

Increasing Water Yield by Removing Eastern Redcedar from Encroached Prairie

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Research Team

Rationale

- Woody plant encroachment into grasslands is a worldwide issue that fundamentally changes water and carbon cycling
- *Juniperus* spp. have encroached large areas in Oklahoma (>3,000,000 ha), Texas, Kansas, Missouri, and Nebraska
- Preliminary data indicated that a *J. virginiana* (eastern redcedar) woodland watershed in north-central Oklahoma yielded less water than an adjacent grassland watershed

Example of eastern redcedar encroachment

1979

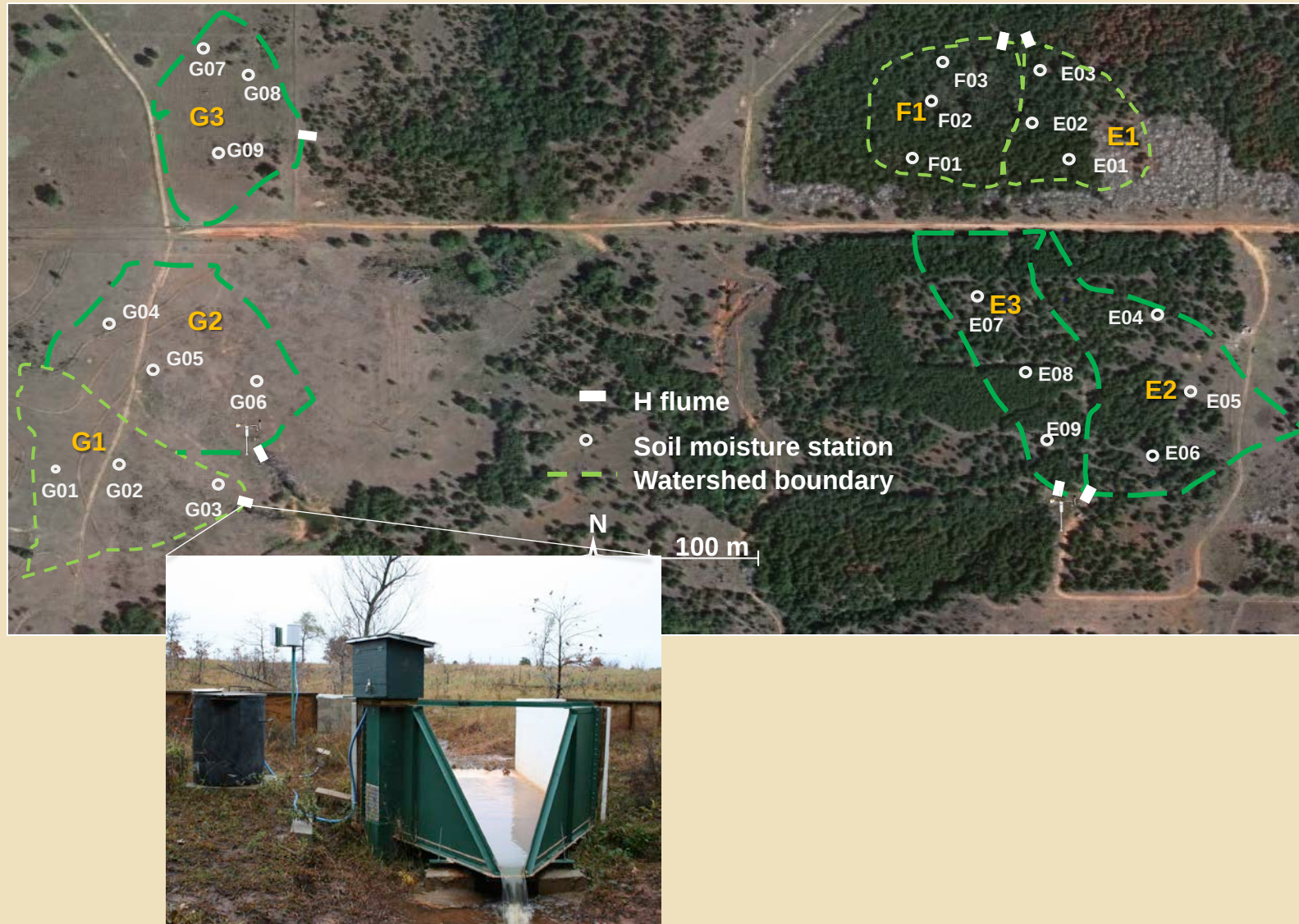


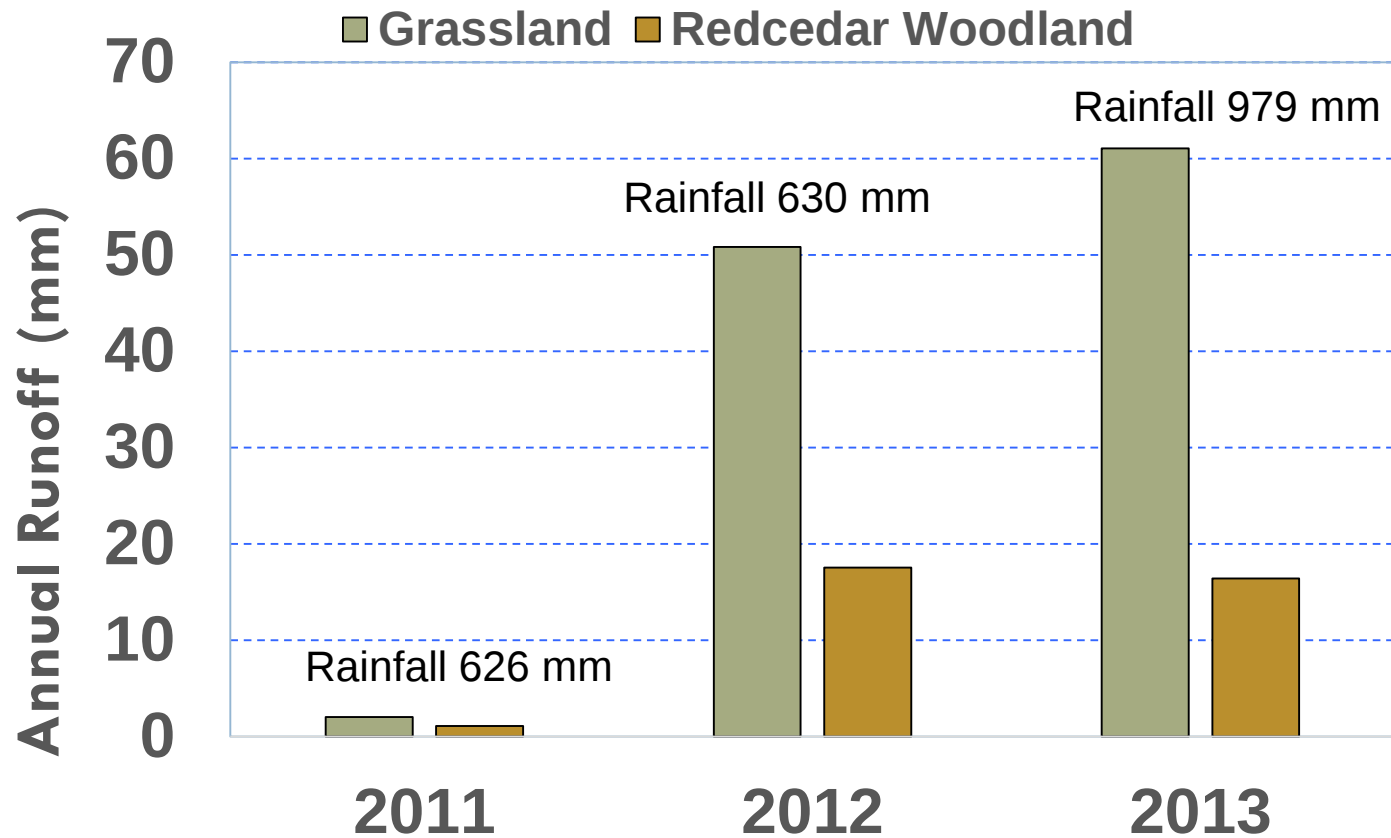
2011



How much water do we get from eastern redcedar woodland?

5





In 2013:

- 61 mm in grassland vs 16 mm in redcedar
- about 47 mm less runoff in redcedar
- 48,000 gallon per acre

