Under-canopy and intercanopy variation in herbaceous vegetation, soil moisture, 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).

• Previous work showed 3 times more vegetation biomass under dead compared to live trees (Ramirez *et al.* 2006), and soil was significantly drier under dead trees.

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

2-Study questions

• In response to rainfall events and comparing between treated (dead) and untreated (live) juniper stands, are there differences between treated and untreated stands in:
- intercanopy plot soil moisture;
- intercanopy plot vegetation cover and biomass; and
- intercanopy soil temperature?

• Over the period from April to August, 2006, is there a difference between treated and untreated juniper stands in under-canopy soil moisture?

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

• Eight intercanopy locations (12 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).

• One soil moisture probe was installed at the superficial soil layer (0-25 cm) in each intercanopy plot in CD, FG and KI exclosures.

• Basal cover by species was estimated at the beginning of the study using 10 placements of a 10-pin frame in each plot.

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

5-Results

• Basal cover of herbaceous vegetation in intercanopy plots was not significantly different (p≥ 0.05) between treated and untreated plots (Table 1).

Table 1. 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]	

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

• Biomass was significantly greater (p≤ 0.05) in treated than untreated intercanopy plots (Table 2).

Table 2. Intercanopy 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]	

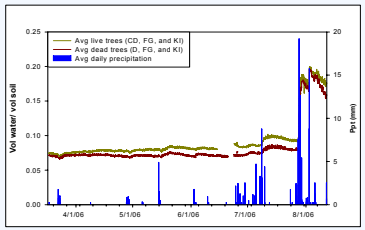
•Temperature was significantly different (p≤ 0.05) between dead, live and intercanopy plots with the highest temperature in the intercanopy (Table 3).

Table 3. Under-canopy and intercanopy 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]	

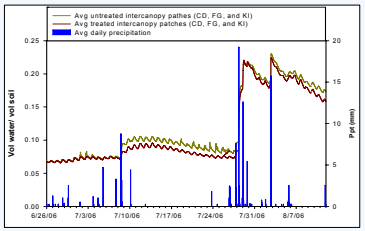
• From similar soil moisture after an extended dry period, soil moisture response to rainfall was different under dead and live trees. As in the previous study, there was greater drying under dead than under live trees (Fig. 1).

Figure 1. Under-canopy superficial soil moisture in untreated and treated herbicide juniper stands



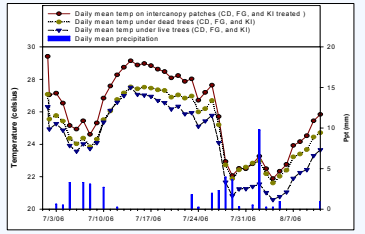
•There was no difference in soil moisture at the start of the period on intercanopy plots. In response to rainfall the soil moisture showed more rapid drying in treated than in untreated plots (Fig. 2).

Figure 2. Intercanopy superficial soil moisture in untreated and treated herbicide juniper stands.



• Soil temperature was different in all treatments: in intercanopy plots where the herbaceous cover is minimum 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 intercanopy soil temperature in untreated and treated herbicide juniper stands.



6-Conclusions

• During the period from early April through early August the superficial soil moisture was higher under live trees than dead trees

• Herbaceous cover was not different between treated and untreated intercanopy plots, apparently due to overall low vegetation cover in the open intercanopy patches.

• In intercanopy plots the superficial soil moisture did not shift with less than about 10 mm precipitation, then with a precipitation of more than 10 mm the moisture was higher in untreated plots than in treated patches.

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

• In addition to possible greater extraction of soil moisture by grass identified in previous work, drier soil under dead trees might be due in part to localized warmer microclimates compared to cooler microclimates under live trees.

Intercanopy plots vegetation in KI exclosure in untreated area (left) and treated area (right) both taken in summer 06

7-Multi-species research

This work is being conducted concurrently with evaluation of sheep and goat grazing effects on Pinyon-juniper woodland vegetation. These two efforts will form the foundation of a doctoral level integrated multi-species hydroecology study of juniper reinvasion.

8-Acknowledgements

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9-Literature cited

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