All Things Tall Whitetop

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Outline

- Introduction/Impacts
- Biology
- Control

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Legal Status

- B list noxious weed California
- Cal IPC - aggressive invader

Impacts

- Ecological
- Economic

Grazing

- Not as good as more desirable grasses
- But reduced forage quantity and quality
  - Lower proteins and digestibility
  - Hay and pasture
- Not “Weed Free”
  - Difficult to market hay

Grazing

- Sheep and goats will eat before mature
- Cows eat when young
- Older stems left "inhibit grazing"

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Wildlife

- Inferior bird cover
- Decreased nesting habitat
- Decreased food

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Native species

- Displaces native species
  - Plants
  - Animals
  - Endangered species
    - Multiple mammals and plants in coastal marshes

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Soil

- Alters biophysical soil processes
- Salt accumulation in liter
- Takes up mercury - emits to atmosphere

Photo courtesy of: Swellnet.com

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Riparian Areas

- Erosion along waterways
- Competes with cottonwoods and willow establishment

Photo courtesy of: UC Davis

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Poisoning

- Horses
  - Reports toxicity when bale feeding
  - Never confirmed

Tall Whitetop

- Other Names
- Latin: *Lepidium Latifolium*
- Common
  - *Perennial pepperweed
  - Broad leafed pepperweed
  - Broad leafed pepper grass

Taxonomy

- Lepidium
- Five other introduced Lepidium
- 15 native Lepidium species
  - Much smaller stature
- Brassicaceae (mustard family)
- Cruciferous vegetables
  - Broccoli, kale, cabbage, kohlrabi, bok choy, cauliflower, rutabaga, canola, and many more!

Photo Courtesy of: Health.com

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Food

- *Shangso chonma* dish of the leaves
- Cooked like collard greens
- Also seeds poor man's pepper

Distribution

- Native to Europe and Western Asia
- Himalayas to Norway

- North America sugar beet seed containment 1900ish
- Also introduced to Australia

- Large expansion in North America after introduction
- Continuing to expand!
- 820,000 acres in West US 2005

Photo Courtesy of: geneticliteracyproject.org

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Map Courtesy of: http://plants.usda.gov/core/profile?symbol=LELA2 http://calweedmapper.cal-ipc.org/maps/

Very diverse ecotypes

- Coastal marshes, tidal shores, wetlands
- Riparian areas
- Grasslands
- Native meadows
- Hayfields
- Dryland pastures
- Salty soils/poor soils
- Around sagebrush

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Elevational gradient

- Elevation
- Up to 8200 feet in California down to sea level
- In Himalayas - up to 14,600 feet!!!
- Cold and warm

Biology

- Basal Rosettes
  - Fall
  - Spring
- Basal Leaves
- 3-12 inches long
- 1-3 inches wide

Biology

- Plants “bolt”
  - Time of year depends on location
  - April-June
- 3-8 ft. tall
- Smaller leaves
- Leaf area maximized at flower bud stage
- 25,000 cm^2
- Per meter ^2 (1000 cm^2)

Photo Courtesy of: UCANR.edu

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Biology

- Plants dry down after flowering
- Create thick thatch layer dead material
- Up to 4 cm thick (Renz)
- Make management difficult
- Shades other species seedlings

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Roots

- Coarse wide space roots
- Some deep
- Some branching
- Not good at soil stabilization along creeks
- Young et. al.
    - 19% roots-top 4 inches soil
    - 85% roots-top 24 inches soil
- Tap roots up to 9 feet deep!