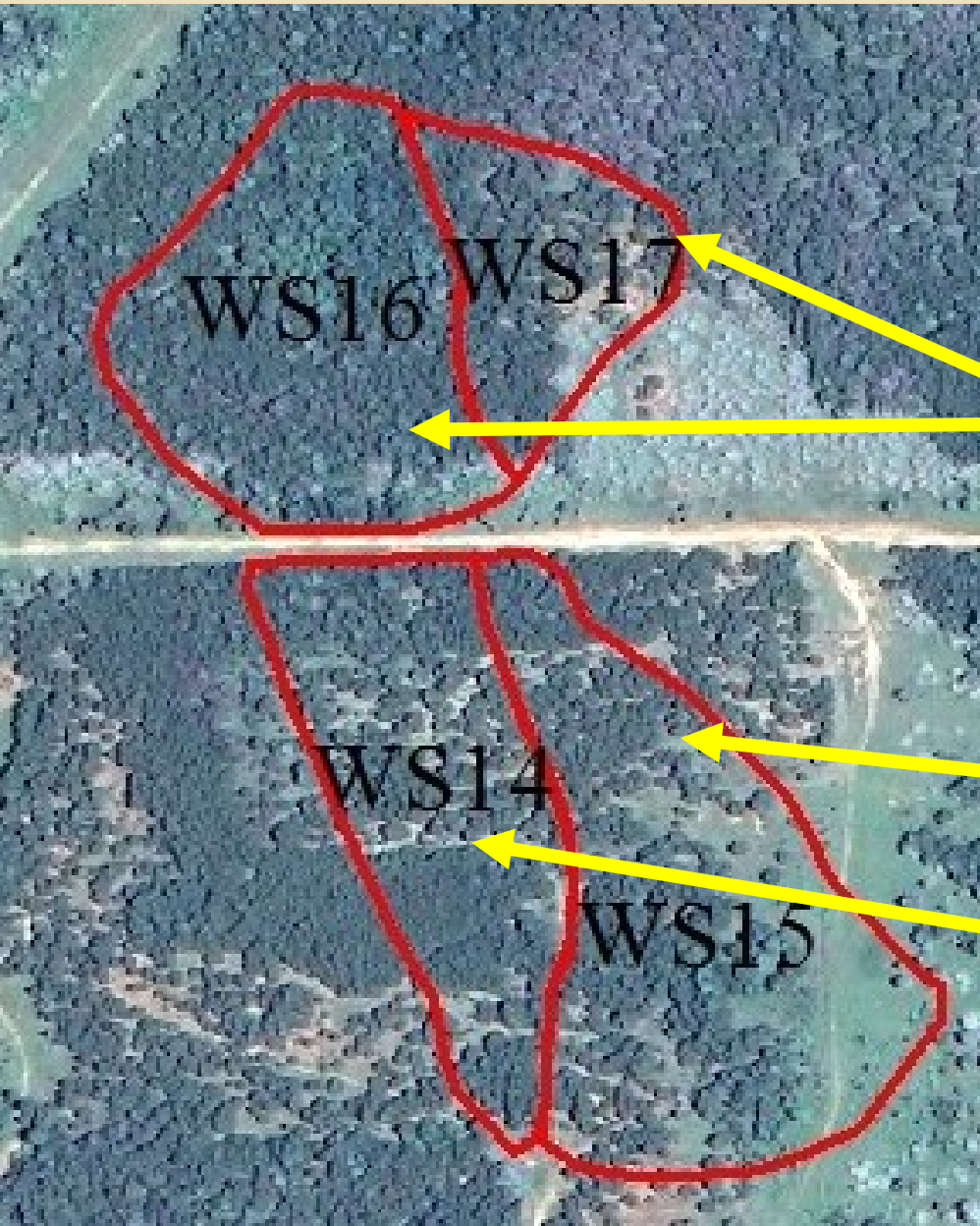
Overall objective

We want to demonstrate that an integrated biofuel feedstock system in the southern Great Plains that includes eastern redcedar, native prairie vegetation, and dedicated feedstock production of switchgrass can be used to support the production of advanced liquid biofuels while improving water yield and quality.

Specific Objective

Determine the impact of harvesting redcedar on water yield at the watershed scale

