Vegetation Control, Fertilization and Oversowing Nitrogen-Fixing Winter Annual Legumes to Improve the Growth of Conifers

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I. Preface

I grow conifer forests on 425 acres in the Umpqua valley of Oregon. Our dominant species is Douglas-fir, but we have in recent years planted diverse species within our stands as a step toward increased forest health and productivity. Our most numerous species in addition to Douglas-fir are:

Hybrid larch (larix eurolepsis)

Grand fir (abies grandis)

Ponderosa pine (pinus ponderosa)

Coast redwood (sequoia sempervirens)

The forests are grown in an intensive silviculture regime including site preparation, vegetation control, fertilization and pre-commercial thinning.

This talk will discuss the sequence of steps which we take in establishing our regenerated forest stands. The results are rewarding. On sites with a site index of about 105 ft. (50 yr. basis), our stands are growing with an effective site index of 140 to 150, an increase of two site classes.

II. Site Preparation and Pre-plant Vegetation Control

Our forests begin as clear land, but without other measures brush and grasses would soon present severe competition to the young trees. The principal brush species are Scotch broom, Salal, and various rubus species. The brush and the grasses present not only moisture competition, but also competition for nutrients and mycorrhizal populations.

Pre-plant chemical site preparation consists of Accord, Arsenal, Escort and Oust applied in appropriate amounts in the late summer. A major function of the Oust is to prevent the germination of Scotch broom and other germinants.

After any residual vegetation has browned, slash is piled and burned. On very steep slopes, broadcast burning is used, though this is becoming more difficult to accomplish. On slopes of less than 20%, a winged sub-soiler is used to reduce the clay hardpans inherent in our soils.

III. Planting and Post-Planting Fertilization

Following the planting operations, the new stock is fertilized with about 40 grams of a slow release fertilizer formulated to be compatible with the needs of the trees and the status of the soils. The fertilizer contains all the macro and micro elements in balanced amounts. Most of the stock has been grown in containers and has a small amount of fertilizer in the plug, but we do not regard this as sufficient to maximize the first years growth.

By the end of the first year, we expect to achieve a height growth in excess of 75% of the initial height, and a diameter growth of about 150%, i.e. the final height will be about 175% of the initial height and the final diameter will be about 250% of the initial diameter. The volume at the end of the first year will thus be in excess of 1000% of the initial volume. We have achieved these values on a consistent basis, with a mortality of less than 2%.

On some sites, we experience a flush of thistles during the end of the first year. If the thistle seems numerous enough to inhibit stand growth, we apply transline in the very early spring.

In short, we regard the robustness of the stand at the end of the first year to be of critical importance to the future of the forests development. We want the trees vigorous and the ground clean.

IV. 2nd and 3rd Year

At the start of the second year, we increase the amount of slow release fertilizer (applied by hand on the surface around the trees) to about 180 grams. The Oust is fall-flown again, to suppress germinants of Scotch broom and other species. The use of Transline the following spring is dependent on the thistle load. If we have controlled the thistle well the first year, we will generally not need to re-control the second year.

At the start of the third year, we apply a faster acting balanced fertilizer to the trees at the rate of about 375 grams per tree. This is the last year for general vegetation control, which usually takes place in the spring as Oust or a combination of Oust and Transline. Any scotch broom or brush escapes are treated with a backpack basal spray. By the end of the third year, the trees are free to grow.

V. 4th Year Forward. Making the Transition to a Forest Stand

The forest soil at the end of the third year has now lost a portion of the organic matter present at the time of harvest. We now have a window of opportunity between the end of the third year and the closure of the stand (achieved by the end of the 7th or 8th year) to restore organic matter, since organic matter will again begin a long-term decline after stand closure.

Organic matter status is of great importance to the storage of moisture and nutrients for the developing forests. This has been recognized in the research literature but not very well emphasized to foresters.

Since we want to add the organic matter, we must grow some ground cover. Ideally, the ground cover would grow only during the cool season of the year and would become dormant in summer so that it did not reduce soil moisture. It should be fairly dense, so that Scotch broom and other brush germinants are excluded. If it could add nitrogen fixation to the system, so much the better. Logic led us to consider winter-annual clovers, and in our case subterranean clover ("sub-clover"). Let us look at some of the characteristics of sub-clover:

1. Sub-clover grows from the first rains in the fall until warm weather in May. Then it matures and dies, extracting no moisture from the soil profile during the summer. It leaves a seedbed which emerges with the fall or winter rains.

2. Sub-clover fixes about 100 lbs of nitrogen per acre. This is organic nitrogen and releases slowly. The nitrogen is distributed throughout the top 3-4 inches of soil.

3. Sub-clover processes inorganic sulfur into organic sulfur complexes which are stable, leach very slowly and are available to the conifers.

4. Germinating sub-clover forms a very dense mat, which is very effective in excluding weak germinants such as Scotch broom.

5. The clover will continue to reseed annually in the new forest stand until the stand closure is quite tight.

6. The seed is protected by a hard coat which allows some seed to survive for several decades.

7. The species is tolerant of acid soils. It does not need the addition of lime to grow well.

In order to grow a good sub-clover stand, it is necessary to supply molybdenum along with the seed and to inoculate the seed with an appropriate inoculant. This process is very conventional for livestock pasture growers.

The enhanced nitrogen status of the soils does encourage wild grasses to grow in along side the clover. By the time the grasses arrive, however, the trees dominate the site and have roots much deeper than the grasses.

The result of this strategy is the rapid development of the organic matter in the new forest soil. The nitrogen level is sufficient to minimize the necessity of adding nitrogen to the fertilizer blends which are applied to the forest.

We expect to pre-commercially thin these stands at 10 to 12 years. New openings as the result of thinning will undoubtedly encourage a resurgence of clover growth.

We take tissue samples from our forest trees and to fertilize them by air when the tissue analyses show that nutrient supplementation is advisable. We believe that this will be on a cycle of 4 to 5 years.

I have attached a tissue analysis below of the stands growing under the conditions which I described above. The trees are on site index 105 soils, growing at an effective site index of 140. These results show a good nutritional status, except that potash, zinc and molybdenum are below our target values. That has just been corrected with a supplemental aerial application.

VI. Final Comments

We have an open door policy on our procedures and results. We have many visits each year from professionals, academics and small woodland owners. If you wish to visit us and see the results yourself, you will be welcome.

Fenn Tissue Analysis

%S	Al	B	%Ca	Cu	Fe	%K	%Mg	Mn	Mo	%N	Na	%P	Zn
.116	393	35.9	.487	3.5	42	.645	.127	130	.048	1.71	12.7	.121	10.4