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Roots continued

- Approx. 40% biomass below ground!
- Roots form “wood like crown”
- Can grow in salty soil
- Penetrates “restrictive” soil layers
- Can grow into water table
- Does not tolerate “prolonged” flooding

Reproduction

- Flowers
  - May through August
  - Small white
  - Flower arrangements
- Insect pollinated
- 16 billion seed/ha
  200 stems per meter
- 6.5 billion seed/acre
  at 18 stems per foot^2

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Dispersal

- Water
  - Root chunks float
  - Seeds sink
  - Mucilage forms…
  - Seeds float!!!
- Wind
- Animals
- Humans
- Seeds drop all winter long…

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Seed Dormancy

- At least 2 years
- Maybe more
- However, no hard seed coat?
- Robbins found 64-100% germ of seedling greenhouse
    - Noticed very few in field

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Young et. al. 1997 Seed Germination Experiment

- Tall whitetop field site
    - Soil collected February
    - Greenhouse put in “flats”
    - Watered
        - Seedling emerged
    - Dried out soil
    - Watered
        - More seedlings
    - Repeated over 2 years
    - Seedlings

Young et. al. 1997 Seed Germination Experiment continued

- No seedlings at field site
- Rototilled
- Still no seedlings
- Very few seedlings documented in field

Seedlings

- But needed for new populations
- Though maybe seedling mistaken for other mustard species

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Carpinelli et. al. 2005

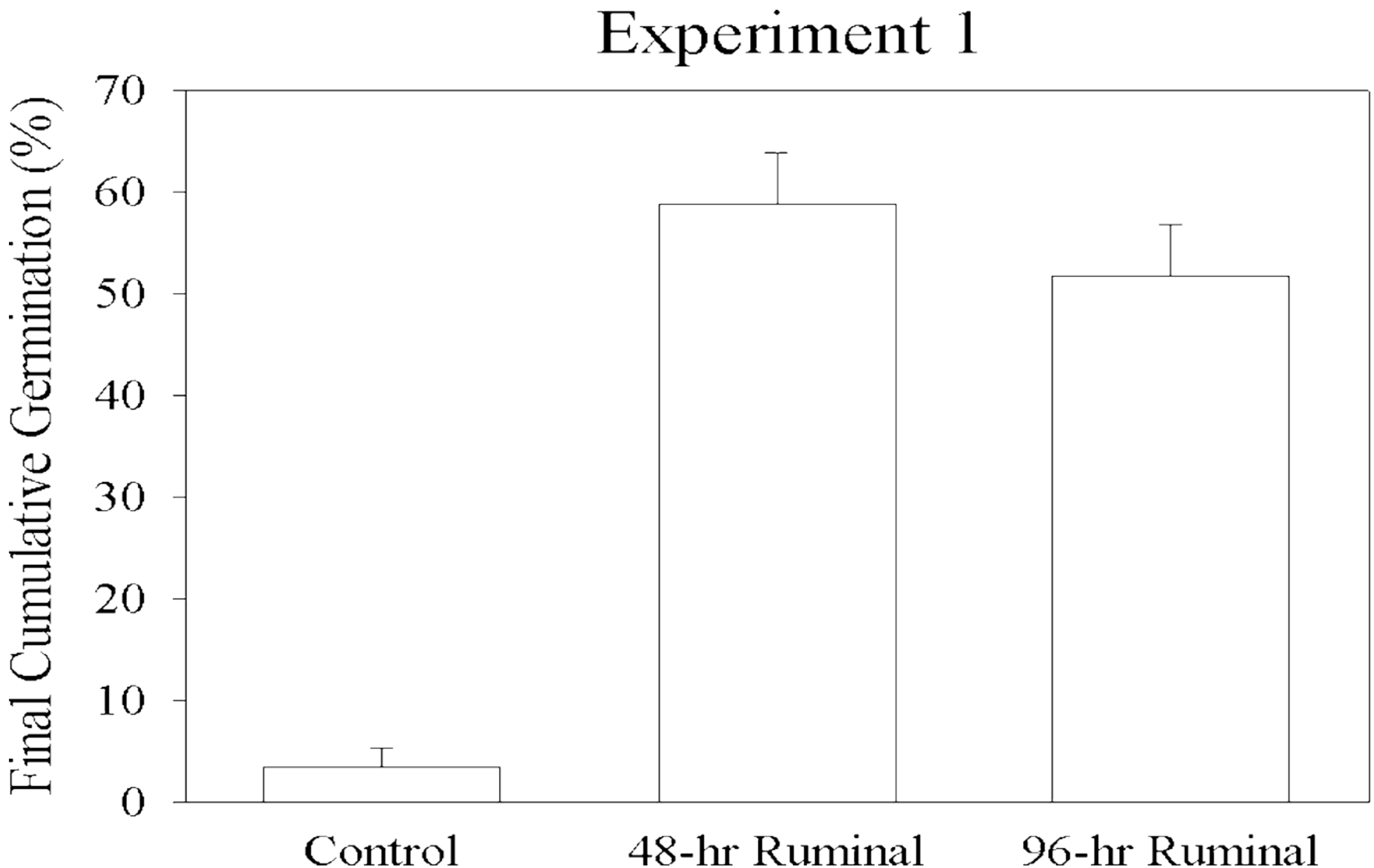
Ruminant digestion germination experiment