Methods – Experimental Design



4 redcedar watersheds

- 2 controls (untreated)

- 2 were cleared of trees

- 1 was sprayed with herbicide

- 1 was allowed to regenerate naturally

Eastern redcedar cut 5/2015 – 7/2015



Image from 7/11/2015



Eastern redcedar ground into chips 12/2015





9/2016

Eastern redcedar watershed
cleared, sprayed, ready
for planting

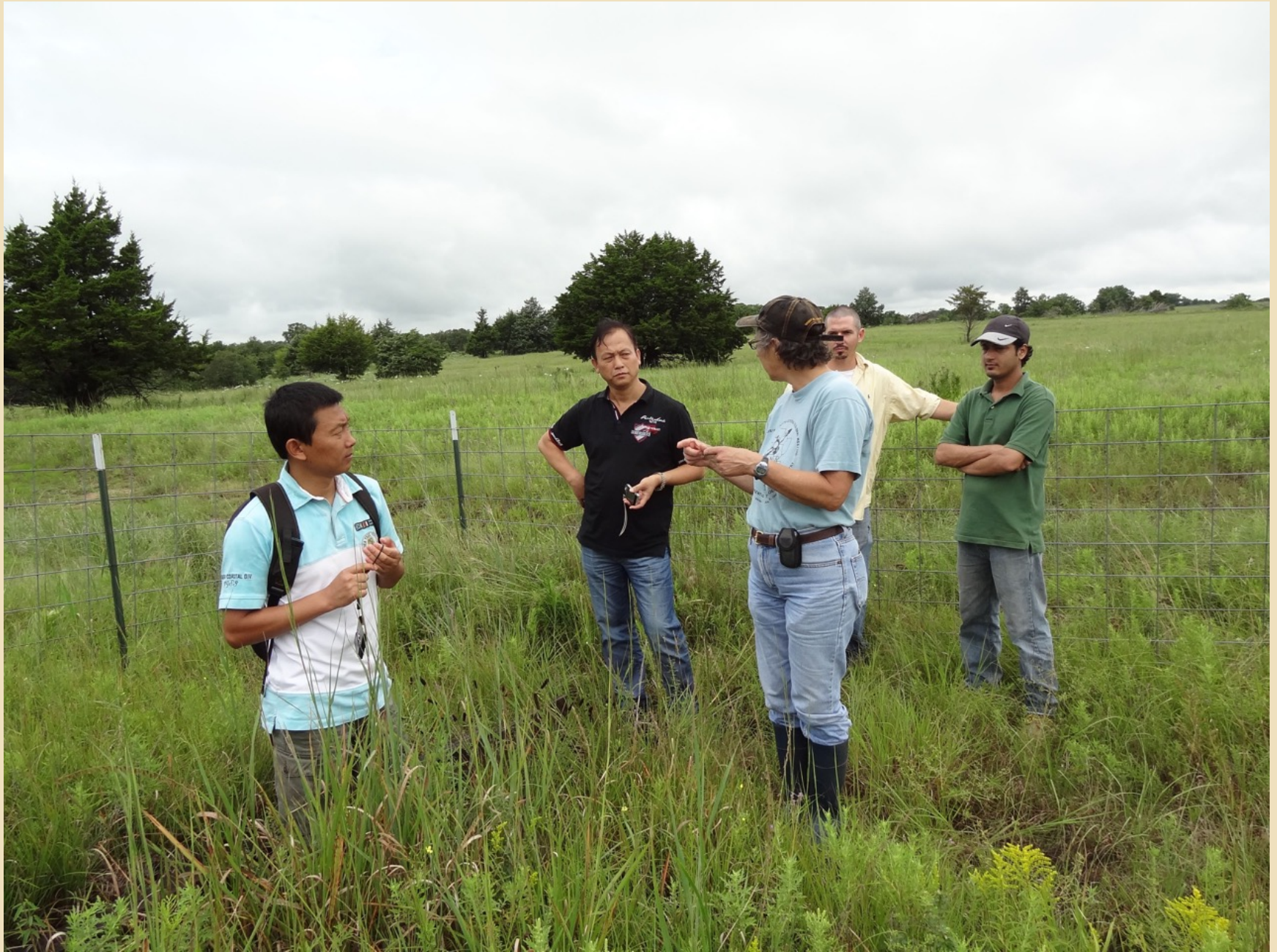
9/2016
Eastern redcedar
watershed cleared,
recovering naturally



