

Introduction

- The Southern California black walnut, *Juglans californica*, is an endemic, drought tolerant, native deciduous tree.
- Juglans californica*, along with other species in the genus *Juglans*, produce the compound juglone (5-hydroxy-1,4-naphthoquinone).
- Juglone has been shown to inhibit the growth of understory plant species due to an allelopathic effect.
- Juglone also has been shown to prevent seed germination *in vitro*, so sensitive plants may be prevented from even germinating in close proximity to a walnut tree (1).
- The effects of juglone have not been explored in California plant communities.
- Determining which native species can co-occur with *J. californica* and be used as companion plantings can increase the use of this drought-tolerant tree in landscaping and restoration.
- Determining which invasive species are suppressed by *J. californica* can indicate its use in inhibiting the spread of weeds.



Objective

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

Methods

Experimental Design:

- Seeds were surface sterilized and sown in groups of 100 in petri dishes and set in light banks.
- The effects of five different concentrations of laboratory grade juglone were tested on 10 different species:
 - 0mM, 0.01mM, 0.05mM, 0.1mM, and 0.5mM

Native Species

Amsinckia intermedia
Phacelia distans
Deinandra fasciculata
Diplacus longiflorus

Invasive Species

Bromus diandrus
Bromus madritensis ssp. rubens
Brassica nigra
Hirschfeldia incana
Carduus pycnocephalus
Silybum marianum

Data collection:

- Total germination in each dish was recorded daily.
- Average radicle length was measured weekly by randomly selecting 10 individuals from each dish.
- Trials were run for a minimum of 3 weeks.

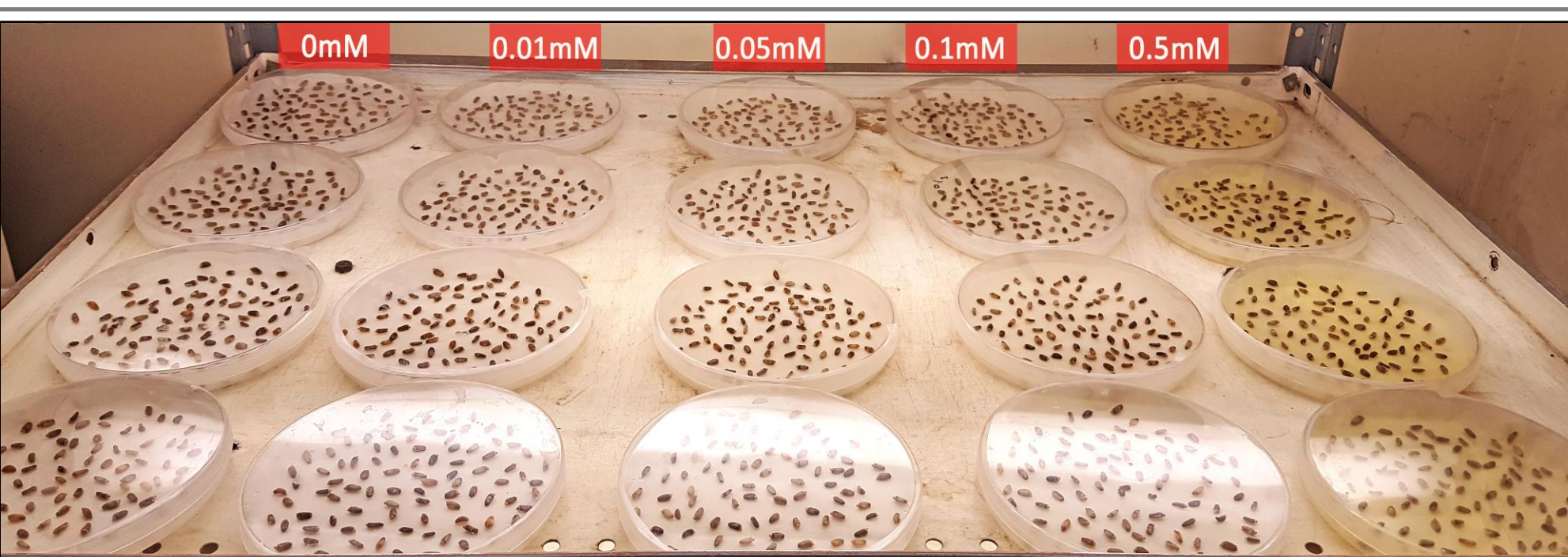


Fig 1. Experimental setup displaying 4 replicate plates per juglone concentration.

