

Effects of watering, mulch, and fabric on tree survival



Results from controlled experiments at King County Restoration Sites

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Why bother studying plants?



Ecological function, pervasive, potentially expensive, highly visible, high variable

The Goal

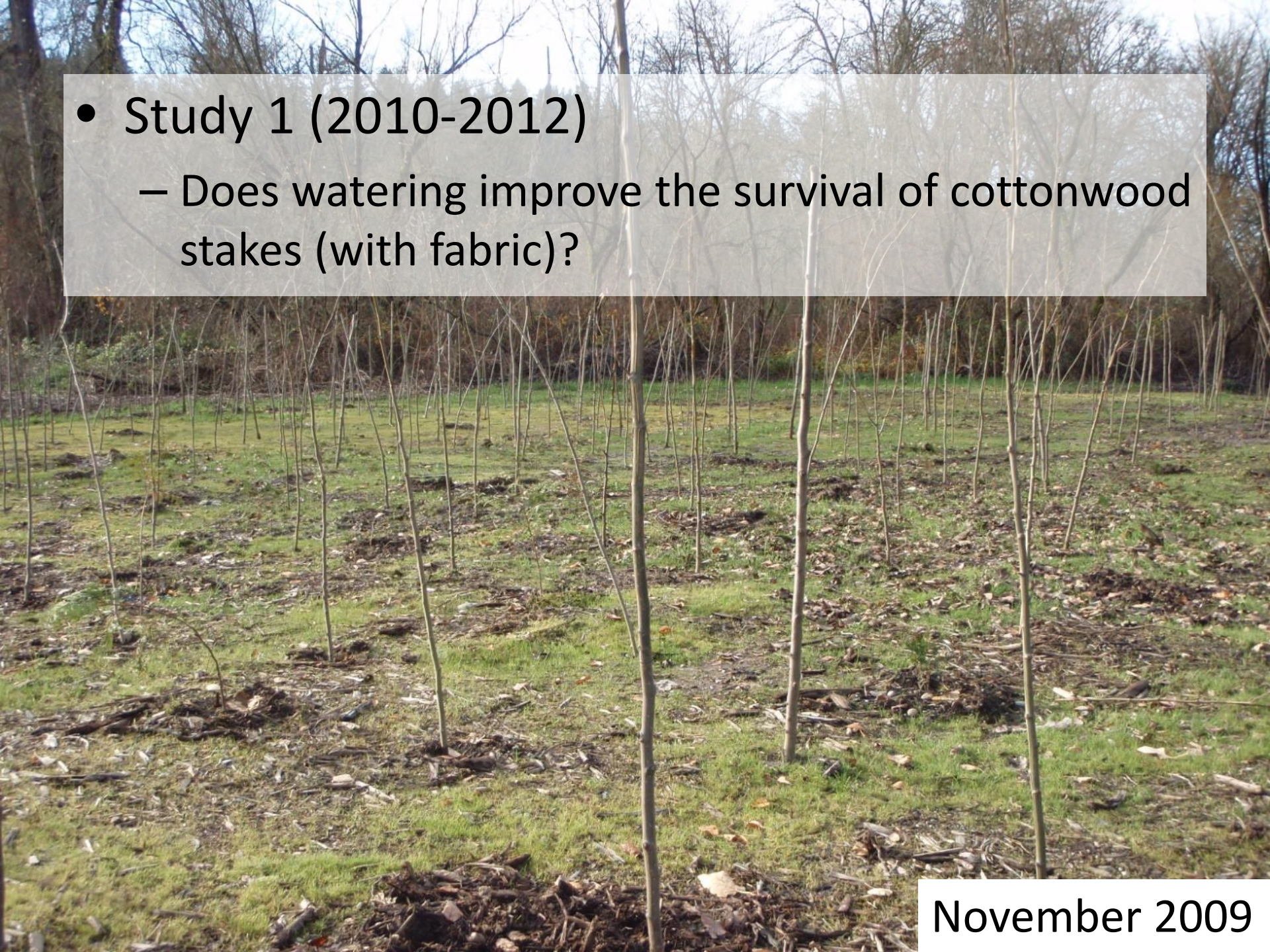
- To develop evidence-based guidelines for re-establishing native forests on restoration sites, based on clearly specified treatments shown to be effective in controlled research with a delineated population
 - Best establishment methods?
 - Planting vs. natural?
 - Most cost-effective maintenance techniques?
 - Watering, fabric, mulch, weeding?
 - How do these vary with site conditions?
 - High vs. low?
 - How do these vary between wet vs. dry years?

Study #1 & 2 - PAUTZKE



August 2012

- Study 1 (2010-2012)
 - Does watering improve the survival of cottonwood stakes (with fabric)?



