated by different letters ($p < 0.05$).

***Stipa pulchra* (Purple needle grass)**
-Native perennial grass-

S. pulchra is least stressed by conditions underneath the canopy of *J. californica* and tolerates juglone

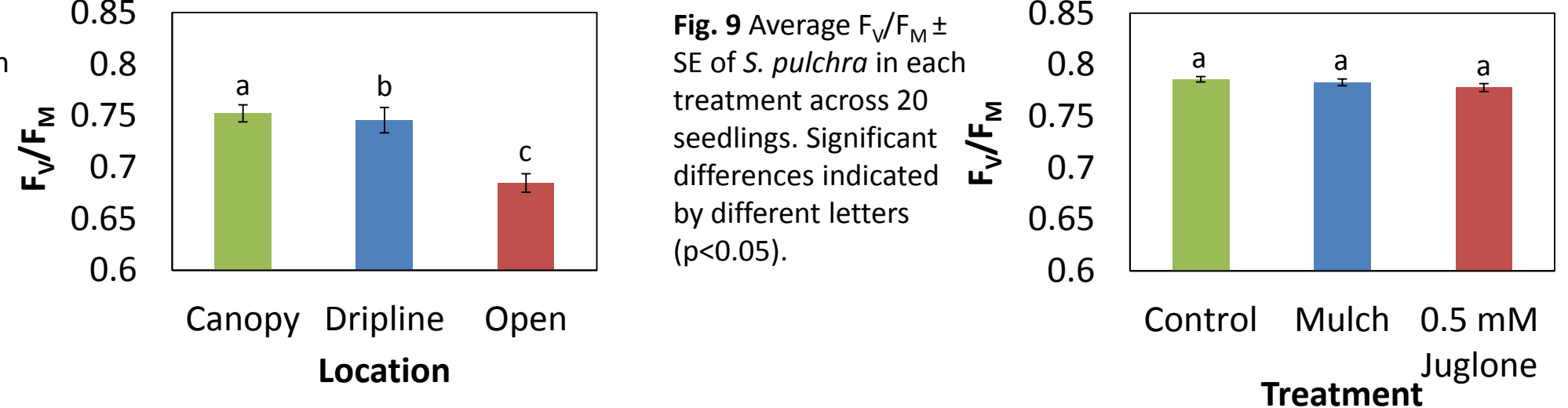


Fig. 8 Average $F_v/F_m \pm$ SE of *S. pulchra* in each location across eight trees. Significant differences indicated by different letters ($p < 0.05$).

Fig. 9 Average $F_v/F_m \pm$ SE of *S. pulchra* in each treatment across 20 seedlings. Significant differences indicated by different letters ($p < 0.05$).

***Prunus ilicifolia* (Holly-leaf cherry)**
-Native tree, shrub-

P. ilicifolia is least stressed by conditions underneath the canopy/dripline of *J. californica* and responds positively to juglone