Results

-INVASIVE SPECIES GERMINATION-

Bromus madritensis ssp. rubens (Red brome)



Germination of *B. madritensis* was inhibited by juglone concentrations greater than or equal to 0.1mM.

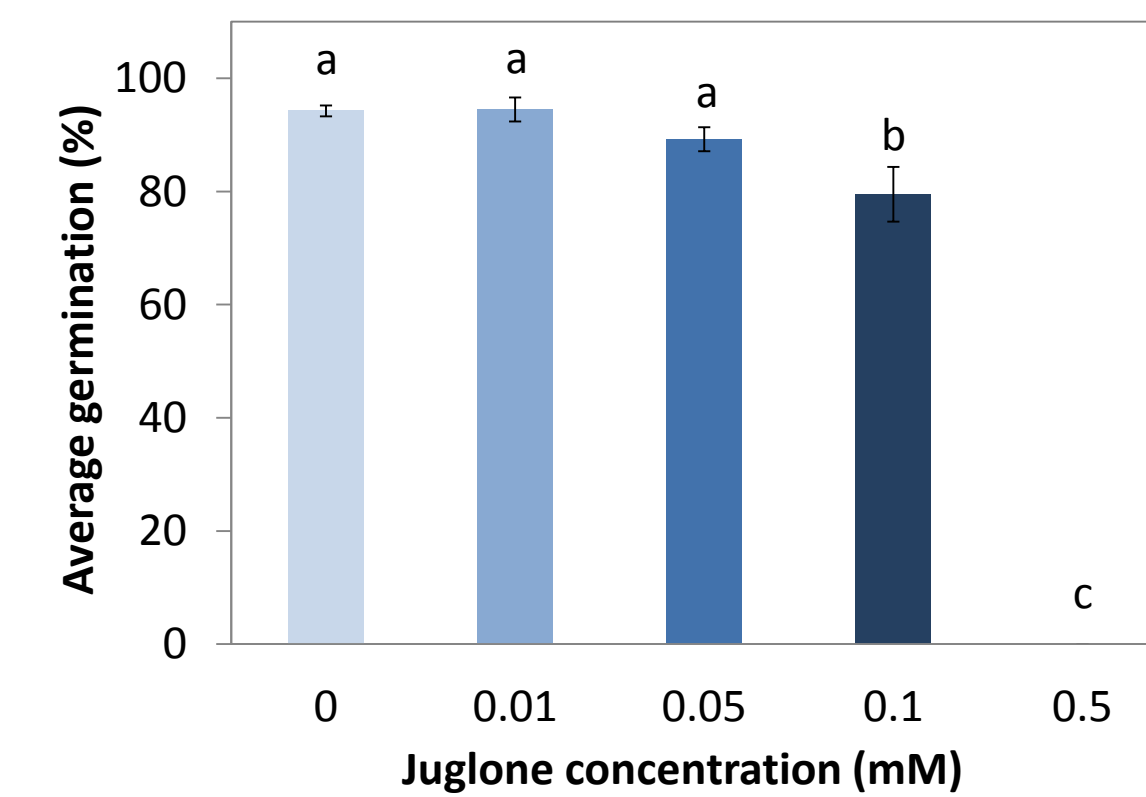


Fig 2. Final average germination \pm SE for *B. madritensis*. Significant differences indicated by different letters ($p < 0.05$).

Bromus diandrus (Ripgut grass)



Preliminary results show that germination of *B. diandrus* is inhibited by juglone concentrations greater than or equal to 0.05mM.

