Under-canopy and inter-canopy variation in herbaceous vegetation and soil temperature of one-seed juniper stands treated with herbicide

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1-Introduction

• Pinyon-juniper woodlands cover 20-30 million ha in western North America (Tueller et al., 1979 cited by Harris et al., 2003). Reduction in forage for livestock and game, loss of understory cover (Tausch et al., 1981) , and loss of soil by runoff are associated with juniper encroachment.

• Woody plants create microclimates beneath and around canopies (Breshears et al., 1998), and in such conditions there is a soil moisture threshold beneath which under-canopy herbaceous vegetation cannot survive (West et al., 1978; Tausch and Tueller, 1990 cited by Wilcox and Davenport 1995).

• In situations where intercanopy patches are underlain by juniper roots, typically below 15 cm depth, the soil surface is relatively depleted of vegetation due to juniper root competition with grasses for water and nutrients (Johnsen 1962).

• The objective of this study was to add to an ongoing study the characterization of inter-canopy spaces in order to understand both under-tree and intercanopy effects of pinyon-juniper control treatments.

2-Study questions

Comparing herbicide treated (dead) and untreated (live) juniper stands, we studied treatment effects on:

- Under-canopy herbaceous vegetation cover and biomass;
- Under-canopy soil temperature;
- Inter-canopy plot vegetation cover and biomass; and
- Inter-canopy soil temperature.

3-Study site

- The study was conducted at the NMSU Corona Range and Livestock Research Center located in central NM at an elevation of 1,876 m.
- Tebuthiuron was applied aerially to 959 ha of juniper stands in 1995.
- Three grazing exclosures were established: CD, FG,and KI.

4-Methods

• Twelve under-canopy plots per exclosure (6 treated and 6 untreated) were placed in 2005. In Spring 2006, eight intercanopy locations (2 m²) per exclosure (4 treated and 4 untreated) were added to existing under-tree locations in three exclosures (CD, FG, and KI) .

• Three temperature probes were installed at 20 cm depth in each exclosure (CD, FG, and KI) at the drip line under dead and live juniper trees and outside the plots in intercanopy plots (treated).

• Herbaceous vegetation basal cover and biomass were measured in winter.

• Basal cover by species was estimated using 10 placements of a 10-pin frame in each plot prior to plot installation.

• To determine under-canopy and intercanopy biomass, random plots in each exclosure and each treatment were clipped of all surface vegetation to simulate high intensity infrequent grazing (12 intercanopy plots and 18 under-canopy plots).

5-Results

• Biomass was significantly different (p≤0.05) between treated and untreated juniper stands during 2005 and 2006. The average combined treated plus untreated biomass was not significantly different (p≥0.05) between years (2005 vs 2006) (Table 1).

Table 1. Under-canopy biomass (g/m²) comparison in 2005 and 2006 in treated and untreated juniper stands

	2005			2006		
Exclosure	Treated	Untreated	Treated+Untreated	Treated	Untreated	Treated+Untreated
CD	55.54	7.82	31.68[b]	27.57	1.38	14.48[b]
FG	88.73	32.82	60.77[a]	66.88	32.02	49.47[a]
KI	39.06	13.11	26.08[b]	52.62	10.93	31.78[a]
All exclosures	61.10[a]	17.92[b]	39.51[1]	49.02[a]	14.80[b]	31.90[1]

[a,b] Values sharing the same letter between exclosures or treatments are not significantly different (p ≥ 0.05)

[1] Values share the same number between years are not significantly different (p ≥ 0.05).

• Basal cover of herbaceous vegetation under-canopy was greater (p≤ 0.05) under treated than untreated juniper stands (Table 2).

Table 2. Under-canopy basal cover (%) of herbaceous vegetation in untreated and herbicide-treated juniper stands in 2005.

	Treated			Untreated			Avg veg
Exclosure	Bare g	Litter	Veg	Bare g	Litter	Veg	Treated+Untreated
CD	16.50	70.00	14.00	36.66	61.66	0.83	7.41[b]
FG	10.33	70.50	19.00	11.00	78.66	8.16	13.58[a]
KI	17.83	69.33	11.50	26.50	70.33	1.66	6.58[b]
All exclosures	14.88[b]	69.94[a]	14.83[a]	24.72[a]	70.22[a]	3.55[b]	

• Basal cover of herbaceous vegetation in inter-canopy plots was not significantly different (p≥ 0.05) between treated and untreated plots (Table 3).

Table 3. Intercanopy basal cover (%) of herbaceous vegetation in untreated and herbicide-treated juniper stands.

	Treated			Untreated			Avg veg
EXCLOSURE	Bare g	Litter	Veg	Bare g	Litter	Veg	Treated+Untreated
CD	38.75	50.00	9.25	76.00	19.50	4.50	6.87[a]
FG	13.50	69.25	16.75	55.75	24.50	19.75	18.25[a]
KI	40.00	38.50	19.50	46.50	35.00	16.75	18.12[a]
All Exclosures	30.75[b]	52.58[a]	15.17[a]	59.42[a]	26.33[b]	13.67[a]	

• Biomass was significantly greater (p≤ 0.05) in treated than in untreated inter-canopy plots (Table 4).

Table 4. Inter-canopy biomass (g/m²) in untreated and treated herbicide juniper stands.

			Avg
EXCLOSURE	Treated	Untreated	Treated+Untreated
CD	91.35	3.90	47.63[a]
FG	64.65	13.83	39.24[a]
KI	86.32	6.45	46.39[a]
All Exclosures	80.77[a]	8.06[b]	

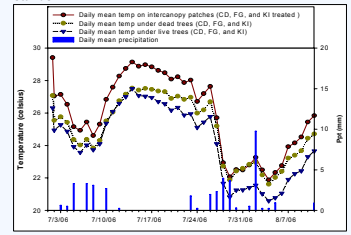
• Temperature was significantly different (p≤ 0.05) between dead, live and inter-canopy plots, with the highest temperature in the intercanopy (Table 5).

Table 5. Under-canopy and inter-canopy soil temperature (°C) in untreated and treated herbicide juniper stands.

				Avg All
Exclosure	Dead	Live	Intercanopy	Treatments
CD	24.96	24.14	26.54	25.21[a]
FG	25.37	24.73	26.39	25.50[a]
KI	24.63	23.78	24.83	24.41[b]
All Exclosures	24.99[b]	24.22[c]	25.92[a]	

• Soil temperature was different in all treatments: in inter-canopy plots where the herbaceous cover was lowest the temperature was the highest, under dead trees the temperature was intermediate, and under live trees the temperature was the coolest (Fig. 3).

Figure 3. Under-canopy and inter-canopy soil temperature in untreated and treated herbicide juniper stands.



6-Conclusions

• Treating one-seed juniper with herbicide apparently makes more water available for herbaceous vegetation resulting in greater understory herbaceous vegetation cover and biomass.

• Although interspaces in treated and untreated had similar basal cover, grass biomass production seemed to be enhanced in treated stands, likely due to increased availability of water, nutrients, and space along with slightly higher temperatures.

• Soil temperature was the highest in all cases on inter-canopy plots for each exclosure and there were temperature differences under dead trees, live trees, and inter-canopy plots.

Under-canopy plots in treated and untreated juniper stands of FG exclosure (top, taken in winter 2006)

Inter-canopy plots in treated and untreated juniper stands of KI exclosure (bottom, taken in summer 2006)

9-Literature cited

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