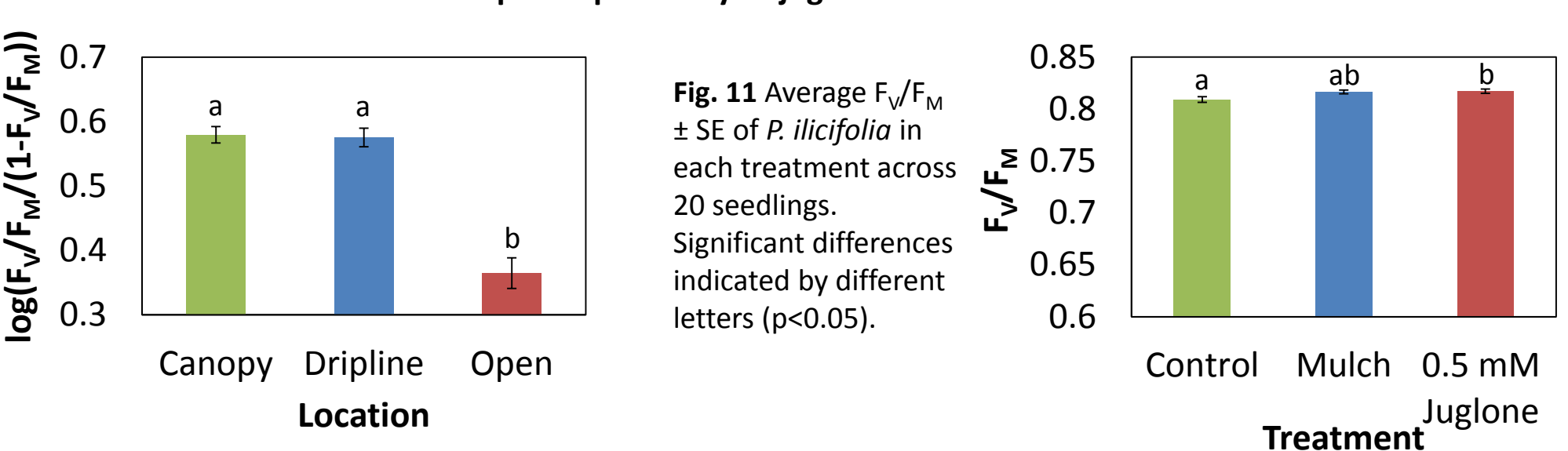


Fig. 10 Average $F_v/F_m \pm$ SE of *P. ilicifolia* in each location across eight trees. Significant differences indicated by different letters ($p < 0.05$).

Fig. 11 Average $F_v/F_m \pm$ SE of *P. ilicifolia* in each treatment across 20 seedlings. Significant differences indicated by different letters ($p < 0.05$).

Plant Stress Results (continued)

***Salvia apiana* (White sage)**
-Native shrub-

S. apiana is least stressed by conditions underneath the canopy of *J. californica*

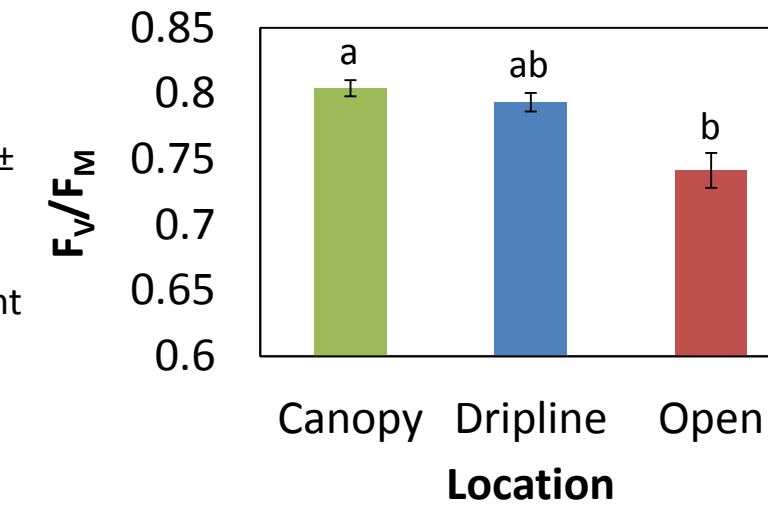


Fig. 4 Average $F_v/F_m \pm$ SE of *S. apiana* in each location across eight trees. Significant differences indicated by different letters ($p < 0.05$).

***Eriogonum fasciculatum* (California buckwheat)**
-Native shrub-

Location did not affect the stress level of *E. fasciculatum*

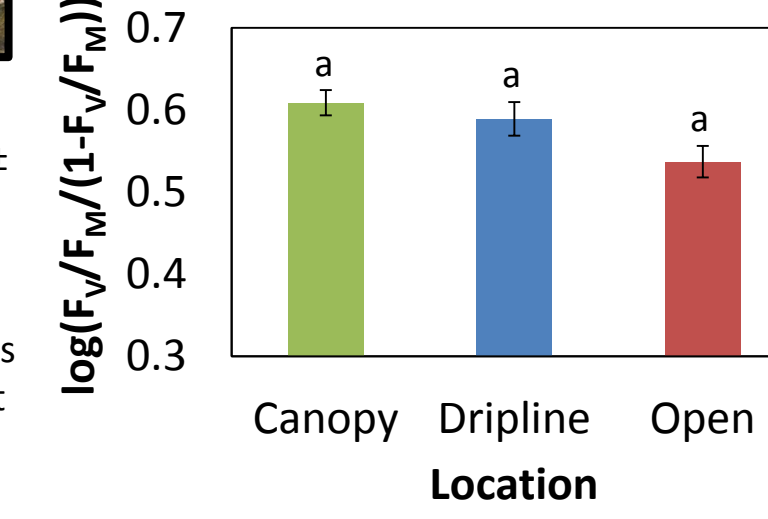


Fig. 3 Average $F_v/F_m \pm$ SE of *E. fasciculatum* in each location across eight trees. Significant differences indicated by different letters ($p < 0.05$).