Photo Courtesy of Stephanie Stockley at www.the-standard.org

Carpinelli et. al. 2005

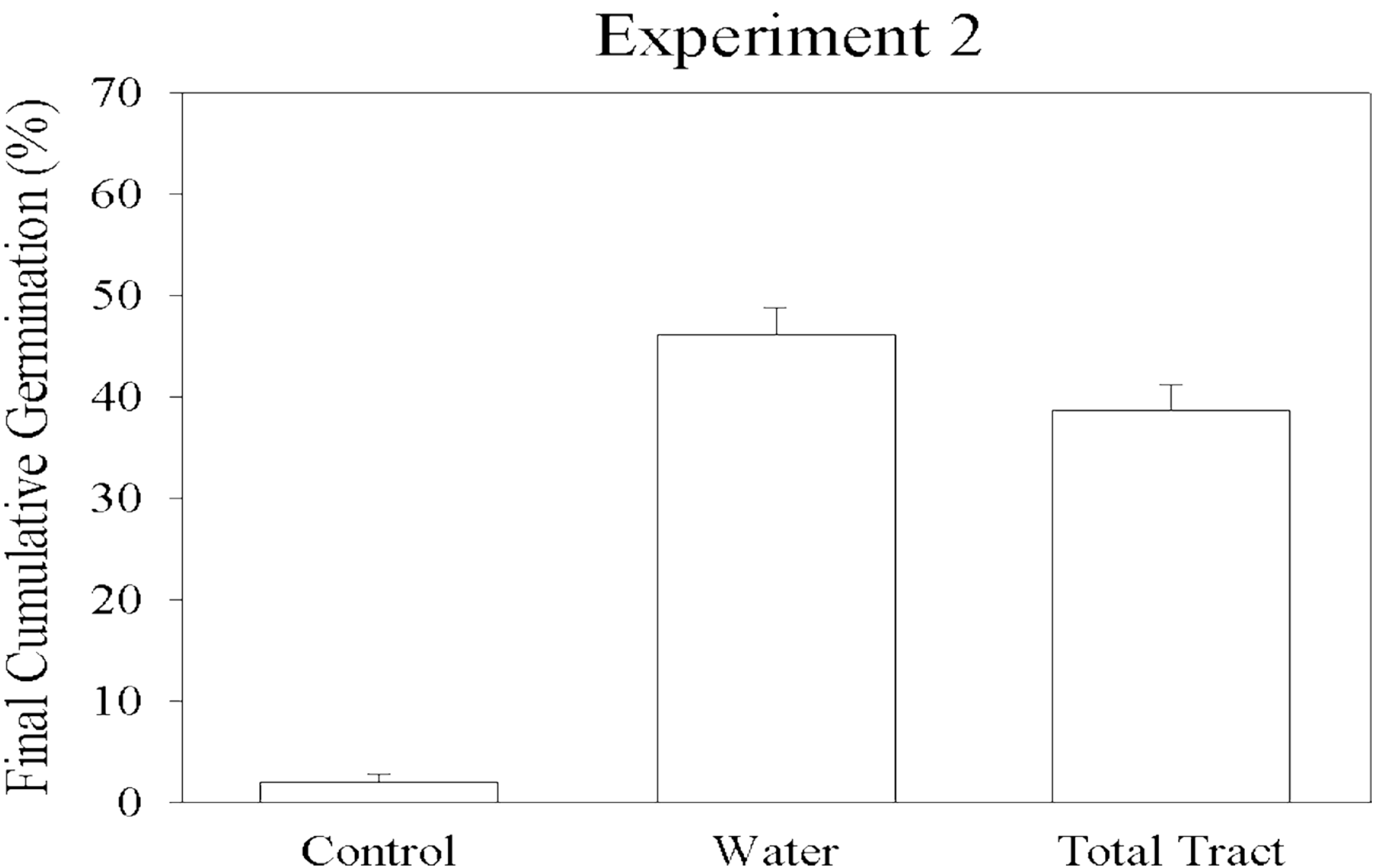
- Two experiments
- Incubation in cannulated cow
    - Seed in mesh bags
    - 48 and 96 hours
- Incubation in water and Ruminant digestion
    - Inserted and passed in mesh bags