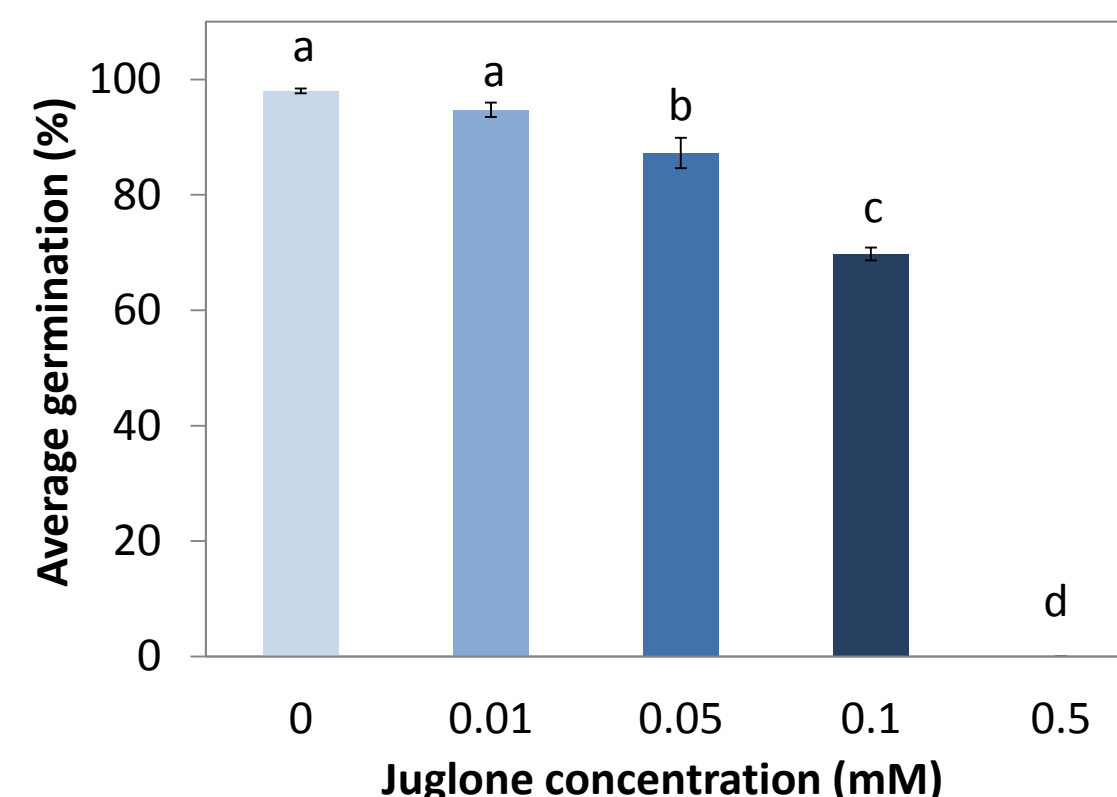


Fig 3. Final average germination \pm SE for *B. diandrus*. Significant differences indicated by different letters ($p < 0.05$).

Hirschfeldia incana (Shortpod mustard)



Germination of *H. incana* was inhibited by juglone concentrations greater than or equal to 0.01mM.

