

## DETERMINING THE LONG - TERM EFFECTS OF SHRUB CONTROL AND NITROGEN FERTILIZATION IN PONDEROSA PINE PLANTATIONS

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**Objective:** Determine the long-term (25 year) carryover effect of vegetation control and fertilization in planted ponderosa pine on two contrasting site qualities.

**Background:** Balderston Plantation consists of 33-year-old ponderosa pine growing at 3,200 ft. on the Eldorado National Forest between Georgetown and Blodgett. The plantation was established in spring 1967 after windrowing a 20-year-old brushfield of whiteleaf manzanita. A release spray of 2,4,5-T was applied after 1 year. But by 1975, manzanita again dominated the site, averaging between 9 and 12 tons biomass/acre.

Balderston straddles a geologic contact that divides it into two soil types. A Pleistocene volcanic mudflow covers the eastern half. The soil is the Cohasset soil series, a loam with relatively high water holding capacity, fertility, and site index. To the west are older Paleozoic marine sediments that have metamorphosed and weathered to the Mariposa soil series--a gravelly, silt-loam of relatively low water-holding capacity, fertility, and site index. The two soils are dominated by the same Mediterranean climate that averages 53 inches of winter precipitation. Therefore, the site is *ideal* for comparing silvicultural treatment effects on contrasting soil types.

Six treatments were applied in fall 1975 to 0.1-acre plots on each soil. They consisted of two shrub treatments (retention or removal) and three levels of nitrogen fertilization (0, 200 and 400 lbs N/acre). These six factorial treatments were replicated three times on each soil type (18 plots per soil type, 36 plots in all).

**Early results:** First-year measurements (Powers and Jackson 1978) showed no immediate effect of treatment on tree heights or diameters on the Cohasset soil series, although needle mass was increased substantially. On the Mariposa soil series, shrub removal in itself had no immediate effect on tree growth, although needle mass was nearly doubled. Tree growth was not affected by fertilization alone, but height growth was doubled when fertilization was combined with shrub removal. Fertilization with shrub removal also increased needle mass beyond that of shrub removal, alone. No differences were found between 200 or 400 lbs N/acre.

First-year increases in needle,- mass suggested that growth increases would follow. Measuring again at 5 years (when trees were 14 years old) showed that shrub removal doubled annual height increment on the Mariposa soil. Furthermore, height increment was tripled when shrub removal was combined with fertilization. Combined treatments also increased volume increment by more than twice that of any other treatment. On the more productive Cohasset soil, 5-year height increment was increased substantially by shrub control and was doubled by the combined treatment. Volume increment increased more dramatically than height. Results are summarized in Table 1.

**Table 1. Mean annual height and volume increment following treatment at Balderston plantation on two soil series. " +N" treatments are for 200 lbs /acre, only. Different letters in a column indicate significant differences at  $\alpha=0.05$ .**

Treatment	Mariposa soil series (MAI)			Cohasset soil series (MAI)		
	Height (ft)		Vol. (ft <sup>3</sup> /ac)	Height (ft)		Vol. (ft <sup>3</sup> /ac)
	First yr	Five yrs	Five yrs	First yr	Five yrs	Five yrs
Control	0.41 a	0.39 a	1.14 a	1.35 a	0.94 a	14.57 a
+ N	0.52 a	0.43 a	1.43 a	1.68 a	1.36 a	22.86 ab
- Shrubs	0.54 a	0.82 b	4.00 a	1.49 a	1.59 b	30.86 bc
+N -Shrubs	0.98 b	1.35 c	10.29 b	1.71 a	2.11 c	44.96 c

Five-year findings were summarized in Powers 1983 and other papers. At that time, 400 lbs N/acre treatments had produced more height growth response than 200 lbs N/acre (not shown). No further measurements have been made. However, plots have been protected from other activities and their boundaries have been reestablished.

The Balderston experiment has historical value. It is California's first well-designed study of interactions between competing vegetation and fertilization. The fact that plots have been protected for more than 2 decades affords a terrific opportunity to examine long-term trends. Trees can be remeasured and periodic changes in long-term (25-year) response can be charted.

**Proposal:** Remeasure all trees in the Balderston plots for survival, dbh, height and annual height increment, current volume, crown dimensions, and density of competing shrubs. Periodic height growth will establish trends over time. Foliar samples will also be taken for biomass and possible chemical analyses (at a later time). Field work will be done in late summer 2000. Findings to be presented to the Cooperative by spring 2001.

**Cost:** \$5,000 for personnel, vehicle, per diem, and statistical expenses.

#### References:

Powers, R.F. and Jackson, G.D. 1978. Ponderosa pine response to fertilization: influence of brush removal and soil type. Res. Pap. PSW-132. USDA For. Serv. Pacific SW Res. Stn., Berkeley, CA.

Powers, R.F. 1983. Forest fertilization in California. p. 388-397. In: Ballard, R. and Gessel, S.P. (eds.) IUFRO Symposium on Forest Site and Continuous Productivity. Gen. Tech. Rep. PNW-163. Pacific NW Res. Stn., USDA For. Serv. Portland, OR.