Panoramic of cut eastern redcedar watersheds 9/2016



Grassland watershed early summer



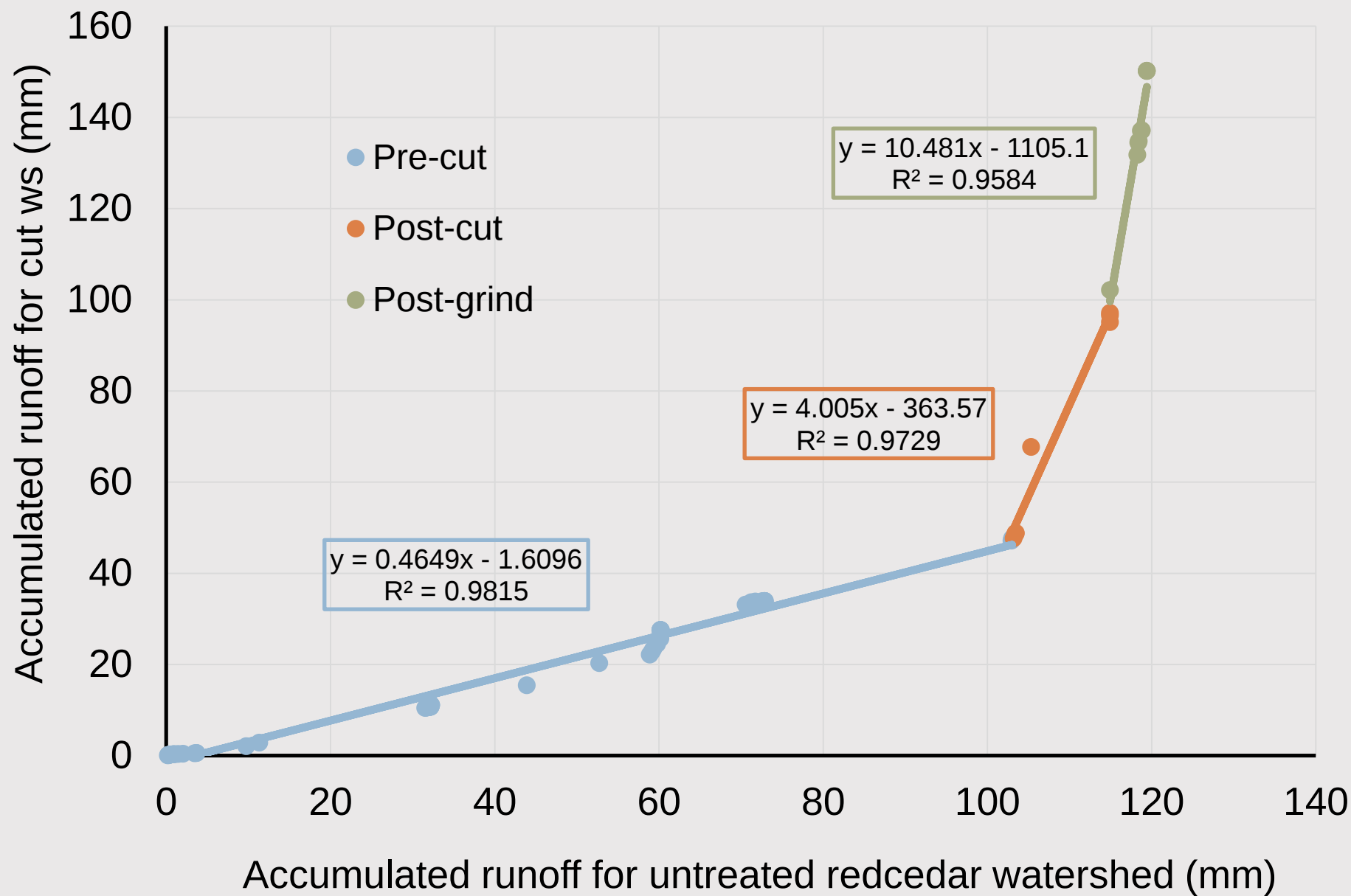
Sprayed and non-sprayed grassland watersheds June 2016