Tall Whitetop Germination



Carpinelli et. al. 2005

Tall Whitetop Germination



Carpinelli et. al. 2005

Root Spread

- Can re-establish from roots
- Less than I inch long…
- Root buds
- Patch size

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Root Spread Renz

- Patches spread 3-6 feet per year
- 1999 to 2001
- Patch size increased anywhere from 44% to 129%

Root spread case study

- Young et. al.
- Honey Lake Wildlife Area
- Area 131 feet*131 feet
- 1993
  - Two 1 yard patches - 10 stems/yard
- 2000
  - Mostly covered some 100 stems/yard
- 2002-2003 decline in stand
  - Precipitation/water table?

Wotring et. al. 1997

- Treated 2,4-D summer at bloom stage
- Root fragments collected following year
- Untreated 50% grew
- Treated only 5% grew
- Herbicide translocated to root
- But 5% not enough to control

Blank and Young 2002

- Amelioration of sodic soils
- Changes in Ca, Na, and Mg ratios
- Tall whitetop
  - Increased Mg and Ca levels
  - Reduced sodium absorption ratios
  - Sodic soil amelioration over many years
- However, then need to get rid of Tall whitetop!
- Probably not economical

Blank et. al. 2002

- Riparian areas
  - Fine shallow root species
  - Grasses Sedges
- Tall whitetop
  - Not restricted by water of restrictive layers
  - Deep roots
  - Get nutrients!
- Over many years - bring nutrients up
- Non mobile P becomes depleted in deep root zone
- Eventually favoring other species
- 15 year old stands still alive....

Control

- Mechanical
- Biological
- Chemical

Control

- Mechanical
- Biological
- Chemical

- Need to control root!
- Need to prevent seed!
- Need to establish competitive vegetation!

Mechanical

- Young - can be difficult
  - Terrain
  - Water
  - Ag setting easier
- Disking
  - Roots resistant to drying
  - Can spread
  - Renz spread 3 X faster with disking
  - Continual disking has potential

Mechanical continued

- Mowing
  - Reduce stored sugars
  - Multiple times a year
  - Mow at bud stage
  - Reduce litter
    - Allow grazing
    - Allow herbicide

Tarping: Hutchinson and Viers 2011

- South of Sacramento
- Study two locations
- Treatments
  - Control
  - Mowing
  - Mowing + tarping
  - Mowing + tilling + tarping
  - Mowing + Glyphosate (Roundup)
  - Mowing + Chlorsulfuron (Telar)

Hutchinson and Viers 2011

- 2 years after treatment change in stem density
  - Control - 15% increase
  - Mow - 70% reduction
  - Mow + tarp - 12%
  - Mow + till + tarp - 94%
  - Mow + glyphosate - 99.5%
  - Mow + chlorsulfuron - 100%

Hutchinson and Viers 2011

- Mow + till + tarp - did reduce stems
- Authors say
  - More labor intensive
  - More costly
  - More rehabilitation
  - Less favorable than herbicides on natives
- But no herbicide!