November 2009

Study Design

Details

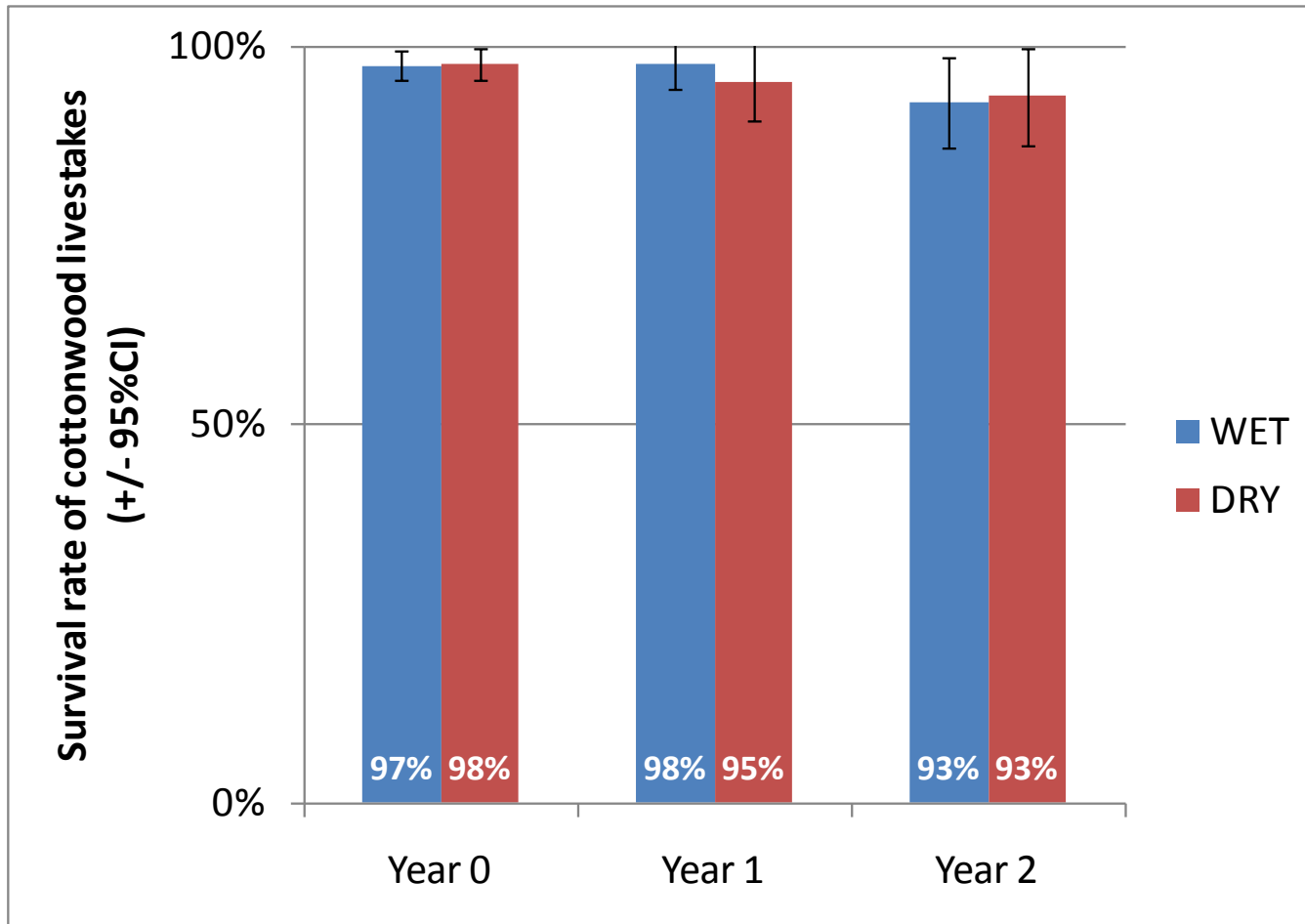
- 20 plots (10 x 10 m)
 - 10 wet
 - 10 dry
- Spatially randomized
- 721 cottonwood stakes
 - Avg. 36 per plot
 - fabric
- 165 cedar
 - Avg 8 per plot
 - fabric
- Treatment randomly assigned at plot level
- Watered 3 times in 2010
 - 15 July – 30 Aug

