Forest Fertilization to Maximize Economic Return

A Case Study of Results on a Privately Owned Intensively Managed Forest

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Background facts

Location - North Douglas County, Oregon

Precipitation - 55 inches/yr with a dry season extending from May through mid-September

Geologic province - Tyee sandstone formation --soils are very old (about 55 million years)

Slope and aspect - Gently north sloped - about 5% steep enough to require cable logging

Soil series - Honeygrove (9-11 inches water capacity), MacDuff (5-7 inches), Brand (kaolin clay 2-3 inches)

Douglas fir site index (50yr) - 117 ft on Honeygrove, 105 on MacDuff, 0 on Brand

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History - Old growth logged in 1950’s. Some ground converted to pasture, some allowed to re-grow though natural regeneration - a classic stump ranch. Acquired by Fenn in 1965. Sheep grazing proved unprofitable, so property was converted into forest plantations. First major planting in 1978-79 with 160 acres of Douglas fir. (Since 1979, 390 acres of 425 acre property have been converted to high yield plantations with several conifer species.)

Plantation technical features - Planting densities of the 78-79 plantations were 680 stems/acre. Douglas fir were tubed with Vexar tubes to avoid deer damage. Maximum labeled rates of herbicides were applied.

Plantation Growth Observations - Plantations on previously fertilized pastures exhibited early vigor. Plantations on stump ground exhibited reduced growth, and in some places could not escape the brush.

Iron and boron were applied by helicopter, and the results were dramatic -- earlier bud break, larger needles, better color.

Academic institutions were contacted with suggestions for a joint research program. The climate was not receptive. One of the academics spoke of “cowboy science”.

Although the academic institutions did not show much enthusiasm for pursuing the possibility of fertilization with nutrients other than nitrogen, I did have the good fortune to encounter a Weyerhaeuser forester, Tim Kosderka, who had similar interests and great skills as a field forester.

With Tim's encouragement and my own curiosity, I gathered published data which could give us ahead start. The major sources were R.V. Wood and E.K. Nambiar in Australia, Graham Will in New Zealand, Reid Carter and Tim Ballard in British Columbia, Bob Powers in California and Jim Moore in Idaho.

These sources covered several conifer species, a broad range of nutrients and in some cases the concept of serial fertilizer applications over several years.

Although we felt that we had established a firm technical base for proceeding with our intensive silvicultural program, we needed the means for evaluating the economic feasibility. We searched for a growth and economic model which would serve this purpose, and could not find one. We therefore created our own model.

In order to get an accurate measure of the forest growth, we installed fixed growth plots -- we have 15 plots on our 160 acres of our most mature stands.

Since fertilization cannot compensate for lack of control of competing vegetation and cannot compensate for failure to regulate stand density, we attempted to optimize both of these parameters. We applied appropriate herbicides both as a site preparation before planting and as post planting applications for 2-3 years.

Photo of the Fenn forests

- We plant at relatively high densities (537-900 stems per acre) to get early stand closure and to produce trees with low taper, small knots, and good form. Our thinning procedures are designed to encourage continued stand vigor and to yield positive cash flow.

  We have established a fixed fertilization protocol for new plantations:

  Newly planted trees receive about 42 grams of a slow release multi-nutrient fertilizer

  2nd year trees receive about 150 grams of the slow release multinutrient fertilizer

  3rd year trees receive about 325 grams of a multinutrient fertilizer with conventional release characteristics

The specific fertilizer formulations can be optimized by tissue sampling of trees removed in the previous harvest or from nearby trees of plantation age. If this data is not available a generic formulation will be used.

A tissue sampling sequence will begin when the plantation reaches closure (usually 6-7 years) This initiates the period of maximum nutrient stress. Nutrient deficiencies which are detected are corrected by aerial fertilization with specific blends computed from the tissue test results. We have found that trees which are monitored over a 10 year period will reach maturity with high productivity.

Let us now look at the results of this program in terms of forest productivity and in terms of forest economic value.

---The conventional plantation will produce about 120 cu.ft./acre over a 50 year rotation age on our soils.

--- Our timber stands are on track to produce about 360 cu.ft./acre over a 35 year rotation.

---At an 8% discount rate, the net present value of the conventional plantation is barely a break-even.

---At an 8% discount rate, the net present value of our intensively managed plantations is over $1000/acre.

---We have profitably commercially thinned our 1979 plantations twice (at 21 and 26 years). The conventional plantation is not ready for its first commercial thinning until about 30 years.

Our observations of your newer plantations, where all of the lessons learned are incorporated, show even greater departure from the conventional plantations. We now project about 450 cu.ft./acre over a 30 year rotation. At an 8% discount rate, the net present value reaches about $2500 per acre.

Dr. Barry Shivers from the University of Georgia's Wardell School of Forestry, discussed their work with optimal management of loblolly pine stands (genetics, thinning, vegetation control and fertilization) in a California meeting a few years ago. His numbers were almost identical to those we now measure in our younger plantations. Further, his calculated economic returns were almost identical.

There have been several symposia and meetings on forest fertilization since we began our work in 1992. I hope that you will forgive me if I critique some of the work that has been presented:

1. There has been heavy emphasis on one year or two year results. Our observations show that several years are required in order to see meaningful results. For a crop that will grow for several decades, one or two years just doesn’t tell the story.

2. There appears to have been a tendency to worship statistical perfection over good acute observations. Most forest lands are inherently heterogeneous and don’t lend themselves to normal distributions.

3. The plot sizes for most of the experiments are too small, and are not representative of the heterogeneity of the typical commercial forest.