Plant Stress Results

***Heteromeles arbutifolia* (Toyon)**
-Native shrub-

H. arbutifolia is least stressed by conditions underneath the canopy of *J. californica*

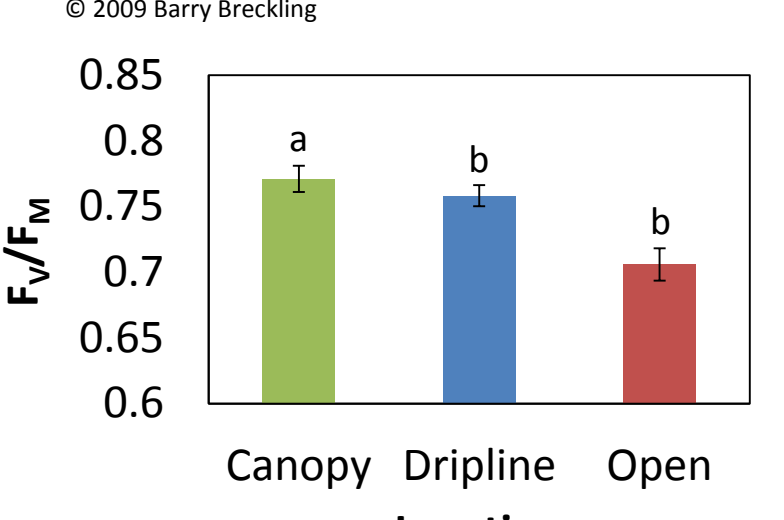


Fig. 2 Average $F_v/F_m \pm$ SE of *H. arbutifolia* in each location across eight trees. Significant differences indicated by different letters ($p < 0.05$).

***Salvia mellifera* (Black sage)**
-Native shrub-

S. mellifera is least stressed by conditions underneath the canopy of *J. californica*

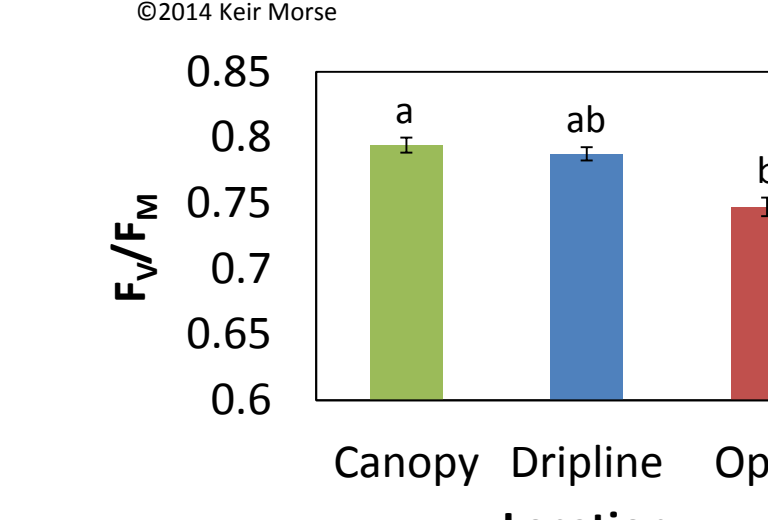


Fig. 3 Average $F_v/F_m \pm$ SE of *S. mellifera* in each location across eight trees. Significant differences indicated by different letters ($p < 0.05$).

***J. californica* Microclimate**

Transmittance of PAR increases from the canopy to the open

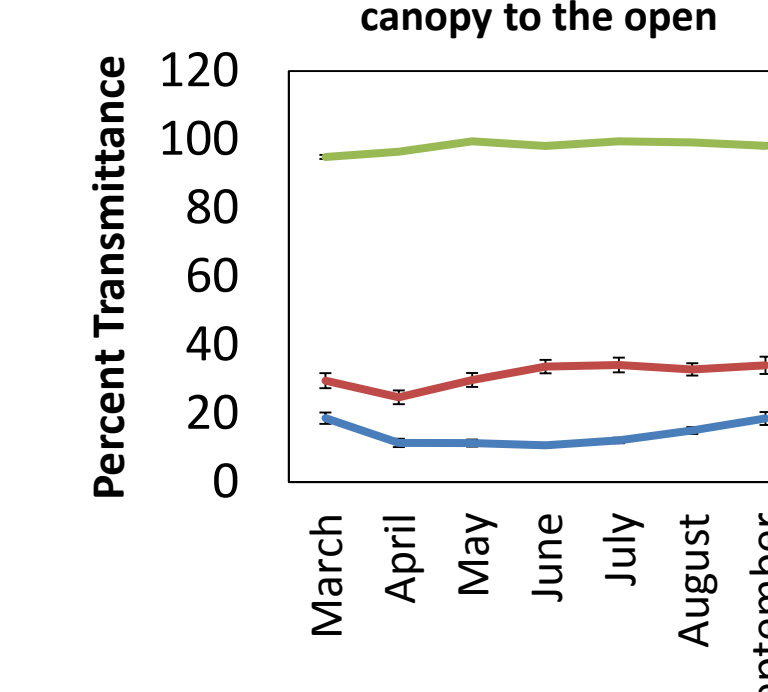


Fig. 14 Average transmittance of photosynthetically active radiation (PAR) \pm SE in each location across 8 trees.