Layout

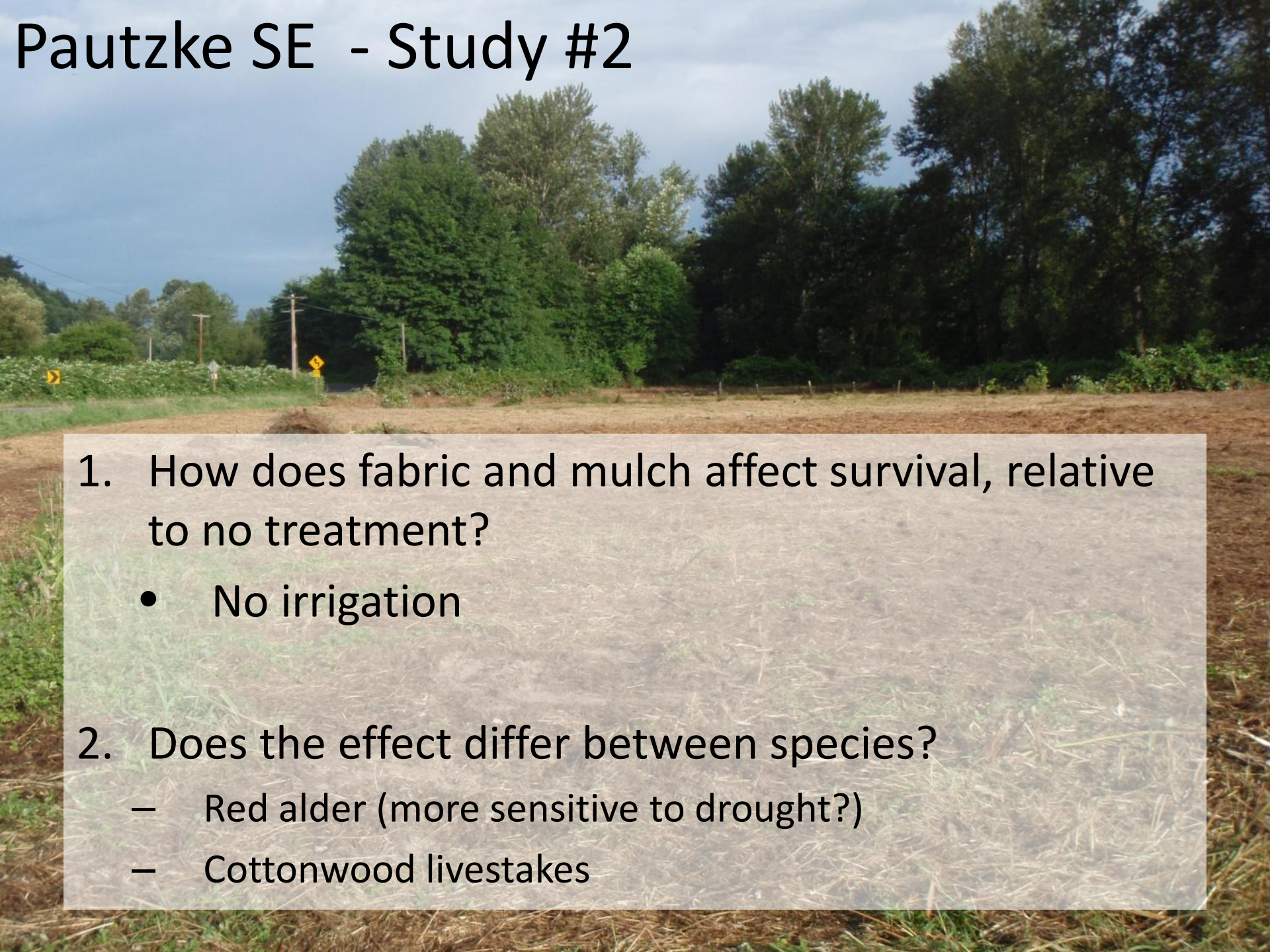


2010 photo

Results



Pautzke SE - Study #2

- 
1. How does fabric and mulch affect survival, relative to no treatment?
 - No irrigation
 2. Does the effect differ between species?
 - Red alder (more sensitive to drought?)
 - Cottonwood livestakes

Study Design

Details

- 30 plots (7.6 x 7.6 m)
 - 15 alder
 - 5 mulch
 - 5 fabric
 - 5 nothing
 - 15 cottonwood
- 650 trees
 - 25 plants per plot
- Treatment randomly assigned at plot level
- Not watered

Layout

- Cottonwood live stakes

f n m f f m m n n f m f n m n

- Potted 1-gal red alder

n n f m m m f f n f m n f n m

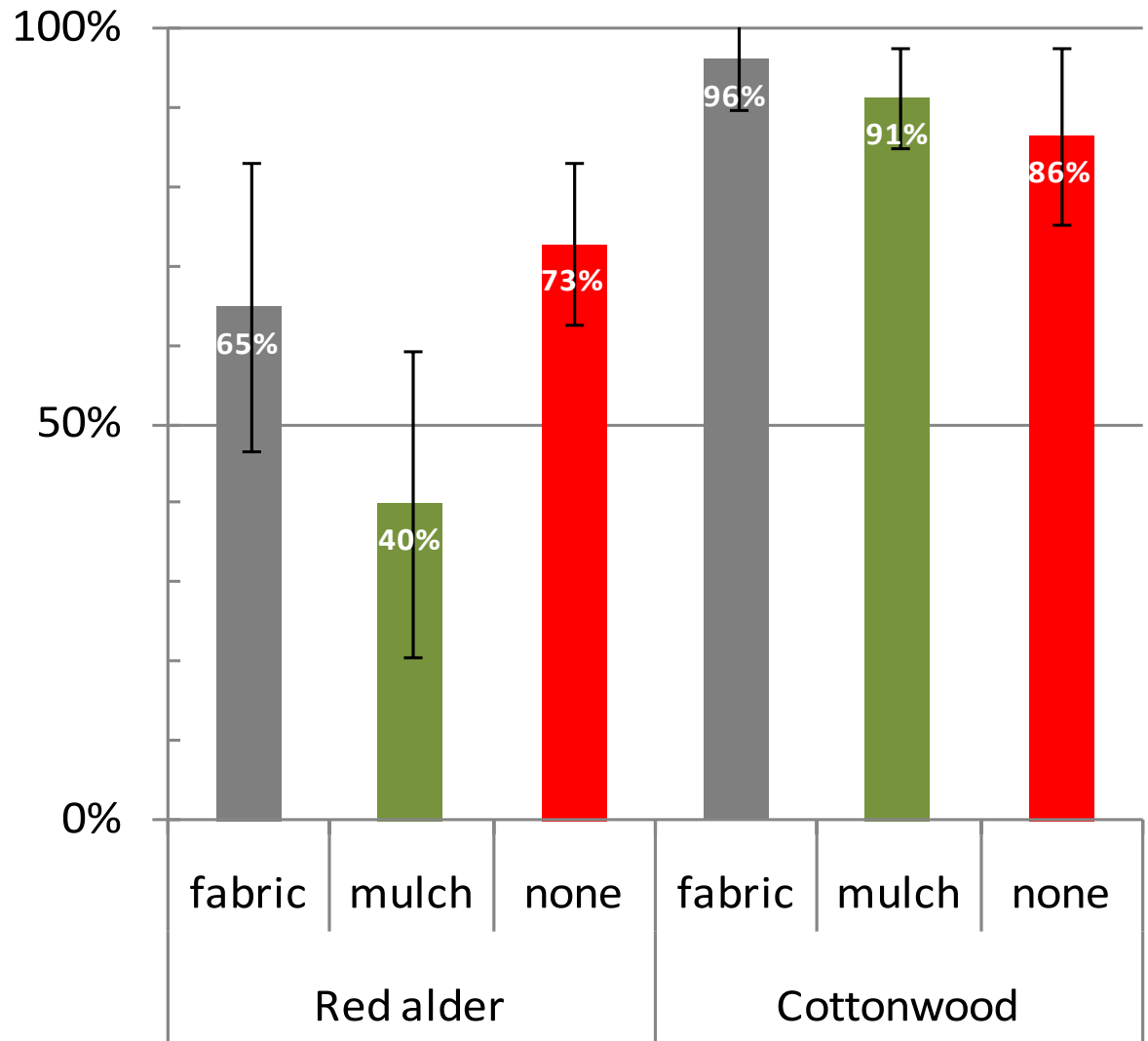
“Be very careful if you use mulches around trees and shrubs! Voles are often encouraged by a nice, loose mulch.”