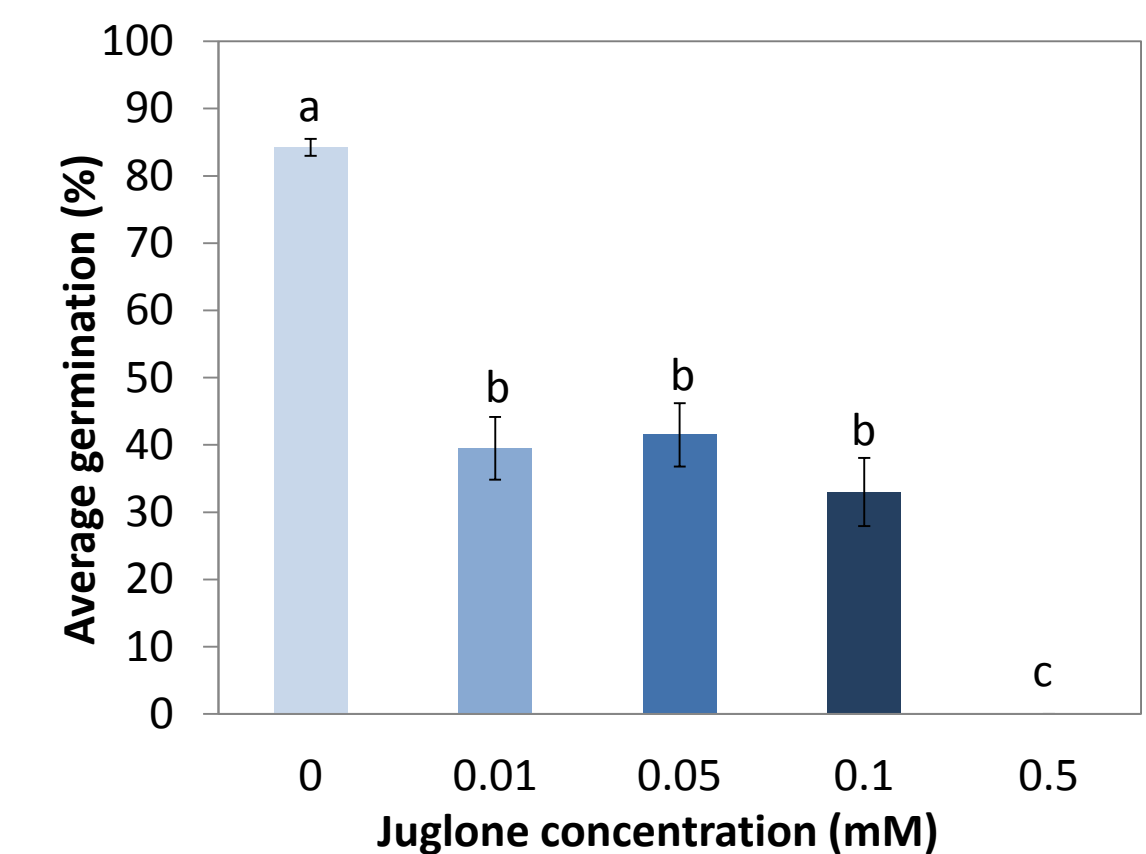


Fig 4. Final average germination \pm SE for *H. incana*. Significant differences indicated by different letters ($p < 0.05$).

Brassica nigra (Black mustard)



Preliminary results show that germination of *B. nigra* is inhibited by juglone concentrations greater than or equal to 0.01mM.

