BRIGHAM YOUNG UNIVERSITY

Wildlife and Wildlands Conservation

Hydrologic Response to Mechanical Shredding in a Juniper Woodland in Utah

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Goal

To discover the hydrologic impacts of mechanical shredding

Background

- **What**: Range managers employ tree reduction methods, such as mechanical shredding (or Bull Hog ®), to improve ecological function.
- **Why**: The method avoids the risks associated with other methods and the resulting mulch residue is thought to protect soils from erosion.
- **How Much**: More than 10,000 ha shredded in Utah since 2004.
- **Questions** remain concerning the hydrologic effects of tracks and mulch residues that are left behind by the vehicle.

Tire tracks

Mulch residue

Objectives

- Measure infiltration rates and sediment yields on bare and residue-covered microsites
- Measure compaction of tire tracks
- Measure infiltration and sediment rates of tracked and untracked microsites

Methods

Location: Onaqui Mountains, UT

- lat 40°12'46"N, long 112°28'17"W
- Slope: 15%
- Aspect: North
- Dominate Vegetation
  - Utah juniper (pre-treatment)
  - Black sagebrush
  - Bluebunch wheatgrass
  - Sandburg's wheatgrass

Mechanical Shredding (BullHog®)

- Trees shredded in the fall of 2006 using a Tigercat M726E Mulcher®
- Tracks covered 15% of hill slope

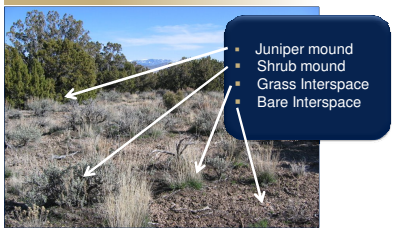
With Residue vs without residue

- Percent residue cover: Point frame (7 points on 15 transects)
- Microsite comparison: interspace and bare interspace
- Sediment yield as a function of percent residue cover

Study Design

- Soil resistance measurements
  - Summer 2008
  - 7 & 8 points along 2 transects
  - Nearest 4 microsites per point
- Simulated rainfall
  - Spring 2008
  - Randomized block
  - Five blocks
  - Ten plots per block
  - Plot dimension: 0.5 m²

Microsites



Rain simulations

Dry soil simulation (64 mm/hr)
- 45-minute simulation
- Collect runoff in timed intervals

30-minute break

Wet soil simulation (102 mm/hr)
- 45-minute simulation
- Collect runoff in timed intervals

Data Analysis

- Soil resistance: Repeated measures analysis
- Simulated rainfall: Mixed model analysis
  - Random factor: Block
  - Fixed factors: microsite and treatment
- Best-fit non-linear regression: Tablecurve ® 2D

Rain Simulator

- Meyer and Harmon (1979) simulator
- 80100 Veejet nozzle

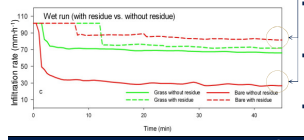
Tracked vs Untracked

- Soil resistance: Fieldscout SC900 ® cone penetrometer
- Microsites comparison: Juniper mound, shrub mound, grass interspace, and bare interspace

Effect of residue

Infiltration and sediment

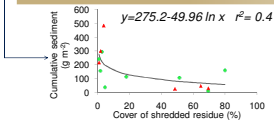
Does tree residue increase infiltration and decrease sediment yield?



- No runoff on residue -covered plots during dry run.
- Residue for bare interspace significantly ($P < 0.05$) raised final and minimal infiltration rates.
- Sediment was significantly ($P < 0.05$) lower with residue cover compared to without on bare interspace.
- Residue bare interspace was similar to grass interspace.

Wet run (soil initially wet)	Grass interspace		Bare interspace	
	No residue	residue	No residue	residue
Number of plots out of five with runoff	5	3	5	4
Final infiltration (mm•h⁻¹)	66.1 a	67.3 a	26.7 b	81.9 a
Minimum infiltration (mm•h⁻¹)	65.4 a	62.7 ab	24.0 b	78.1 a
Cumulative sediment (g•m⁻²)	133 b	83.8 b	313 a	38.6 b

Sediment - residue cover regression

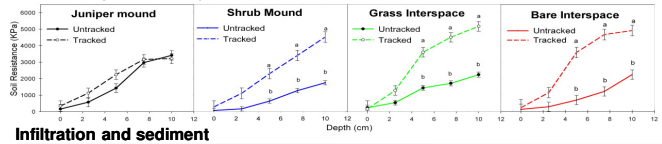


- The best fit non-linear regression was significant ($P = 0.0128$).
- As residue cover increases above 20%, cumulative sediment decreases.

Effects of tracks

Soil resistance

Does tracking result in Compaction?



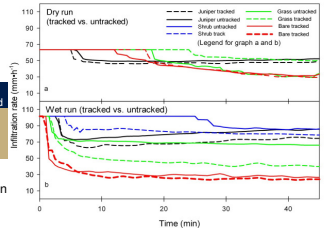
- Shrub mound, grass interspace, and bare interspace have significantly higher soil resistance on tracked soils compared to untracked soils from 5 to 10 cm.
- Juniper mound showed little difference between tracked and untracked soils.
- For all plots, soil resistance increased as depth increased.

Infiltration and sediment

Does tracking reduce infiltration and increase sediment yield?

Dry Run (soil initially dry)	Juniper mound		Grass interspace		Bare interspace	
	Untracked	Tracked	Untracked	Tracked	Untracked	Tracked
Number of plots out of five with runoff	3	3	3	3	5	5
Cumulative sediment (g•m⁻²)	29.2 a	37.6 a	16.1 a	77.7 a	62.0 a	83.5 a

Wet run (soil initially wet)	Juniper mound		Shrub mound		Grass interspace		Bare interspace	
	Untracked	Tracked	Untracked	Tracked	Untracked	Tracked	Untracked	Tracked
Number of plots out of five with runoff	5	5	3	4	5	5	5	5
Final infiltration (mm•h⁻¹)	85.7 a	74.2 a	85.0 a	79.3 a	66.1 a	39.8 b	26.7 b	24.2 b
Minimum infiltration (mm•h⁻¹)	71.7 a	62.6 a	83.0 a	77.0 a	65.4 b	37.7 a	24.0 b	20.1 b
Cumulative sediment (g•m⁻²)	48.8 c	75.0 bc	20.9 c	70.5 bc	133 bc	211 ab	313 a	403 a



- Dry run (soil initially dry)
  - Did not achieve steady state
  - Shrub mound did not have runoff
  - Cumulative sediment was not different
- Wet run (Soil initially wet)
  - Tracked grass interspace had lower infiltration rate than untracked grass interspace
  - No other significant differences

Implications

- Mechanical shredding (or Bull Hog®) is a viable method of vegetation control where juniper trees have excluded understory vegetation.
- Site and temporal characteristics should always be considered when applying mechanical treatments as specific soil conditions may be associated with low infiltration.
- During shredding, spread the mulch as much as possible.

Literature Cited

Meyer, L. D., and W. C. Harmon. 1979. Multiple-intensity rainfall simulator for erosion research on row sideslopes. *Transactions of the ASAE*. 22:100-103.

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