[-WSU extension website](#)



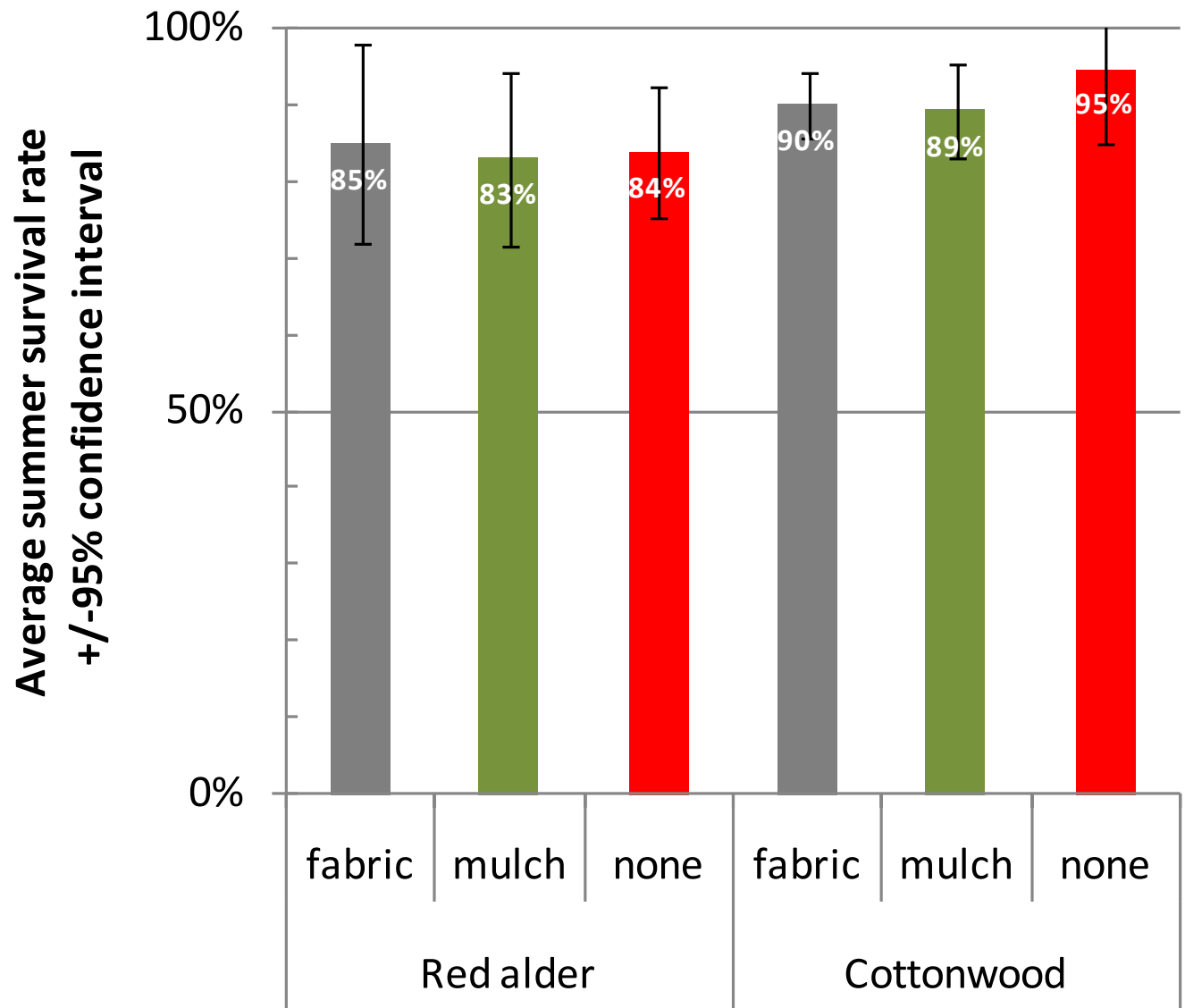
Average pre-summer survival rate
+/- 95% confidence interval