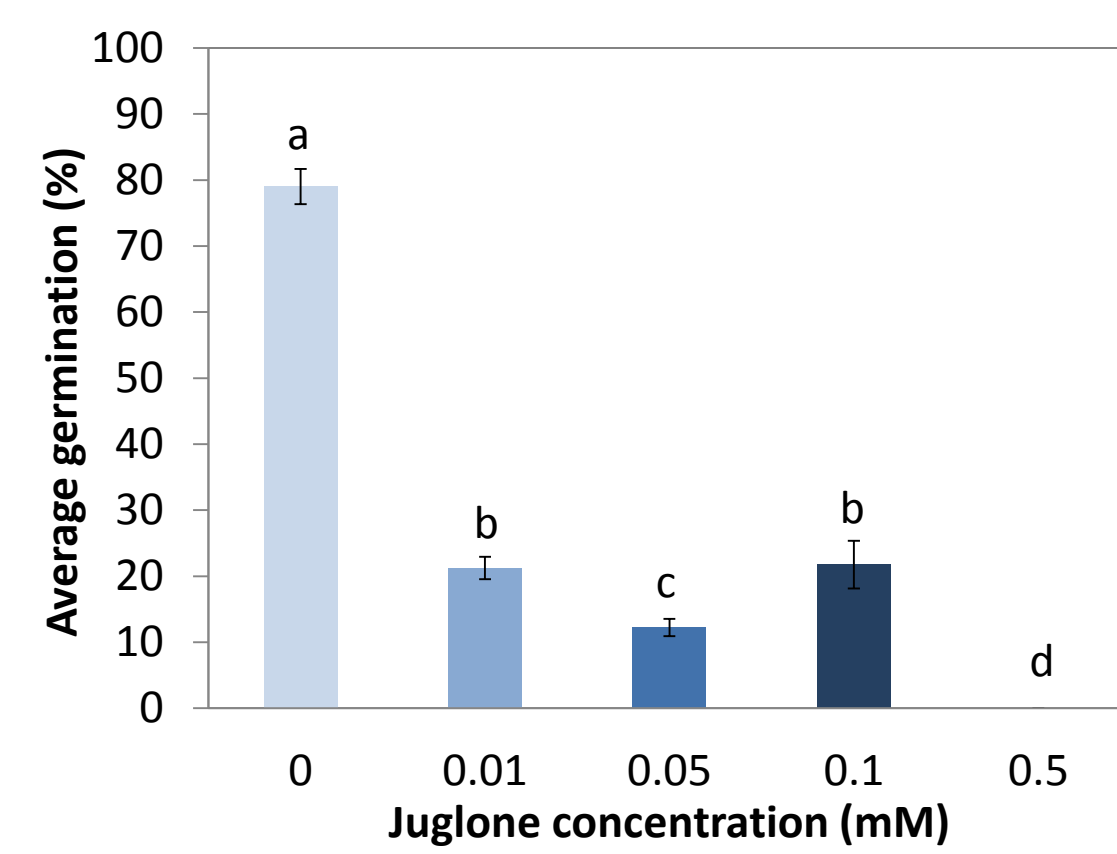


Fig 5. Final average germination \pm SE for *B. nigra*. Significant differences indicated by different letters ($p < 0.05$).

-NATIVE SPECIES GERMINATION-

Amsinckia intermedia (Common fiddleneck)



Germination of most native species was inhibited by juglone concentrations greater than or equal to 0.05mM.

