

# Assessing the success of scarification in promoting germination in *Cuscuta glomerata*, a hard-seeded parasite

Julie Bailard<sup>1</sup> and Drake Mullett<sup>2,3</sup>

<sup>1</sup>Carleton College, <sup>2</sup>Northwestern University, <sup>3</sup>Chicago Botanic Garden

## Background

- Rope dodder, *Cuscuta glomerata*, is one of few parasitic plants in tallgrass prairie that derives all fixed carbon from its host
- Parasites like dodder might mediate interspecies competition to maintain biodiversity in increasingly fragmented prairie
- Laboratory study of *C. glomerata* could yield information about its peculiar, rootless lifecycle and its interactions with hosts, but no one knows how to germinate *C. glomerata*
- Other species of dodder are hard-seeded and need scarification with acid, sanding, or boiling to break the seed coat

## Question

**Which scarification methods and climate incubation conditions most successfully promote germination in *Cuscuta glomerata*?**

## Methods

840 *C. glomerata* seeds from one individual were sorted into 7 scarification treatments groups, each with 4 climate conditions, with 3 replicates,  $n=10$

Seeds were submerged in concentrated  $H_2SO_4$  for 10, 20, or 30 minutes and rinsed 5 times with  $dH_2O$

Seeds were boiled in  $dH_2O$  for 10, 20, or 30 seconds and rinsed 5 times with cool  $dH_2O$

Seeds were rinsed 5 times with  $dH_2O$

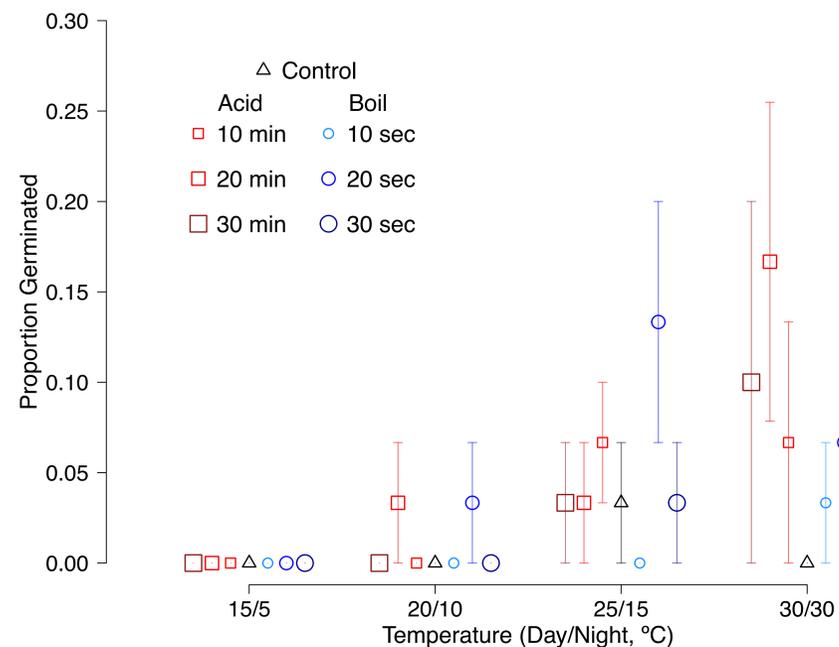
Seeds from all scarification treatments were randomly assigned to 84 4cm Petri dishes. A replicate contained 10 seeds from each scarification treatment in 7 dishes. 3 replicates were assigned to each of 4 climate conditions: 15/5°C, 20/10°C, 25/15°C, and 30/30°C

Seeds were checked for radicle protrusion every 24 hours for 6 days



Brian O'Brien, 2013

## Results



**Figure 1.** Proportion of *C. glomerata* seeds exposed to scarification treatments that successfully germinated after 6 days of incubation in one of four climate conditions

- A comparison of generalized linear models with a likelihood ratio test suggested that incubation temperature ( $p=2.5 \times 10^{-9}$ ) and scarification treatment ( $p=0.031$ ) additively influence germination success
- The highest average germination rates observed for each scarification treatment were generally among the replicates exposed to 30/30°C
- Acid submersion for 20 min produced the highest germination rate at optimal climate conditions (16.7%)
- Boiling for 20-30 seconds both offered similarly high germination rates (13.3%) at 25/15 and 30/30 incubation conditions respectively
- Untreated seeds and seeds boiled for 10 seconds rarely germinated (at most 3.3%) even in warm conditions

## References

1. Benvenuti, S., G. Dinelli, A. Bonetti, and P. Catizone. 2005. Germination ecology, emergence and host detection. *Weed Research* 45: 270-278.
2. Hutchison, J. M., and F. M. Ashton. 1979. Effect of desiccation and scarification on the permeability and structure of the seed coat of *Cuscuta campestris*. *American Journal of Botany* 66(1): 40-46.
3. Jayasuriya, K. M. G. G., J. M. Baskin, R. L. Geneve, C. C. Baskin, and C. T. Chien. 2008. Physical dormancy in seeds of the holoparasitic angiosperm *Cuscuta australis* (Convolvulaceae, Cutaceae): dormancy-breaking requirements, anatomy of the water gap, and sensitivity cycling. *Annals of Botany* 102: 39-48.
4. McCormac, J. S. and J. L. Windus. 1993. Fire and *Cuscuta glomerata* Choisy in Ohio: a connection? *Rhodora* 95(882): 158-165.
5. Sarić-Krsmanović, M., D. Božić, D. Pavlović, L. Radivojević, and S. Vrbničanin. 2013. Temperature effects on *Cuscuta campestris* Yunk. seed germination. *Pesticides and Phytomedicine* 28(3): 187-193.
6. Tingey, D. C., and K. R. Allred. 1961. Breaking dormancy in seeds of *Cuscuta approximata*. *Weeds* 9(3): 429-436.

## Discussion & Conclusion

- *C. glomerata*, like other dodder species, is hard-seeded, and requires scarification of the outer seed coat before it can germinate
- Incubation temperature and scarification treatment both influence germination success in *C. glomerata*, with effects combine additively
- Given the high germination rate of scarified seeds incubated in warm conditions (30/30°C), *C. glomerata* seeds favor balmy conditions
- Acid scarification and scalding treatments were able to produce similarly high germination rates. Both could be viable scarification methods for artificial germination in the laboratory
- Acid scarification longer than 20 minutes reduced germination rates.  $H_2SO_4$  dissolves the outermost seed coat layers and damage the embryo faster in *C. glomerata* than some dodder species but slower than others, implying interspecific variation in seed coat thickness
- The success of scalding in increasing germination may relate to the influence of burning on rope dodder proliferation observed in Ohio populations after statewide extirpation

## Acknowledgments

- Team Echinacea
- Funding provided by the National Science Foundation