2011 to May 2012



Summer survival Sept 2012

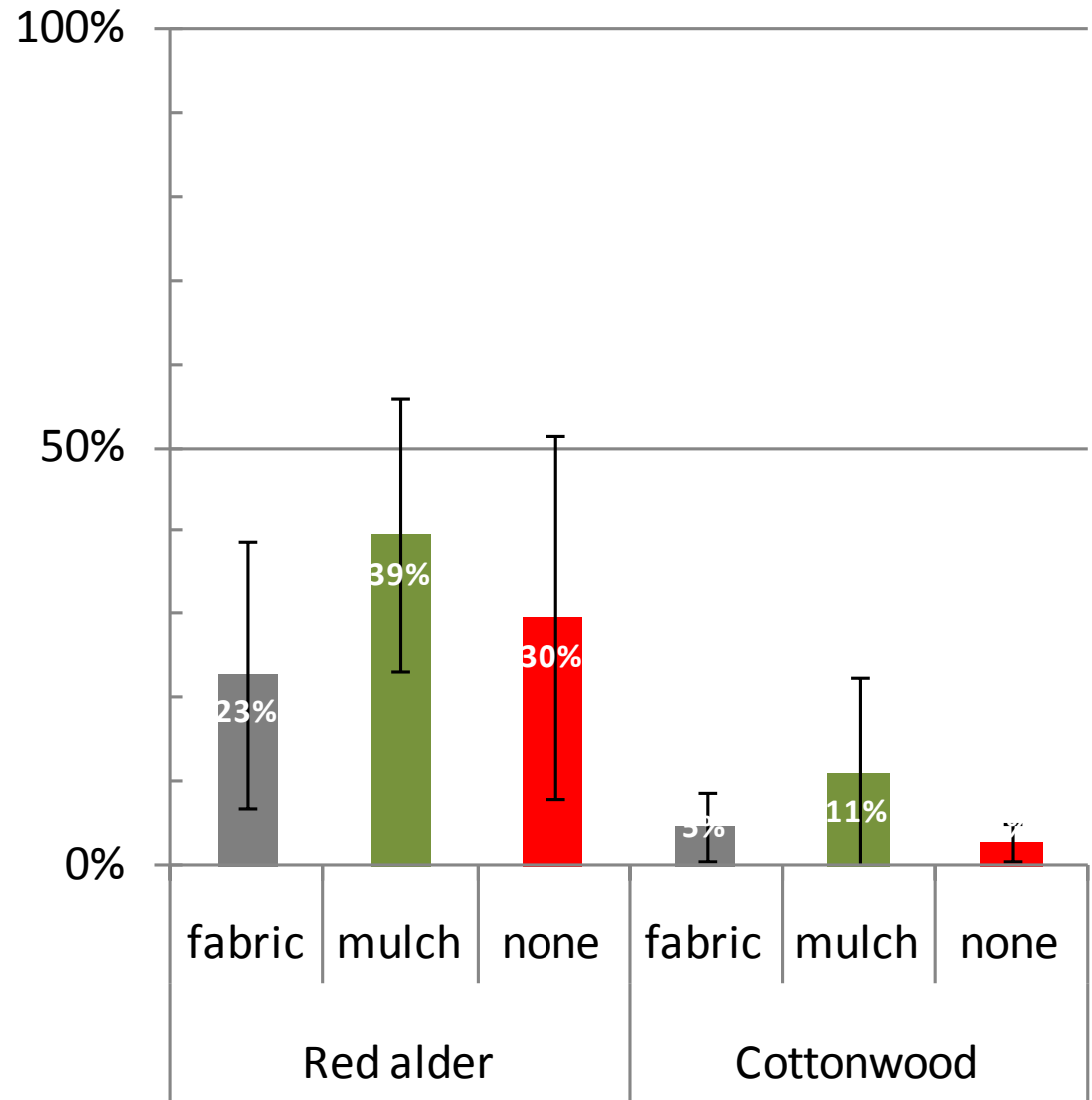
(after 45 days of no rain)



Vole damage on surviving stems 2012



Average Percentage of surviving stems
with vole damage
+/-95% confidence interval



Cost:Benefit Analysis

Species	Plant + Installation	Treatment	Install & removal	Subtotal per plant	Subtotal per acre
1-gal potted red alder	\$11.25	None	\$0	\$11.25	\$20,000
		Mulch	\$1.81	\$13.06	\$23,000
		Fabric	\$4.09	\$15.34	\$27,000
8' Cottonwood live stake	\$9.82	None	\$0	\$9.82	\$17,000
		Mulch	\$1.81	\$11.63	\$20,000
		Fabric	\$4.09	\$13.91	\$24,000

- Adding fabric to the entire site (3.3 acres) would have unnecessarily added a cost of roughly **\$23,000**.

An aerial photograph showing a winding river or stream on the left side, bordered by a dense forest of green trees. To the right of the water, there is a large, open area with a mix of green grass, shrubs, and scattered trees. A dirt path or road winds through this area. In the top left corner, a paved road with a white line runs horizontally. The overall scene is a natural, wooded landscape.