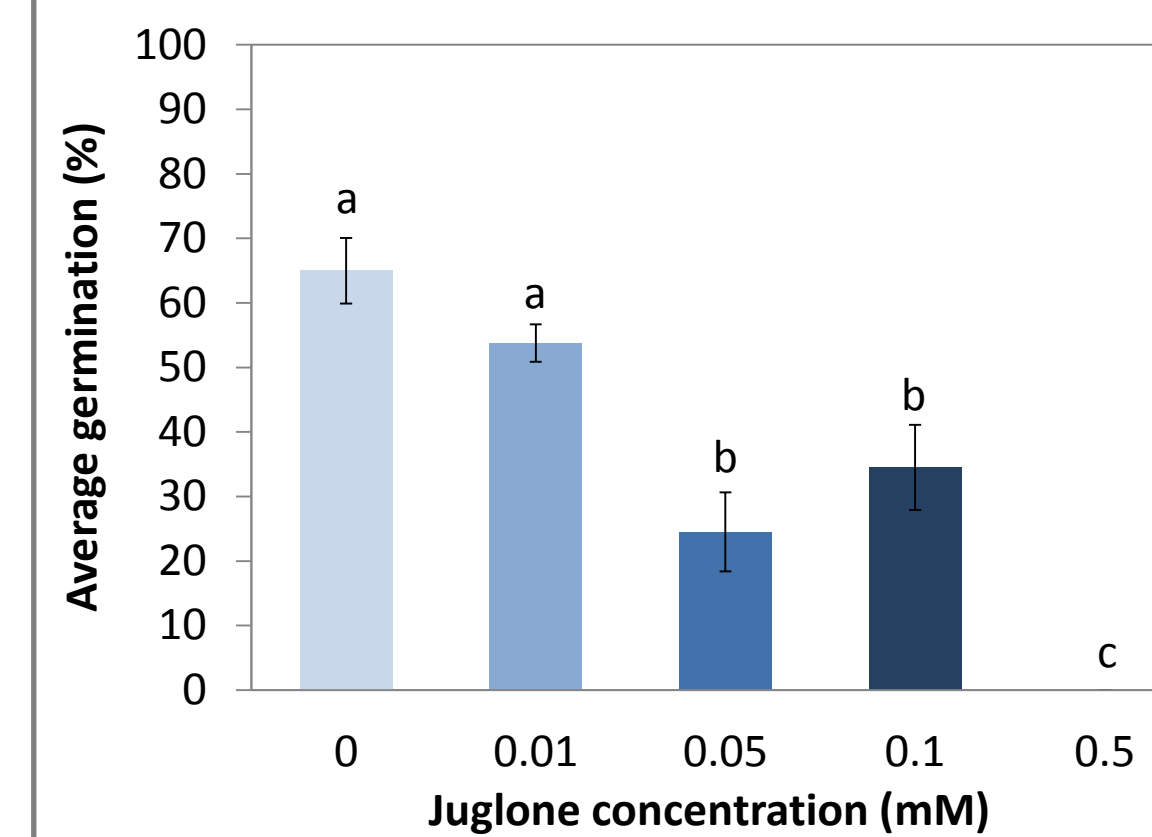


Fig 6. Final average germination \pm SE for *A. intermedia*. Significant differences indicated by different letters ($p < 0.05$). Results shown for *A. intermedia* were qualitatively similar for all native species.

Deinandra fasciculata (Clustered tarweed)



Germination of *D. fasciculata* was stimulated by 0.05mM and 0.1mM concentrations of juglone.

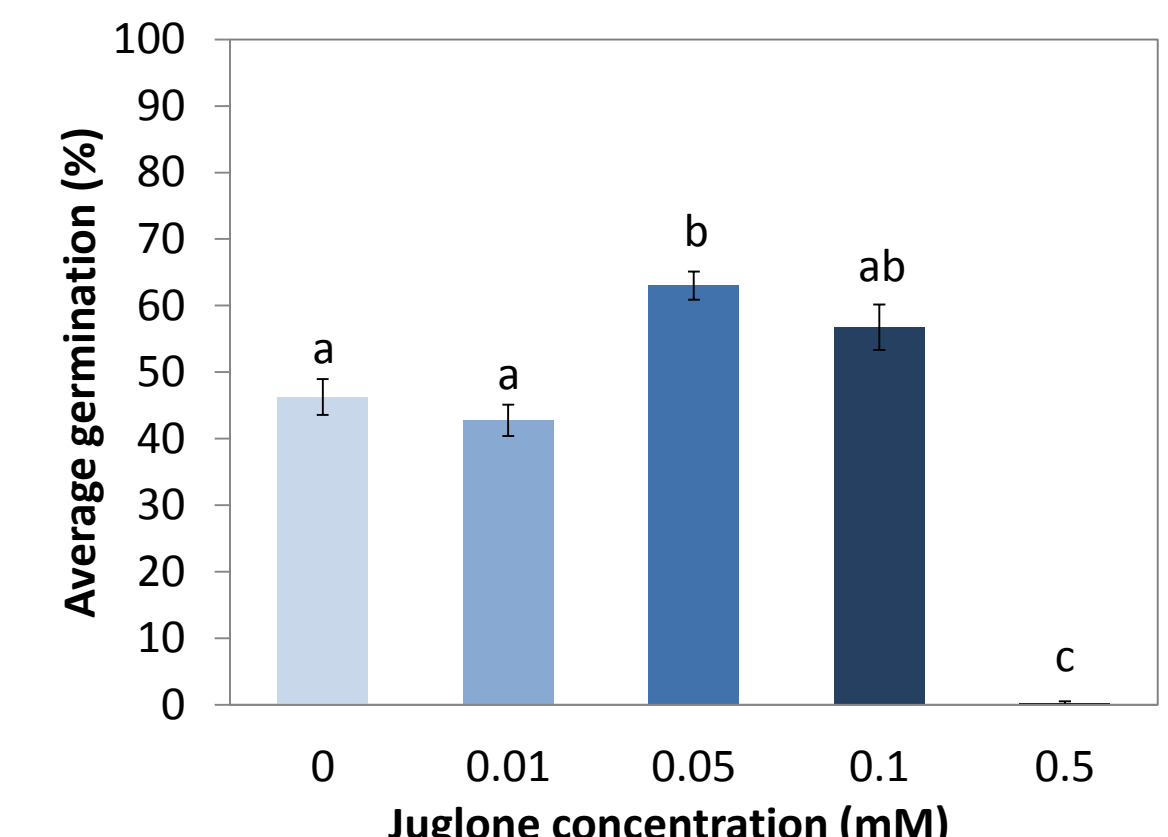


Fig 7. Final average germination \pm SE for *D. fasciculata*. Significant differences indicated by different letters ($p < 0.05$).