Biocontrol

- Species being investigated
  - Testing for efficacy
  - Testing for no target hosts
    - Native Lepidium
    - Related crops
  - Gall-forming weevil *Ceutorhynchus marginellus*
    - Other species support adult development
  - Stem-mining flea beetle *Phyllotreta reitteri*
    - Testing

Williams et. al. 2014

- Native Attackers!
- Weevils
- Flea beetles
- Leafhoppers
- White Rust (Albugo)
    - Wet years reduce seed production

Targeted Grazing Handbook (Idaho)

- Sheep and goats
- Graze off 85% growth
  - Every 3-4 weeks
- One year
  - Reduce population
- Multiple years to eliminate
- Combine with herbicide

Allen et. al. 2001.

- Study with grazing sheep
- 75% perennial pepperweed cover
- Nine 16*32 ft. plots
- Treatments
  - Grazed
  - Mowed
  - Untreated

Allen et. al. 2001.

- 1 season
- Grazed plots
  - 37 plants/meter^2 to 8.3 plants/meter^2
- Mowed plots
  - 37 plants/meter^2 to 17.7 plants/meter^2
- Grazing could be tool

Herbicides

- Published in Extension articles
- 2,4-D-2 qts/acre
  - Only on Nufarm label (taken off others)
  - Still can be used on other “broadleaf weeds”
- Chlorsulfuron (Telar) - 1 to 2.6 oz/acre
- Glyphosate (roundup) - 2 to 4 qts/acre
- Imazapyr (habitat) - 1 to 2 qts/acre
- *Not labeled in California
  - Imazapic (Plateau)
  - Metsulfuron (Escort)

Herbicide cost

- 2,4-D - 2 quarts, $9 to $12.5 per acre
- Telar (generic) - 2 ounces, $37 per acre
- Roundup (or generic) - 2 quarts, $8 to $13 per acre
- Habitat - 1 quart, $32 per acre

Renz and DiTomaso 2006

- Three locations
  - Susanville
  - Roadside
  - Floodplain
- Herbicides- Bud Stage
  - Telar
  - Roundup
  - 2,4-D
- Mowing + herbicides sickle bar mower 1-2 inches

Renz and DiTomaso 2006

- Biomass reduction 1 year after treatment
- Herbicide alone
  - Chlorsulfuron (Telar)
    - 74-99%
  - Roundup (inconsistent)
    - Increase 20% one site
    - 32%
    - 84%
  - 2,4-D (inconsistent)
    - 13 to 74%

Renz and DiTomaso 2006

- Biomass reduction 1 year after treatment
- Herbicides + Mowing
  - Mowing alone
    - 2-28%
  - Mowing before Telar
    - 99%-100%
  - Mowing before Roundup
    - 98% and 81% - at two low elevation sites
    - 87% reduction high elevation
  - Mowing before 2,4-D
    - 9% and 62% reduction low elevation
    - 92% reduction high elevation

Young et. al. 1998

- Disking and herbicides study
- Disking
  - Lead to initial control
  - One year after no difference
- 2,4-D (ester) June application
  - April following year 2% cover
  - October 85% cover
  - Short term control
- Glyphosate June application
  - October that year 45% cover
  - April following year 85% cover
- Chlorsulfuron June application
  - 5% cover 2 years after
- Disking + 2,4d didn’t increase control

Young et. al. 2002

- Tall whitetop and revegetation
- 2,4-D
- Telar
- Tall wheatgrass

Young et. al. 2002

- 2,4-D
  - Initial tall whitetop control
  - Lapsed following year
- Telar
  - Good tall whitetop control
- 2,4-D and plant next year
  - Tall wheatgrass seedlings outcompeted
- 2,4-D and plant + low rate 2,4-D over seedlings
  - Good tall wheatgrass establishment
- Telar + plant
  - No seedling establishment