Rainbow Bend

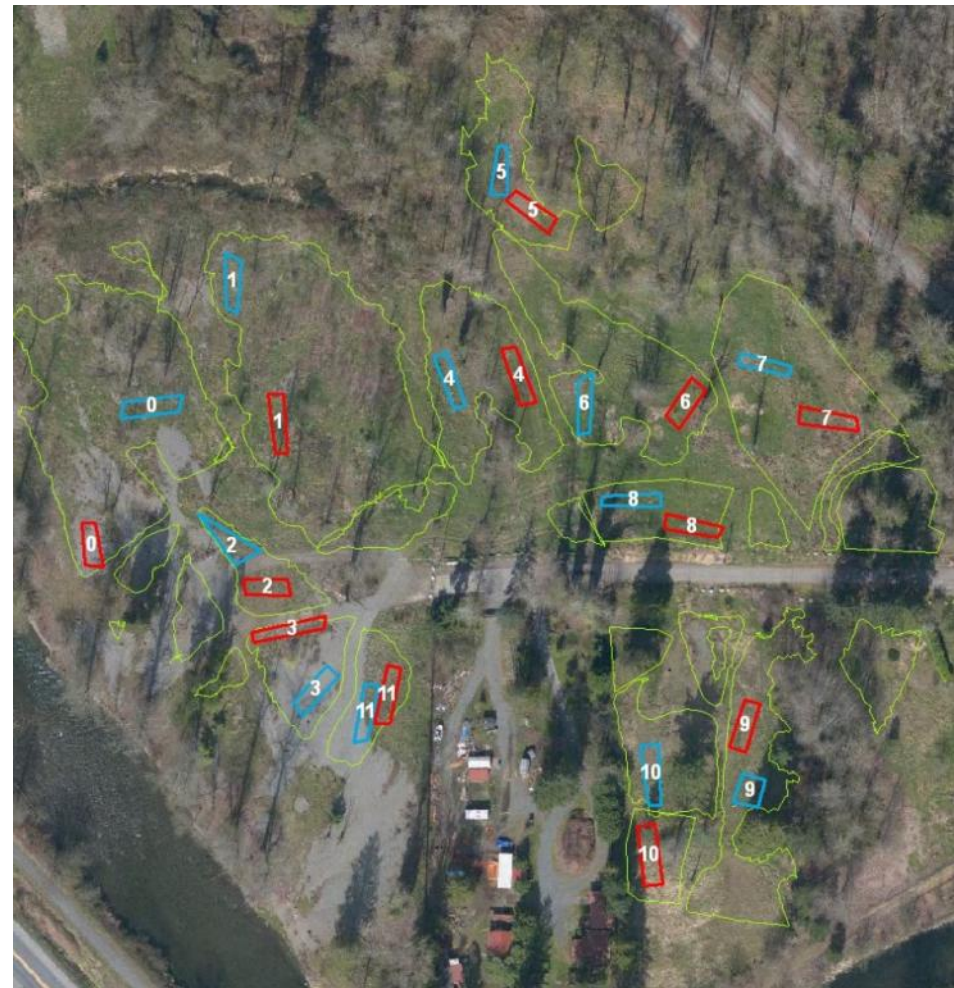
Aug 2012

Study design

Details

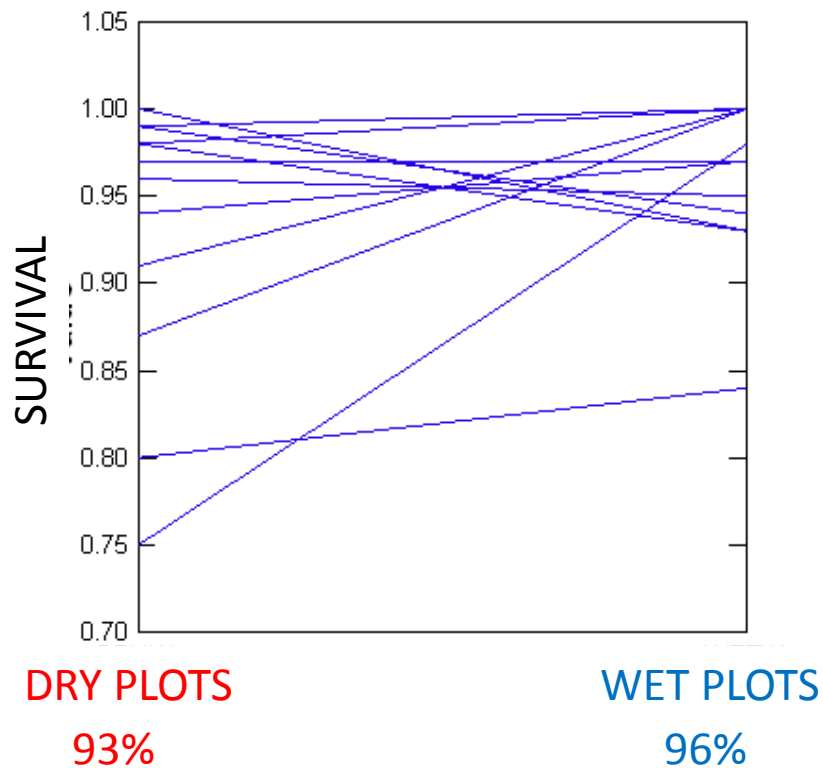
- 24 paired plots (4 x 16 m)
 - 12 wet
 - 12 dry
- Spatially randomized
- 960 cottonwood stakes
 - Avg. 77 per plot (49-109)
- Randomly assigned treatment at plot level
- Watered 3 times in 2011
 - 2 gallons each plant