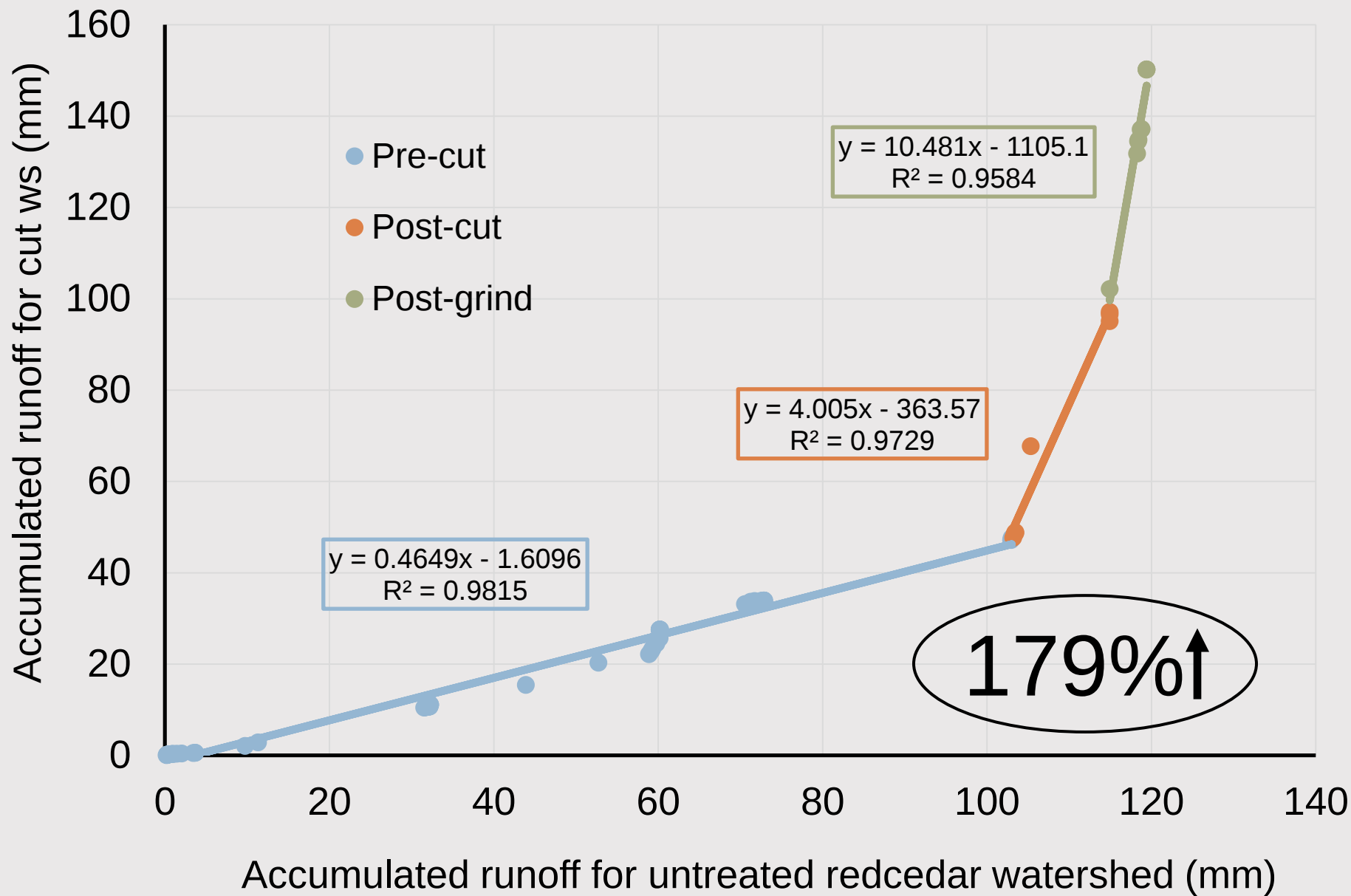


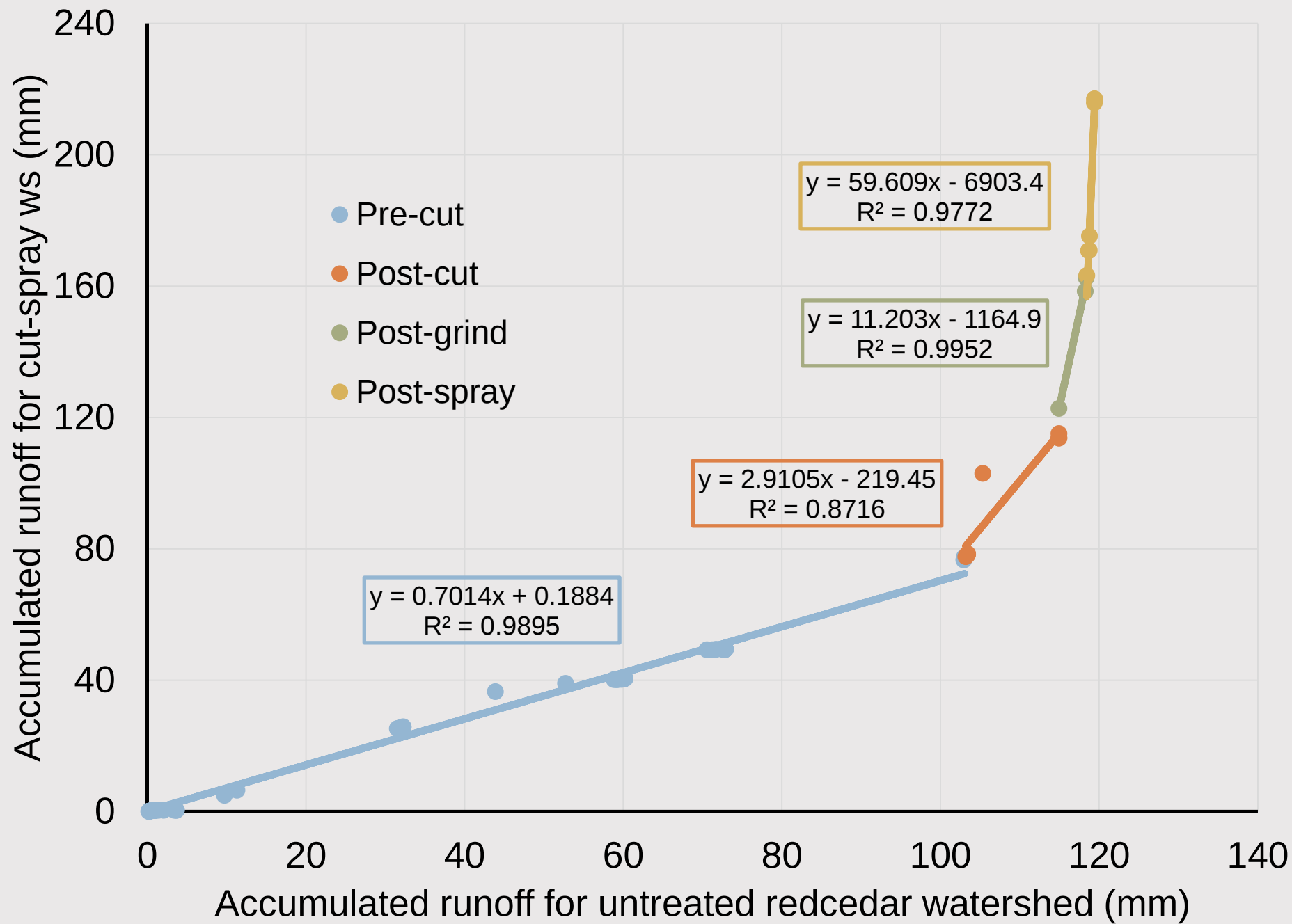
Biomass Yield

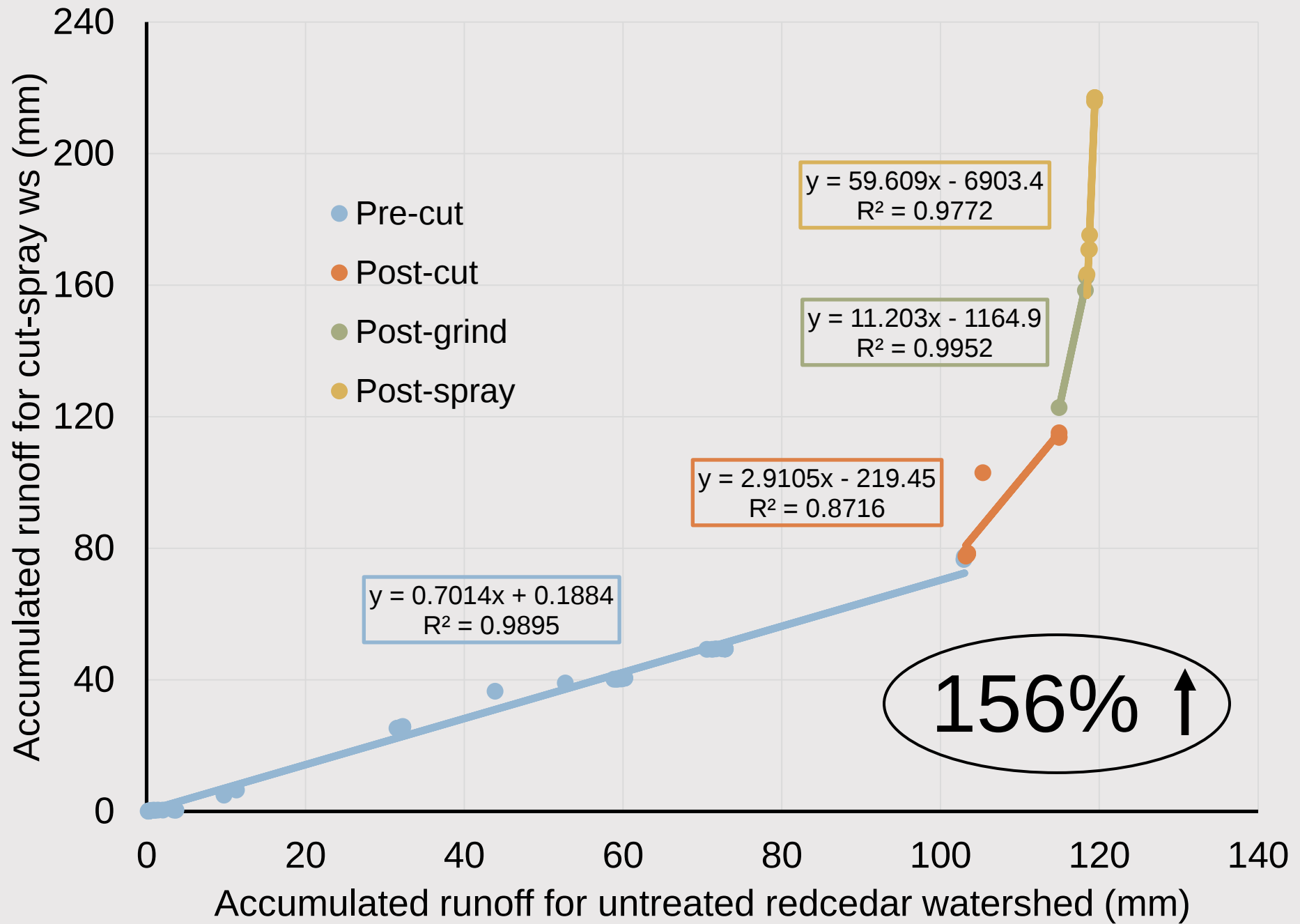
- 52 – 94 Mg/ha on eastern redcedar watersheds
 - ▣ A 20 cm diameter tree has between 15 and 40% foliage depending on growth form
 - ▣ For comparison, a mature loblolly pine plantation has between 200 and 300 Mg/ha and a mature post oak/blackjack oak forest has ~ 200 Mg/ha of aboveground woody biomass.
- 2.3-3.2 Mg/ha annual production from native grassland
- Likely yield from switchgrass will be 2-10 Mg/ha on these marginal sites