Wilson et. al. 2008

- Two sites by Susanville
- 50-70% live cover Tall Whitetop
- 4 year study
- Physical treatments
  - Burning
  - Grazing
  - Disking
  - Mowing
- In combination Herbicide Treatments
  - 2,4-D
  - Telar
  - Roundup
- Seeding

Wilson et. al. 2008

- Burn
  - Winter 2003 and 2004
  - Fire carried 2003 not 2004
- Flail mower
  - November and June
  - 2003-2005
- Winter grazing
  - February 2003
  - March 2004
  - March 2005

Wilson et. al. 2008

- Herbicides applied in June
- Applied in September for mowing
  - Roundup 1st year
    - 2,4-D 2nd year
    - 2,4-D 3rd year
  - 2,4-D
    - 1st 2nd and 3rd year
  - Telar
    - 1st year and 2nd year
    - No herbicide 3rd year

Wilson et. al. 2008

- Seeding in March
  - Western wheat
  - Beardless wildrye
  - Basin wildrye
  - Slender wheatgrass
- Seeded two years because of lack of establishment

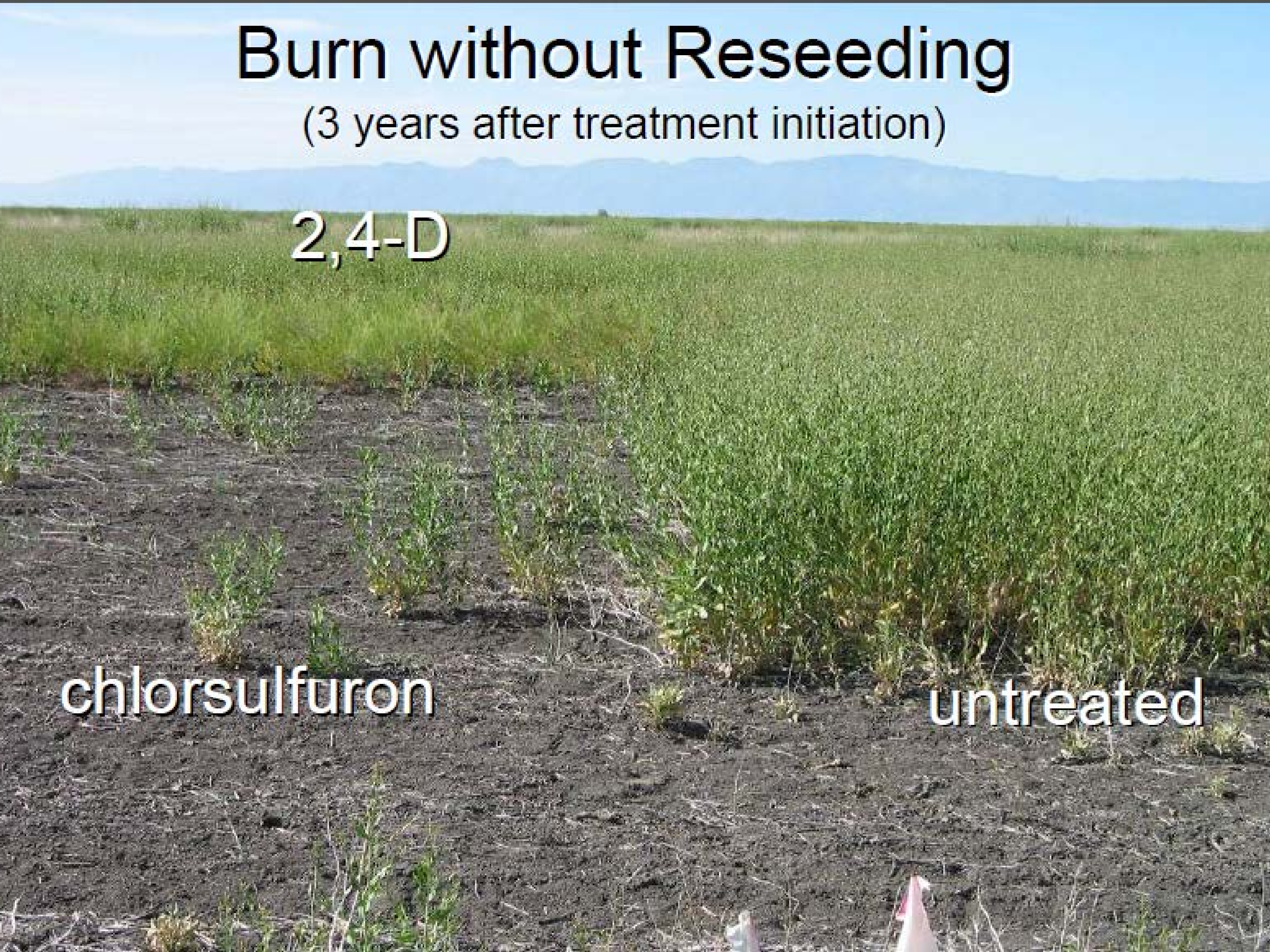
- Wilson et. al. 2008

Graph Courtesy of Wilson et. al.

Graph Courtesy of Wilson et. al.

Chlorsulfuron Injury to Grass Seedlings


No Site Preparation or Reseeding
(3 years after treatment initiation)
untreated
chlorsulfuron


Burn without Reseeding
(3 years after treatment initiation)
2,4-D
chlorsulfuron
untreated


Burn + 2,4-D + Reseeding
(3 years after treatment initiation)