Layout

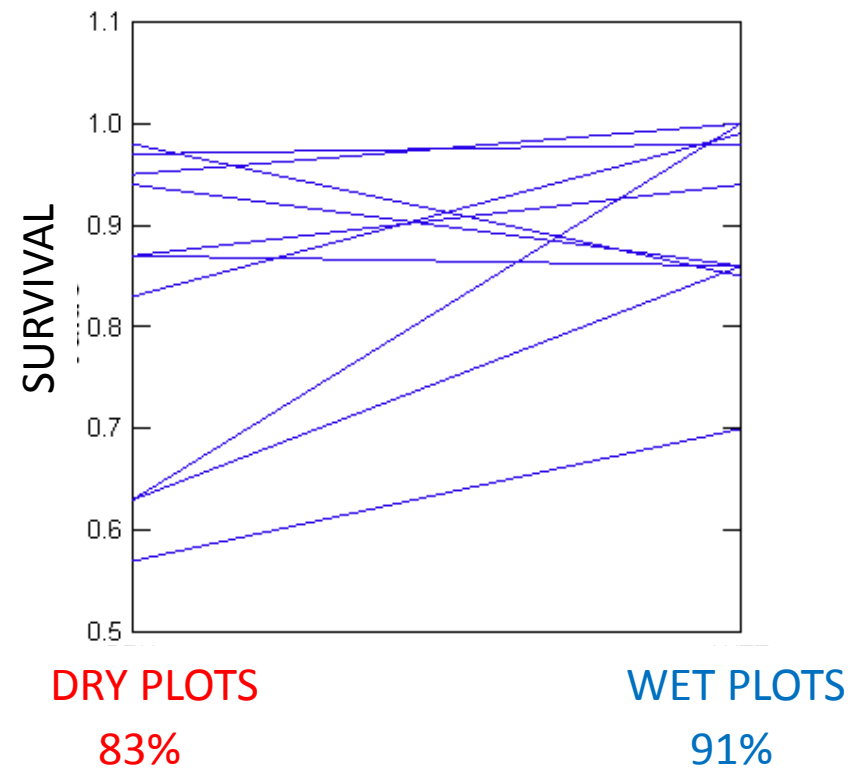


Results of paired *t*-tests

Year 1 ($p = .117$)



Year 2 ($p=0.062$; +8%)



Rainbow Bend Cost : Benefit Results

- Cost to irrigate 15,000 stakes 3 times over 1 summer
 - At \$1-3 each = \$15,000-\$45,000
- If we assume 8% more would have died without irrigation...
 - 1,200 stakes were 'rescued'
 - $\$15\text{-}45,000 / 1,200 \text{ stakes} = \$12.50\text{-}37.50/\text{stake}$
- Cost:benefit comparison
 - \$12.50 - \$37 to irrigate vs. \$10 to replace
 - Irrigation more expensive than replacement
- Performance standards would likely have been met with no watering at all (replacement not necessary)

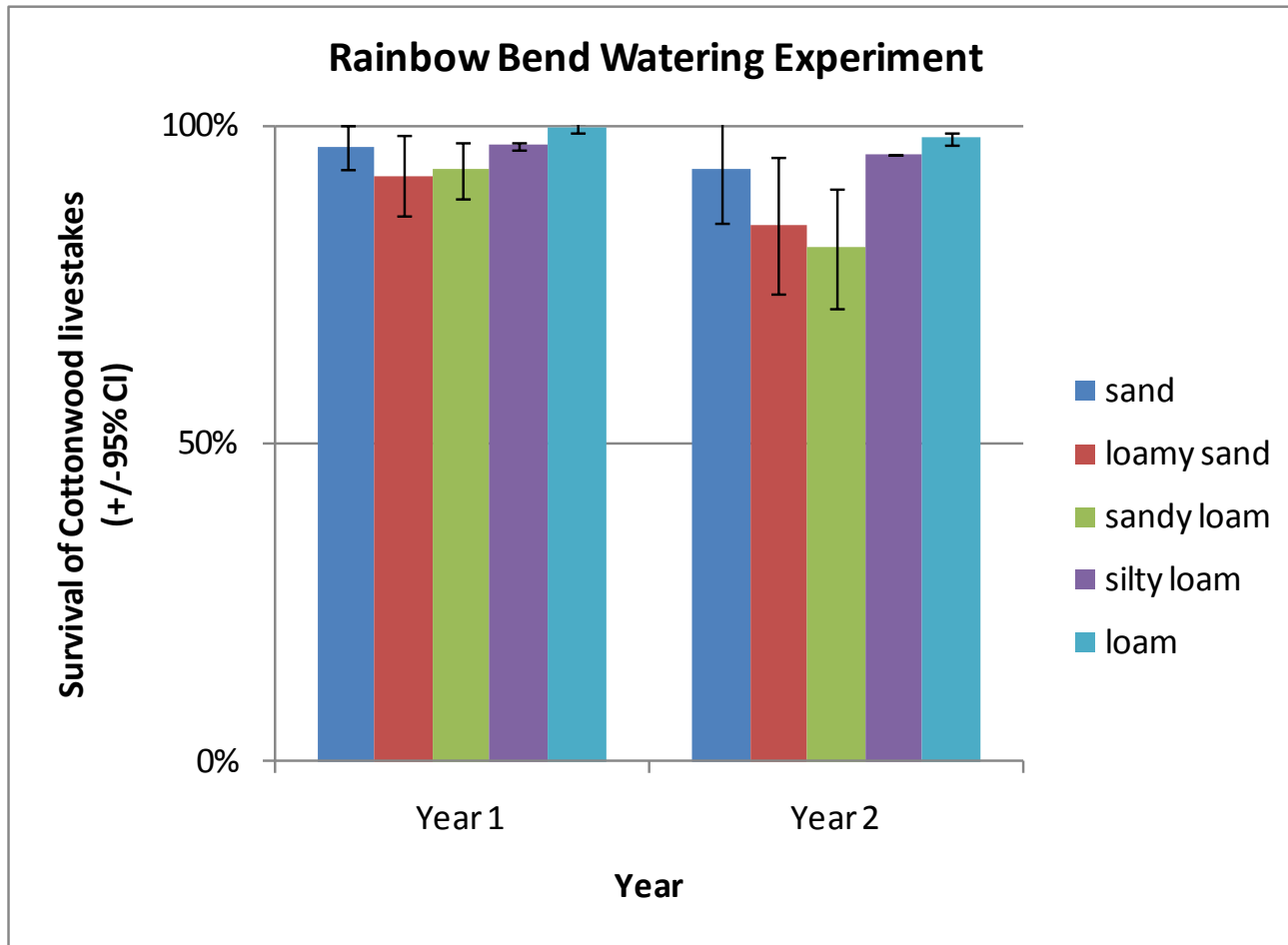
Something else is going on...