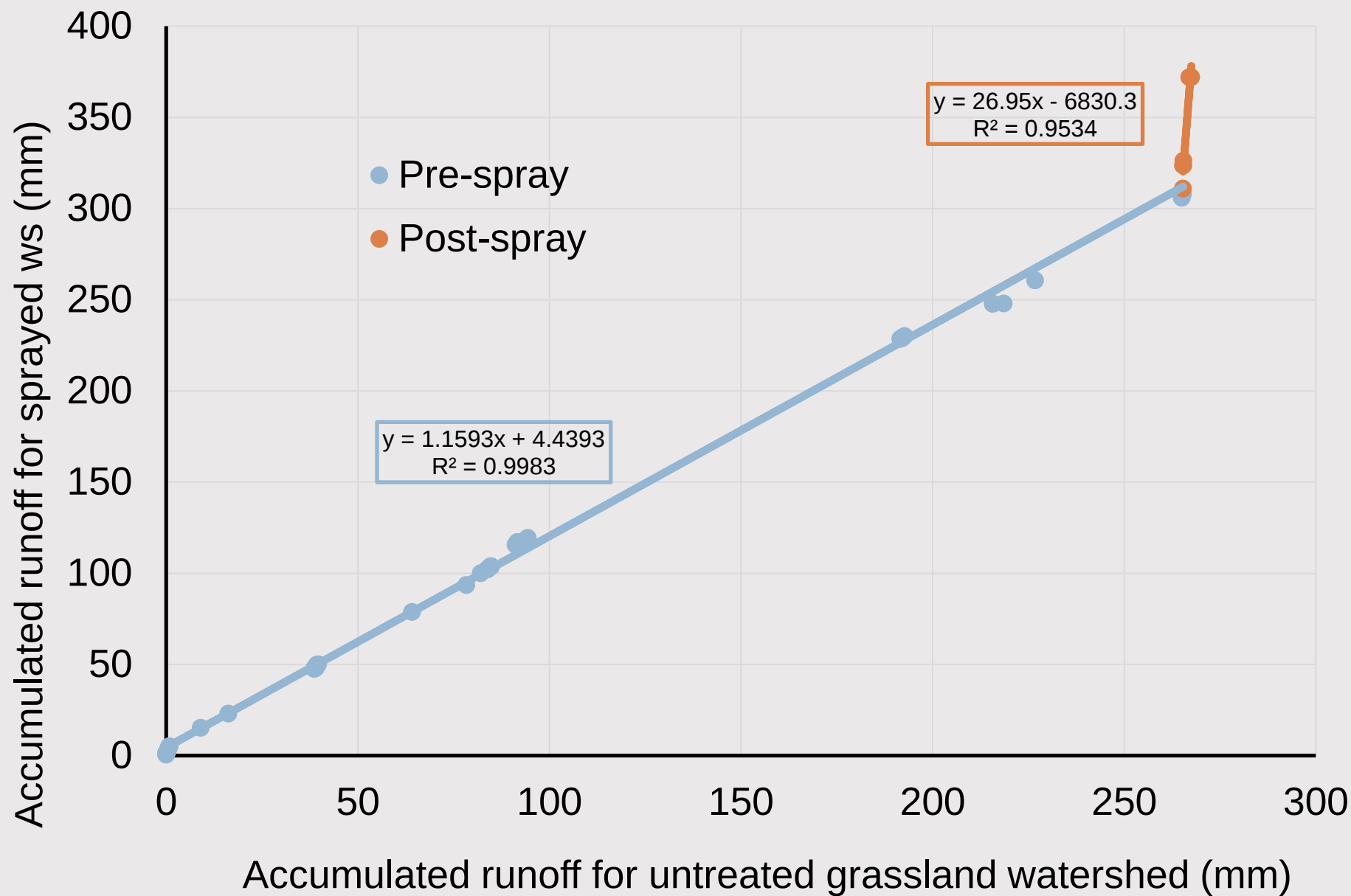


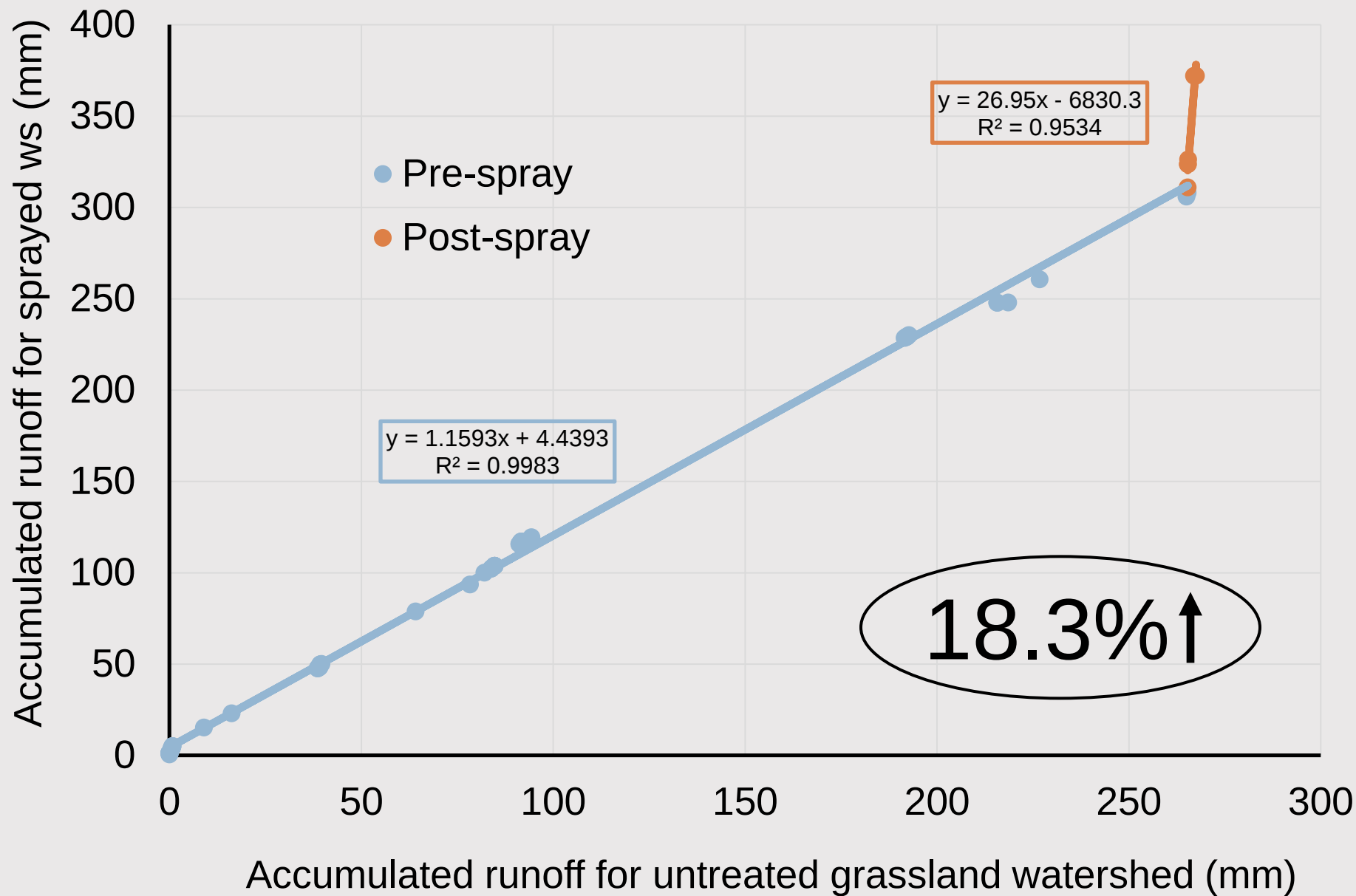


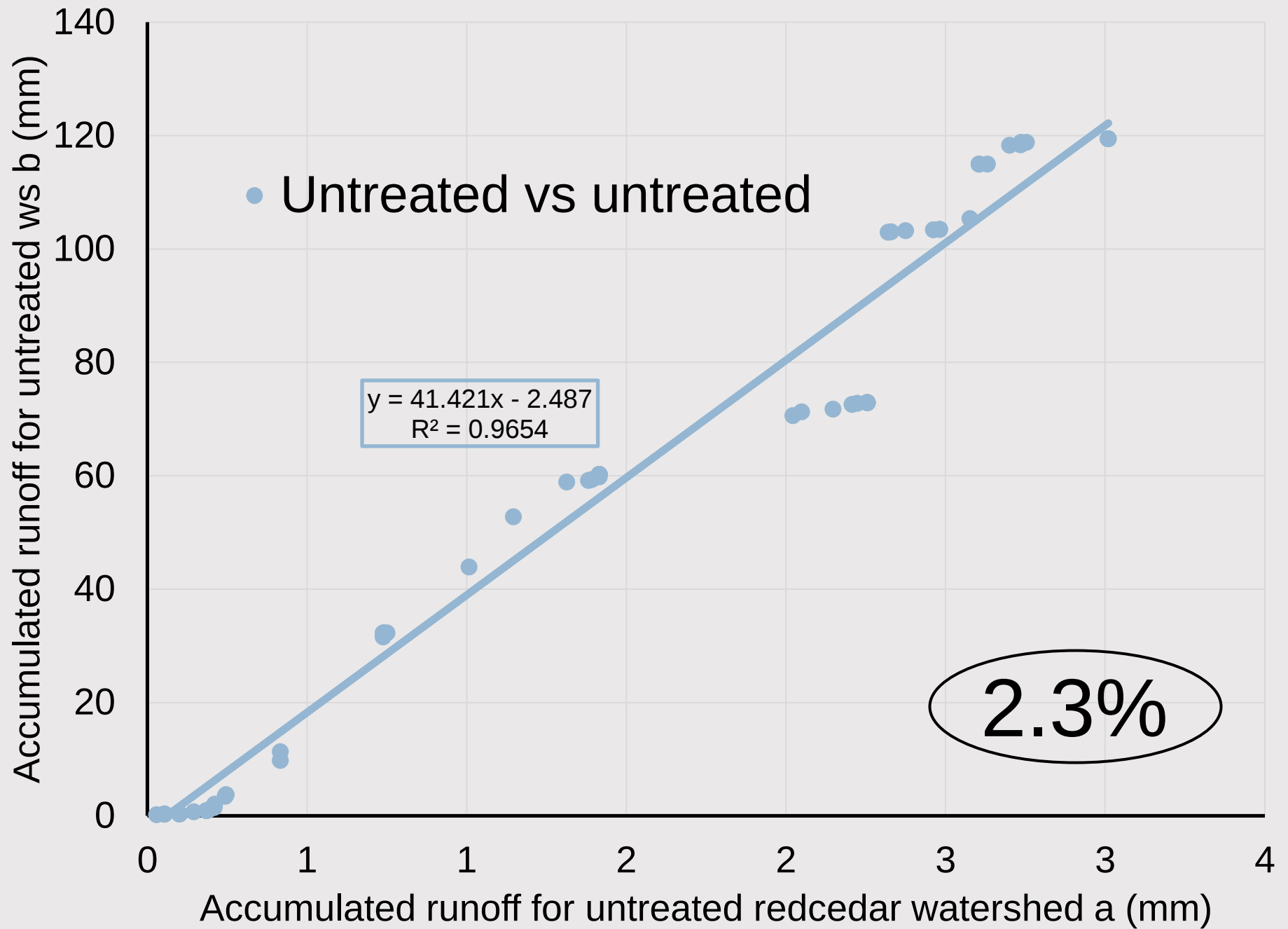












Conclusions

- Cutting eastern redcedar increased water yield by ~100% over 1 year period
- Spraying one grassland watershed increased water yield by ~18% over a six month period
- With over 3 million hectares of eastern redcedar growing largely unwanted and often on marginal lands ample opportunity exists to generate sustainable biofuels production perhaps with an overall positive environmental impact

Going Forward

- We will measure the effects of planting switchgrass in the former grass watershed and in one of the former redcedar watersheds
- We will compare the switchgrass watersheds to native grassland and to naturally recovering redcedar cut watershed and to uncut redcedar watersheds

Where do we go from here?

- How much eastern redcedar is available?
- What are annual rates of productivity for different vegetation types on marginal lands?
- Economic assessment and feasibility studies
- Water yield is critical for agriculture, energy production, industry, and household consumption. Can this societal need be translated into redcedar removal from private lands if markets are lacking?

Additional Activities

- Runoff characteristics, e.g. peak discharge – timing and amount
- Water quality, i.e. sediment load, conductivity
- Water infiltration
- Erosion modeling
- Water cycle modeling
- Movement of deep water
- Soil carbon

Acknowledgements



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Adapting socio-ecological systems
to increased climate variability



Effect of Vegetation on groundwater
recharge in upland ecosystems

Questions?