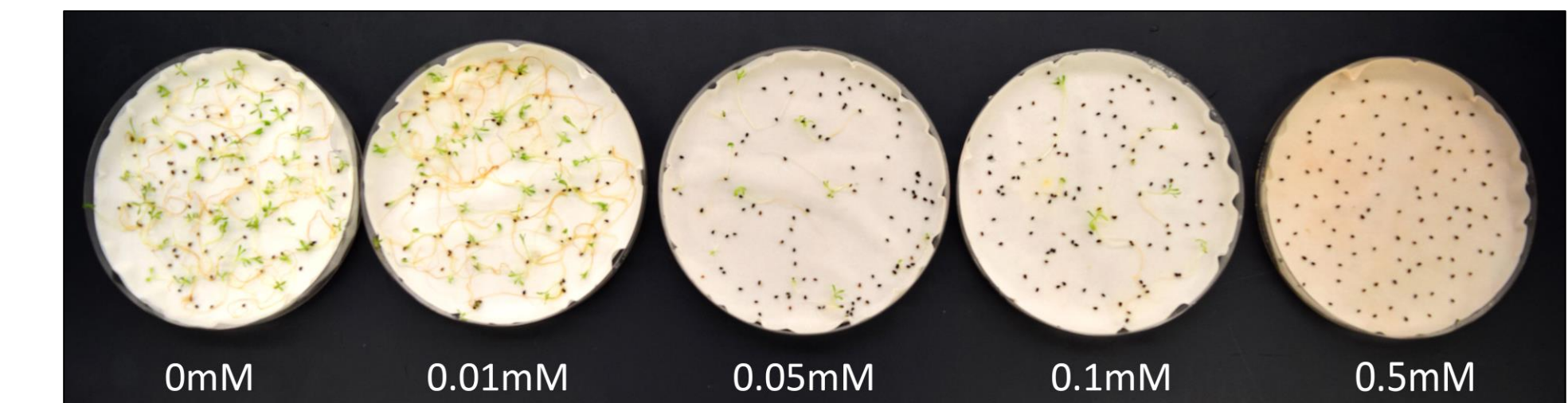


Fig 8. Final germination for *Amsinckia intermedia* among all juglone treatments. Plates treated with juglone concentrations of 0.05mM and higher displayed significantly decreased germination.

Summary

Germination:

Nine of the ten species tested were negatively affected by juglone at varying concentrations.

Negatively affected

- Amsinckia intermedia*
- Diplacus longiflorus*
- Phacelia distans*
- Bromus diandrus*
- Bromus madritensis*
- Carduus pycnocephalus*
- Hirschfeldia incana*
- Brassica nigra*
- Silybum marianum*

Positively affected

- Deinandra fasciculata*

Radicle elongation:

Eight of the ten species tested were negatively affected by juglone at varying concentrations.

Negatively affected

- Amsinckia intermedia*
- Deinandra fasciculata*
- Diplacus longiflorus*
- Bromus diandrus*
- Carduus pycnocephalus*
- Hirschfeldia incana*
- Brassica nigra*
- Silybum marianum*

No effect

- Bromus madritensis*
- Phacelia distans*

-RADICLE ELONGATION-

Juglone either inhibited radicle elongation or had no effect.

Fig 9. Final radicle lengths for *H. incana* after three weeks. Radicle lengths are significantly decreased across juglone treatments.

