Tree seedling germination and establishment in masticated forest stands, Colorado

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Reduce stand density and ladder fuels
Mastication or mulching

- Grinding or chipping trees (usually smaller diameter) in place and scattering the wood
Mulching treatments redistribute the standing biomass from the vertical to the horizontal.
Changes to forest floor

- Physical barrier
- Moderates soil temperature and soil moisture
Seedling Regeneration

- Lodgepole pine
- Ponderosa pine

- Bare mineral soil favorable

- Avoid moisture stress and high temperature stress
Seedling Regeneration

• Douglas-fir
• Pinyon pine

• Some needle litter and duff favorable

• Avoid moisture stress and high temperature stress
Colorado Vegetation

- Alpine tundra
- Forest-alpine ecotone
- Subalpine forest: Lodgepole pine, Limber pine, Douglas-fir, Ponderosa pine
- Montane forest
- Mixed conifer forest
- Shrubland
- Shortgrass steppe

- Pinyon/juniper
- Ponderosa pine / Douglas-fir
Overall study design

– 3 Paired mulched and untreated sites
– 1\textsuperscript{st} Sampled 2 to 4 years after treatment
– 2\textsuperscript{nd} round of sampling taking place now (6 to 8 yrs after treatment)
Overall study design

– Substrate cover and mulch depth measured on 25 1-m² quadrats per transect
– Substrate cover and mulch depth for each seedling measured
Forest floor coverage altered by mulching treatment

- Switch from a needle litter layer to a layer of small pieces of wood
- In Pinyon pine, a decrease in soil cover
Distribution of mulch depth across treatments

- **Subalpine**: 4.5 cm
- **Montane**: 3.3 cm
- **Pinyon Pine / Juniper**: 1.4 cm
Species preferences for mulch depth

Frequency (%)

Lodgepole Pine
- Available sites
- Seedlings present

Douglas-fir
- Available sites
- Seedlings present

Mulch depth (cm)

Available sites
Seedlings present
Species preferences for mulch depth

- Pinyon Pine
- Mulch depth (cm): 0, 0.5, 1, 3, 5, 7, 9, 11, 13, 15

- Ponderosa Pine
- Mulch depth (cm): 0, 0.5, 1, 3, 5, 7, 9, 11, 13, 15

Graph showing available sites and seedlings present for different mulch depths for Pinyon and Ponderosa Pine.
Seedling density relationship to mulch depth muddled

- **Subalpine**
  - Pinyon pine / Juniper
  - Avg Mulch depth (cm) vs. Average Seedlings per hectare

- **Montane**
  - Avg Mulch depth (cm) vs. Average Seedlings per hectare

The graphs illustrate the relationship between seedling density and mulch depth for different vegetation types and elevational zones.
Seedling density relationship to mulch depth muddled

- Lack of exposed mineral soil?
- Favorable microclimate created by mulch?
- Variability in seed production?
- Climatic conditions since treatment?
Distribution of mulch depth across treatments

- **Subalpine**
  - 4.5 cm

- **Montane**
  - 3.3 cm

- **Pinyon Pine / Juniper**
  - 1.4 cm
Seed sowing experiment

- **4 depths** (bare soil, litter layer, 7.5 cm, and 15 cm (in PJ 2.5 cm and 7.5 cm))

Species sown in each ecosystem type:

- **Subalpine**: Douglas-fir and Lodgepole pine
- **Montane**: Douglas-fir and Ponderosa pine
- **Pinyon/Juniper**: Pinyon pine
Seed sowing experiment
Take home messages

- Mulching treatments alter the forest floor substrate by increasing the coverage and depth of small woody biomass.
- Seedlings were able to establish in depths up to 7 cm, but preferentially established in depths less than 3 to 4 cm.
- Median mulch depths were < 4.5 cm in subalpine, montane, and pinyon ecosystems.
Take home messages

- Seed sowing study should help provide some more answers to the impact of mulch depth on seedling regeneration and establishment.
Thank you!