Burn + 2,4-D + Reseeding

(4 years after treatment initiation)

Wilson et. al. 2008

- Combinations of site prep + herbicide + seeding was necessary
- Need to remove thatch
- Need to use maintenance herbicide applications

Blank et. al 2002

- Tall whitetop - roots not limited by high water tables or restrictive layers
- More competitive advantage initially
- With time - more fibrous roots may be more competitive.

Economics

- Is it worth it to control?

Eiswerth et. al. 2005

- Dynamic Benefit- Cost Analysis
- Over 15 year period Walker River Nevada
  - Costs associated with controlling
    - Sprayer
    - Chemical
    - Labor
  - Cost associated not controlling
    - Reduced yield
    - Reduced quality
    - Cannot export contaminated hay
    - Reduced livestock carrying capacity

Eiswerth et. al. 2005

- Three land types
  - Irrigated improved meadow - 50 acres
  - Irrigated native meadow - 125 acres
  - Dryland pasture - 250 acres
- Factors
  - Grazing
  - Grazing + haying
  - Weed expansion rates
  - Herbicide success rates

Eiswerth et. al. 2005

- $7 to $8 per acre cost yearly
- Various expansion rates, etc.
- Grazing only
  - 15-20 years - before weed control pays off
- Grazing + haying
  - 4-5 years before weed control pays off

