Ecohydrologic Effects of Applied Woody Biomass in a Semiarid Ecosystem

New Mexico Recycling Coalition

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Abstract

In late summer, 2006, NMRC began an investigation of edaphic and vegetative responses to a piñon-juniper woodland fuel reduction project in central New Mexico. Specifically, we were interested in the ecohydrologic effects of chipping slash and applying wood mulch in a semiarid ecosystem. Using paired plots in mulched and un-mulched plots within a thinned stand, we measured vegetation changes and, using in-situ sensors, collected continuous measurements of soil moisture, soil temperature, and precipitation.

- **Wood chip mulch did not impact vegetation cover over a one year period.**
- **Herbaceous plant diversity and the relative cover of nonnative species were similar.**
- **Wood chips caused a significant increase in soil moisture under mulched patches.**
- **Soil temperature was less variable and significantly lower, by as much as 20°C (70°F), under the wood mulch.**
- **Erosion from mulched patches was estimated using the MSLE at approximately three times less than adjacent, un-mulched areas.**

Introduction

Mechanical fuel reduction projects are finding increasing use to reduce accumulation of biomass in dense forests, to reduce fire danger, and to improve forest health in wildland-urban interface areas. In many local projects, biomass resulting from the thinning is chipped and applied as mulch to the treated area in an effort to promote reestablishment of herbaceous cover and as an efficient method of disposal. Changes in overstory composition coupled with the instantaneous introduction of a litter layer may dramatically alter the ecohydrology of these water-limited systems.

However, the effects of various fuel reduction techniques on the ecology and hydrology of Southwestern woodlands are largely unknown. In response to this limited knowledge, the New Mexico Recycling Coalition (NMRC) began a comprehensive monitoring program to quantify the effects of wood mulch application on vegetation and soil properties. Here we present the results from one monitoring location near Tijeras, New Mexico. The short-term effects of wood chip application have been positive or neutral in all the systems we have evaluated to date.

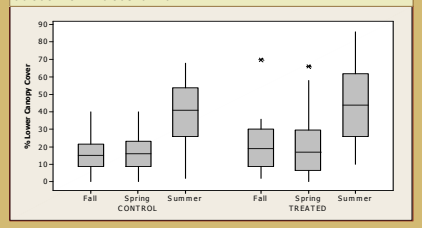
Study Site

This investigation was targeted at a 2.5 hectare area of piñon-juniper (*Pinus edulis-Juniperus monosperma*) woodland that was thinned in June, 2006. The study site was a southeast-facing hillslope with slopes ranging from 25-50%. The overall shape of the study hillslope was linear with a slope length of approximately 120m. The site, Carlito Springs, is part of the Bernalillo County Open Space system.

Mulch Effects on Vegetation

Results from three seasons of measurement indicate that the presence of wood chips did not significantly affect vegetation at any layer (Figure 1). In addition, no significant differences were observed in herbaceous plant diversity and the relative cover of nonnative species was similar.

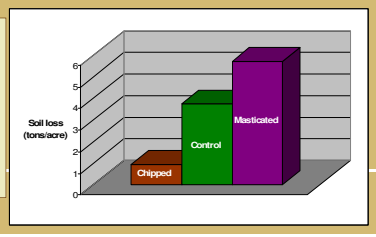
Figure 1. The presence of wood chips on treated plots did not significantly impact the herbaceous vegetation cover measured along line-point intercepts in any season of measurement.



Wood Chip Mulch and Erosion

Based on field measurements of bare soil exposure and soil texture, we estimated and compared erosion rates from control and chipped areas using a traditional erosion model, the modified universal soil loss equation (MSLE)(Brooks *et al.*, 2003). We also used the equation to develop an estimate of erosion resulting from mastication. Wood chips produced through chipping significantly reduce soil erosion while mastication treatments may increase erosion (Figure 2).

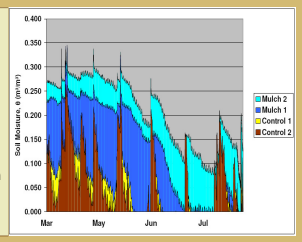
Figure 2. The protection of bare soil by applied wood chips reduced erosion more than three-fold according to MSLE estimates. Mastication may actually accelerate erosion on treated areas.



Soil Moisture Effects

Continuous measurements of soil moisture were collected using EC-5 sensors and EM-50 data loggers manufactured by Decagon Devices. Two sensors were placed in mulched patches and two were placed in adjacent control areas. A large increase in soil moisture under mulched patches indicated a considerable change in soil water content which may support additional plant biomass or potentially contribute to deep drainage beyond the root zone (Figure 3).

Figure 3. Soil moisture was significantly higher under mulched areas than in control areas through most of the measurement period from March 19th through August 19th, 2007.



Fuel Loading

The depth of wood chips was measured within a quadrat placed above each soil moisture sensor location. Based on the field measurements of surface fuel depth and the relationship between fuel bed depth and bulk density of the woody layer (Hood and Wu, 2006), fuel loadings were calculated as weight per unit area. Loading at the Mulch 1 sensor was approximately 7kg/m^2 (31 tons/acre). The Mulch 2 loading was 8kg/m^2 (36.5 tons/acre) and loading at each control sensor was negligible.

Management Implications

Prior to considering wood chip mulch as part of a project, it is crucial to evaluate the need for treatment based on the best available science regarding fire history, ecology, and hazard reduction techniques. The benefits of mulching are proportional to the adversity of the environment in which they are applied. In arid environments wood mulch may be useful for:

- Revegetation projects
- Road rehabilitation
- Roadside erosion control
- Cultural resource protection
- Post-fire rehabilitation

Mulch depths of 1 to 2 inches, as evaluated in this project, seem to improve growing conditions and limit erosion without impairing native vegetation. Wood chip mulch depths of 1.5 inches, or 25 tons/acre, have previously been shown to provide excellent soil stabilization and grass growth compared to other application depths on steep slopes (Meyer *et al.*, 1972). Mulch deeper than 4 inches may prevent light rains from reaching the soil surface and may inhibit seed germination. Large standing biomass volumes in more productive locations or cover types will require the removal of some material to prevent excessive mulch depths following treatment.

References

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