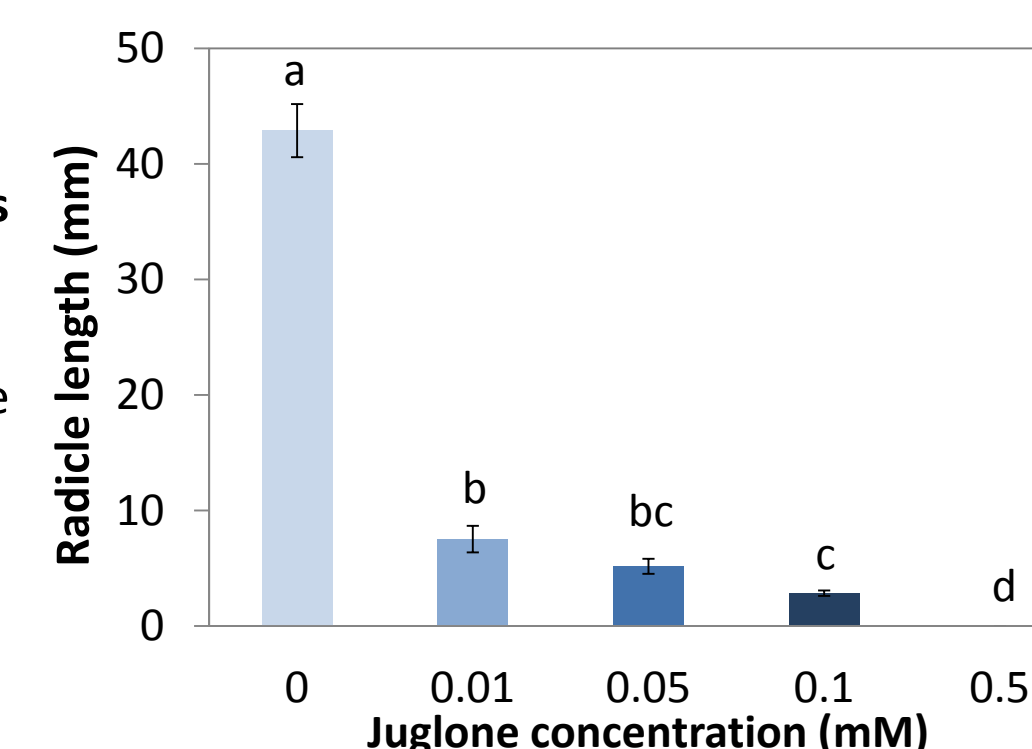
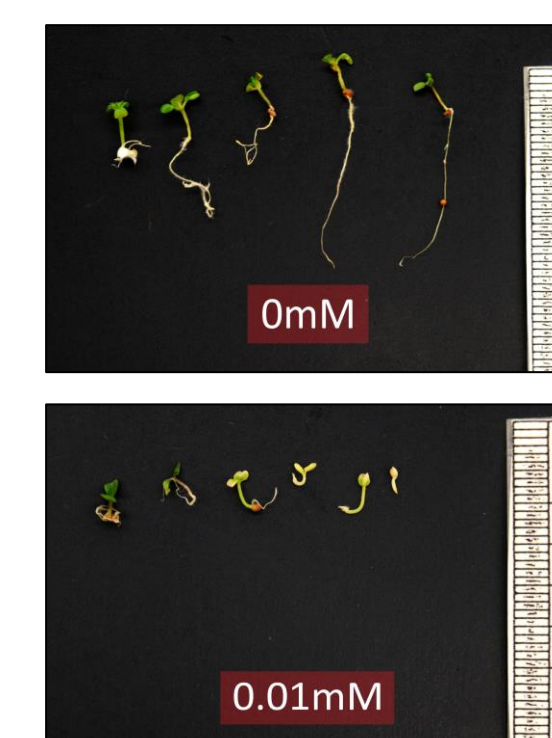


Fig 10. Differences in *Hirschfeldia incana* radicle lengths between 0mM and 0.01mM treatments after 3 weeks. Radicle development was inhibited at 0.01mM.



References

- Rietveld, W. J. 1983. Allelopathic effects of juglone on germination and growth of several herbaceous and woody species. *Journal of Chemical Ecology* 9:295-308.

Acknowledgements

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