PONDEROSA PINE AND UNDERSTORY VEGETATION RESPONSE TO WESTERN JUNIPER REMOVAL

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Western juniper (Juniperus occidentalis) and ponderosa pine (Pinus ponderosa) occur together in many areas of Oregon. Western juniper occupies the driest coniferous zone in North America. Ponderosa pine has a wide distribution, extending from the subalpine forest to the mesic end of the sagebrush/grassland. In areas where western juniper and ponderosa pine forests merge, the main management goal is livestock production. Little management effort is directed toward timber production in these areas.

In the past, much concern has been placed on the encroachment of western juniper into more productive sagebrush/grasslands. Western juniper's highly competitive nature permits it to move into areas and dominate the site, reducing understory herbage production. Bedell and Bunch (1978) found that removal of western juniper in central Oregon could increase herbaceous understory production by almost 30%. Much of the past research has concentrated on the effect of western juniper on associated understory species; little work has been done on the effect of western juniper on other tree species.

In the summer of 1984, this study was begun to examine the effects of western juniper on herbaceous understory and ponderosa pine growth. Objectives of the study are (1) to determine the effect of western juniper on diameter and height growth of ponderosa pine, (2) to determine the effect of western juniper on ponderosa pine water status and soil moisture, and (3) to determine the effect of western juniper on understory production.

METHODS

Two study areas are in Crook County, Oregon, near Prineville. Study Are One is approximately 12 miles east of Prineville on a northeast slope. Area Two is 15 miles northwest of Prineville on a southern slope near Grizzly Mountain. Both study areas are on private land.

Both areas contain western juniper and ponderosa pine intermixed, with western juniper occurring more frequently. Soils range from a shallow rocky clay loam to a moderately deep sandy loam. No one soil type is dominant, and there are intergrades between the two. All areas are bordered on the upper slope by ponderosa pine forest and on the lower slope by a continuous juniper woodland. Dominant shrubs are: mountain big sagebrush (Artemisia tridentata vaseyana), gray rabbitbrush (Chrysothamnus nauseosus), green rabbitbrush (Chrysothamnus viscidiflorus), wax currant (Ribes cereum), and bitterbrush (Purshia tridentata). Perennial grasses present include: Sandberg's bluegrass (Poa sandbergii), bluebunch wheatgrass (Agropyron spicatum), Idaho fescue (Festuca idahoensis), and junegrass (Koeleria cristata).

Four treatments were established: (1) control, (2) ponderosa pine thinned to 130 tress/acre, (3) western juniper cleared, and (4) ponderosa

pine thinned (130 trees/acre) and western juniper cleared. Ponderosa pine and western juniper were handcut in summer 1984. Before trees were removed, all western juniper were measured for diameter (at 12 inches), height, and canopy radius. Ponderosa pine were measured initially in spring 1985, before growth started, and one year later in spring 1986. Diameter at breast height, and tree height were taken in both years.

Pre-dawn water potentials of ponderosa pine were measured every three weeks throughout June, July, and August. Trees were separated into three size classes: under 1 meter, 1 meter to 3 meters, and more than 3 meters. Two trees in each size class were sampled in each treatment.

Understory herbaceous production was estimated by hand clipping by species. Plants were oven-dried and weighed. Production values in this report are for groups of plants, perennial and annual grass, perennial and annual forbs, and shrubs.

RESULTS

Basal Area Growth

No significant response in basal area growth was found in the first year after ponderosa pine thinning and western juniper removal. Basal area growth was greatest in plots where ponderosa pine had been thinned and western juniper removed (Figure 1). Ponderosa pine trees in the 4- to 8-inch diameter class did not have the same level of diameter growth as trees in treatments where only western juniper was removed. Trees in the plots where only western juniper was removed had the greatest increase per tree. In treatments where ponderosa pine was thinned and western juniper removed, trees under 4-inch diameter had the greatest growth per tree, 0.45 square inches. This growth far exceeded the growth in basal area of any group. Pine trees 4 to 8 inches in diameter had the smallest growth in basal area in treatments where ponderosa pine had been thinned and western juniper removed.

Trees 4 to 8 inches in diameter had the greatest growth in basal area per tree in plots where only western juniper had been removed and ponderosa pine left at original density. Pine trees under 4 inches in diameter had the least growth in basal area in this treatment.

Growth in treatments where western juniper was left standing was less than ponderosa pine trees in treatments where western juniper was removed. Pine trees in plots where no cutting was done had the least basal area growth per tree in all diameter classes.

In general, trees under 4 inches in diameter benefited the most from the removal of western juniper, and trees between 4 and 8 inches benefited the least from western juniper removal.

Pine Water Potential

All ponderosa pine trees had higher water potentials in June than in August. Water potentials of trees in plots cleared of western juniper decreased faster than trees in plots with juniper present. Water

potentials increased from -12 bars, on July 6, to under -10 bars, on July 22. A small amount of precipitation fell on July 21 (0.2 inches), possibly accounting for the increase, but trees in plots where western juniper was present did not show this increase. Trees more than 3 meters showed a steady decline in water potential throughout the measurement period.

Understory Production

Understory plants were hand clipped and sorted into species to determine understory production. In this report, plants were placed in groups with similar growth forms to make analysis easier.

Perennial and annual grasses, annual forbs, and shrubs had higher dry weights in plots where western juniper had been removed (Figure 2). Perennial grasses composed the majority of the understory production, outproducing annual grasses by almost fourfold. Perennial forbs were the only group that did not show increased production in plots where juniper had been removed.

CONCLUSIONS

The lag in response of the basal area growth to thinning and western juniper removal may be caused by opening up the canopy too quickly, placing the trees under additional stress. Two years may be needed for the ponderosa pine to adapt to the additional light. A similar condition may exist with the water relations of the plant. The first year may have been spent extending its roots and canopy to capture the additional resources made available by removal of other trees.

Understory responses have been shown to be slow. In a study conducted by Vaitkus and Eddleman (1985) in the general area of Prineville, two years were needed before any significant response of the understory vegetation was observed. Bluebunch wheatgrass and Idaho fescue were the dominant perennial bunchgrasses on this site. Both followed the general trend of the perennial grasses, higher production in areas without western juniper. Two or three years may be needed before any response can be seen to western juniper removal.

LITERATURE CITED

Bedell, T. E., and T. R. Bunch. 1978. Effects of western juniper on forage production and livestock grazing management. IN: Proceedings of Western Juniper Ecology and Management Workshop. Bend, OR. pp. 11-29. USDA Forest Service General Technical Report PNW-74.