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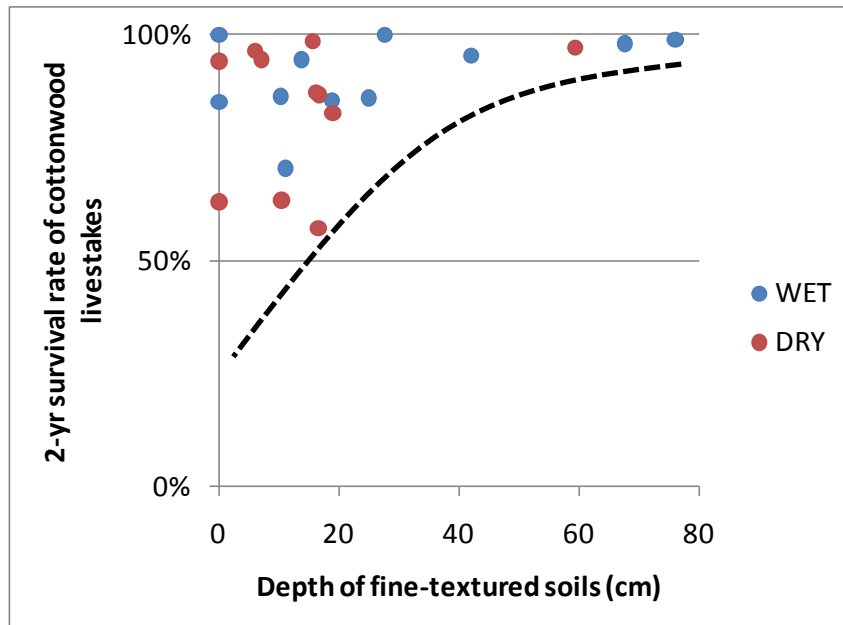
Influence of soil texture



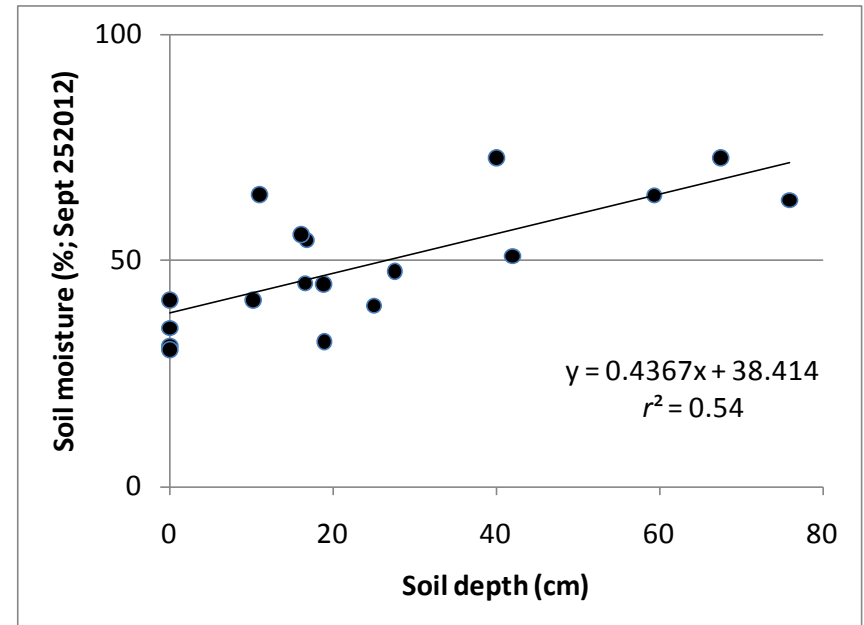
Highest survival in loam, but not evident until 2nd year

Influence of soil conditions

Effect of soil depth on survival



Effect of soil depth on moisture



Survival is consistently high in deep soils – which have more moisture. Perhaps moisture is limiting, but we watered too little to have effect!

Summary



Effects of watering

- On high, sunny sites with good soils (Pautzke)
 - Did not affect survival of cottonwood livestakes
 - Was not necessary to achieve >80% oversummer survival of alder or cottonwood
- On a low, sunny site, with shallow soils (Rainbow Bend)
 - Marginally increased survival, but cost more than replacement
- Preliminary recommendation:
 - Don't assume watering is necessary
 - Map soil texture and depth to guide the planting plan



Effects of wood mulch (hog fuel rings)

- On a high, sunny site with good soils (Pautzke SE)
 - No positive effect on survival
 - Negative effect on red alder, probably by attracting voles
- Preliminary recommendation:
 - Do pre-planting survey to estimate severity of vole damage and avoid mulch where voles are abundant
 - [Developed by WSU](#)



Effects of fabric

- On a high, sunny site with good soils
 - Did not affect survival of red alder or cottonwood livestakes
- Recommendation: More testing needed, use with caution. Fabric has high costs, uncertain benefits at this point.
- Next steps –
 - Testing effects in reed canarygrass now...stay tuned!



Your mileage may vary

- Narrow scope of inference (don't be hasty!)
 - Only cottonwood stakes and alder
 - Representative of wetter than normal springs, followed by mostly drier than normal summers*

Season	Average	2010	2011	2012
Spring	13.4"	128%	149%	141%
Summer	5.7"	112%	54%	60%

- Need more sites, years, and species!!



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Three years after planting