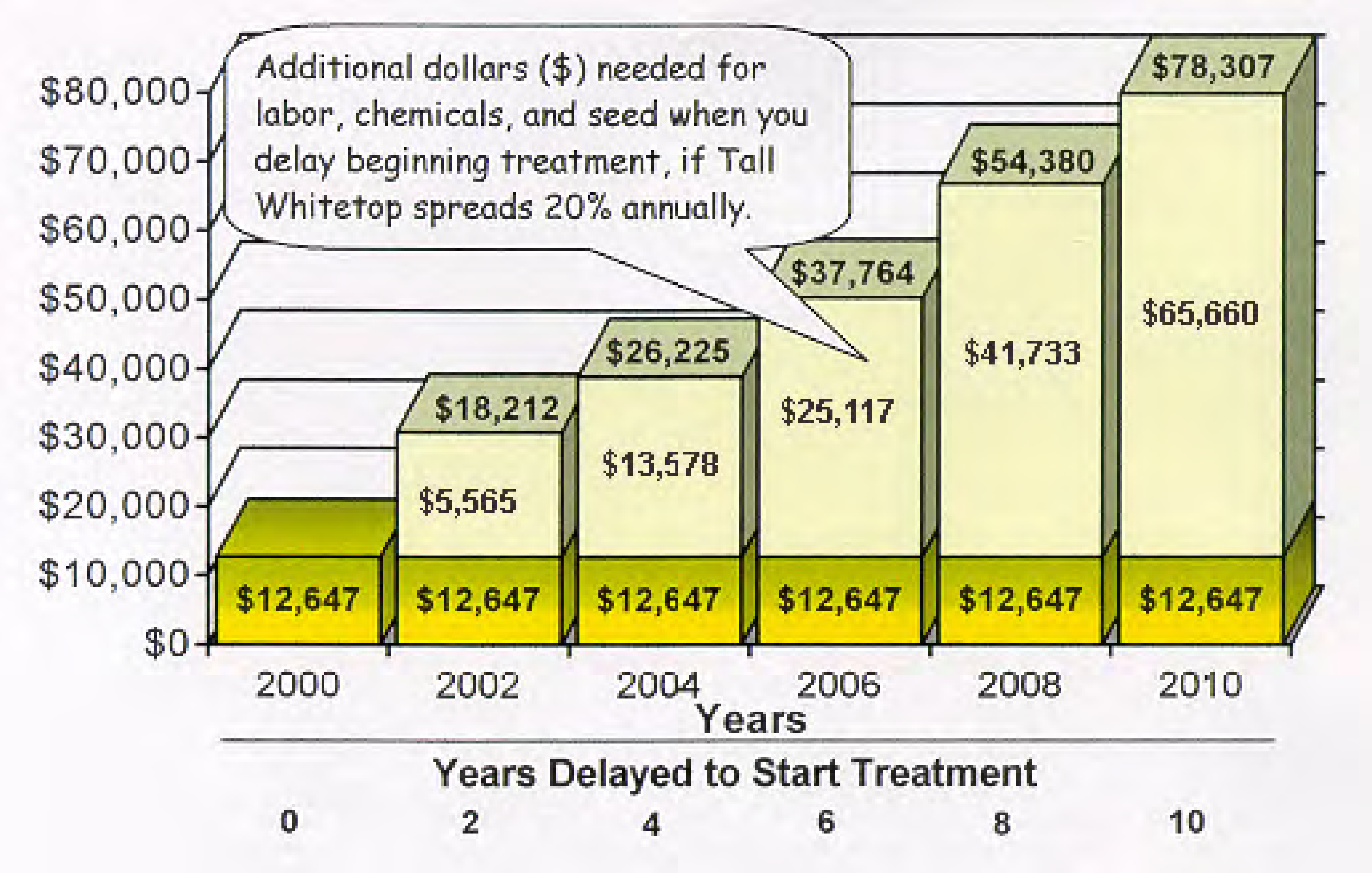
Eiseworth et. al. 2008

- Douglas County Whitetop Project
- Costs of delayed treatment

Eiseworth et. al. 2008

- Year one
  - $7300 in labor
  - $3600 in chemical
  - $1687 in seed
- Not taken into account
  - Sprayers
  - Ecological harm
  - Lost forage
  - Inflation
  - Etc.
- Looked at three weed expansion rates
  - 10%, 20%, 30%

Eiseworth et. al. 2008
20% Expansion rate



Conclusions

- Perennial
  - Hard to control
  - Need to focus on seeds and roots
- Invasive
  - Economic and ecological impacts
- Control
  - Use combination of physical and chemical methods
  - Telar - effective established grasses
  - 2,4-D-Glyphosate - areas needed to be planted

Citations

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Questions?