Soil temperature increases from the base of the tree to the open

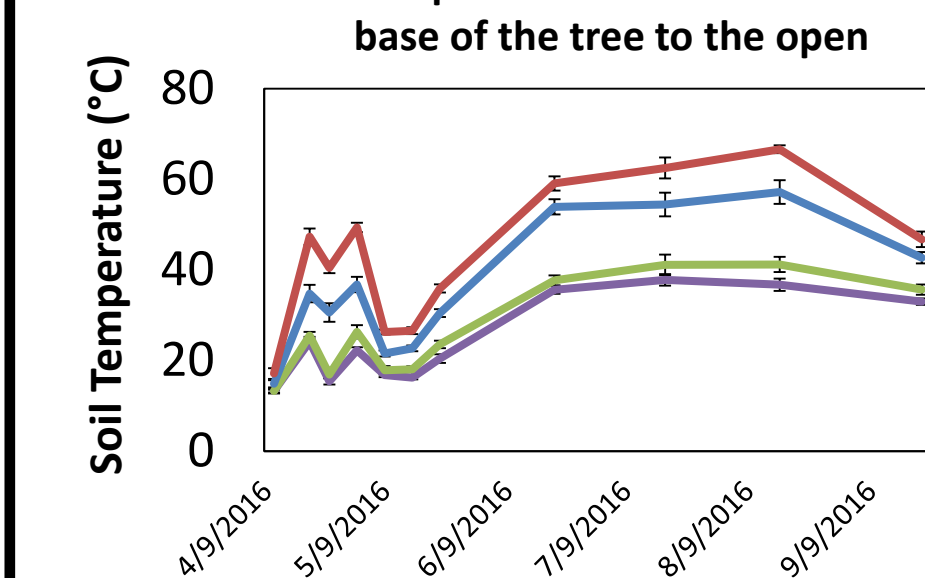


Fig. 15 Average soil temperature \pm SE in each location across 5 trees.

Soil moisture decreases from the base of the tree to the open

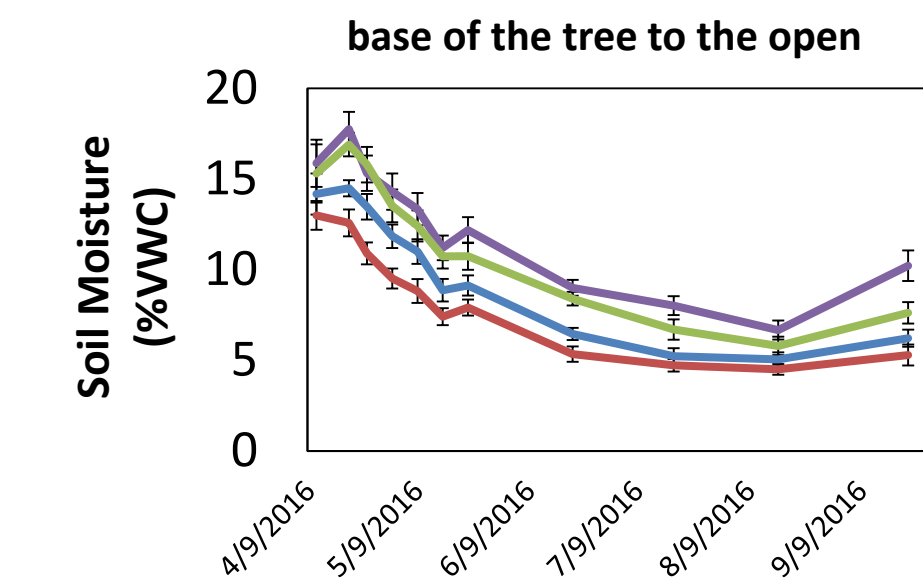


Fig. 16 Average soil volumetric water content \pm SE in each location across 5 trees.

Summary

Objective 1
At the seedling stage:
• *A. californica*, *S. pulchra*, and *F. californica* seem to tolerate juglone
• *P. ilicifolia* responds positively to juglone

Objective 2
• Microclimate conditions vary across space and time
• Conditions underneath the canopy and along the dripline are less stressful than in the open
• All species are less stressed in canopy conditions than in open conditions

Objective 3
In progress

Objective 4
• *E. fasciculatum* seems to thrive in conditions across all locations
• *H. arbutifolia*, *S. mellifera*, and *S. apiana* seem to favor canopy conditions over open conditions
• *A. californica*, *S. pulchra*, and *F. californica* seem to tolerate juglone and canopy conditions
• *P. ilicifolia* seems to respond positively to juglone and canopy conditions

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