

# Early Seedling Fertilization, A Work in Progress

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**S**eedling fertilization has been a hot and cold silvicultural topic over the past several decades. One of the principal reasons for this is the large variability in response observed with seedling fertilization in the field. Fertilization in the nursery setting is a routine and closely regulated practice and usually results in a positive response. Fertilization in agricultural settings has increased the yield and quality of nearly every type of agricultural crop for decades. Thus, fertilization of outplanted conifer seedlings would be expected to enhance growth. However, responses to fertilization in plantations are often inconsistent.

The Vegetation Management Research Cooperative (VMRC) and the Nursery Technology Cooperative (NTC) in the Department of Forest Science at Oregon State University have both been experimenting with seedling fertilization for the past several years. As a result, several key factors critical to fertilization success have been identified. These include: weed control, timing of fertilization, application technique, type and formulation of fertilizer used, amount of fertilizer used and site conditions (moisture availability, soil type, etc.).

## **Soil Moisture and Response to Fertilization**

Part of the reason for inconsistent responses to fertilizers are the drier soil conditions in the field versus the nursery or agricultural environment. Most nutrients absorbed by conifer seedlings are in solution with moisture drawn from the soil. As soils dry, seedlings take up less moisture and nutrients. Additionally, when soil moisture drops, access to nutrients outside the immediate rooting zone decreases due to less mass flow and diffusion of nutrients and a decrease in the seedling's ability to produce new

roots and exploit increasing volumes of soil. Thus, moisture is the key to eliciting a positive fertilizer response. In the agricultural or nursery setting, plants are seldom allowed to experience the extended periods of drought common to most Pacific Northwest reforestation environments. One of the most deleterious impacts of drying soil conditions is the build up of fertilizer salts that can reach toxic concentrations in the rooting zone of outplanted conifers by early to mid-summer.

Good weed control, especially herbaceous weed control, is likely the most important factor in generating a positive fertilizer response. Weed control provides greater soil moisture availability through the growing season. On most sites, fertilization will be ineffective without adequate weed control. On others, because of increased fertilizer salt concentration as soils dry, fertilization may even damage or kill seedlings.

Timing of application is also very important. Although root growth can occur nearly all winter long, the best root growth occurs in soil temperatures of 40° F or higher. Fertilization in late winter to early spring ensures that trees can take full advantage of nutrients when soils warm. If using temperature dependent slow-release fertilizers, late-fall applications can be made such that release of nutrients coincides with the onset of root growth in the spring.

Applying fertilizer late in the spring can be less effective because seedlings have less time to take advantage of nutrients before summer drought decreases nutrient availability and toxic salt concentrations are more likely to occur.

## **Where and How Much?**

The methodology of fertilizer application can also be important. The VMRC and NTC have had excellent results with putting slow-release fertilizer right in the planting hole. Dribbling fertilizer adjacent to the seedling is also



*Patricio Alzugaray, a graduate student working with the Nursery Technology Cooperative, shows off a two-year-old Douglas-fir seedling. This remarkable tree was initiated and outplanted from a 20 cubic inch container with slow-release fertilizer incorporated in the container media.*

a popular method; however, our results have been less consistent with this method. Surface application around the base of the seedling is another popular method. With this method it is especially important to apply the fertilizer early to allow time for the nutrients to leach into the rooting zone; this may take especially long if using slow-release fertilizers. Another less traditional method is to mix slow-release fertilizer in the media of container stock. This has gained increasing attention over the past few years and shows excellent promise. However, fertilized container stock is currently difficult to find and can be expensive.

There are two types of fertilizers used in forestry, soluble fertilizer (such as urea) or coated prill slow-release technology such as Osomocote, Forestcote and Simplot blends. Other slow-release technologies such as IBDU and urea-formaldehyde have been tried with poor success. The coated prill fertilizers are temperature dependent and are designed to release nutrients during warm periods when root growth is greatest. Their labeled release rates are generally based on 70° F temperatures,

but few forest soils reach this temperature, so the release rate can be expected to be longer than label estimates. Toxic salt buildups are less likely using slow-release fertilizers and we recommend them over most soluble forms.

Fertilizer rate is another factor but is not well understood. For example, excellent results have been achieved by the NTC with 18 grams of 18-5-12 Forestcote slow-release fertilizer in the container media. In contrast, the VMRC has had equally encouraging results using 70 grams of Osomocote 10-22-6 (a special blend) in the planting hole. On dry sites it is probably wise to err on the side of caution and use less fertilizer on drier sites because the potential of elevated salt concentrations are highest on these sites. The size of stock being fertilized may also influence the rate to use. As a rule of thumb, larger stock will endure greater levels of fertilizer than smaller stock.

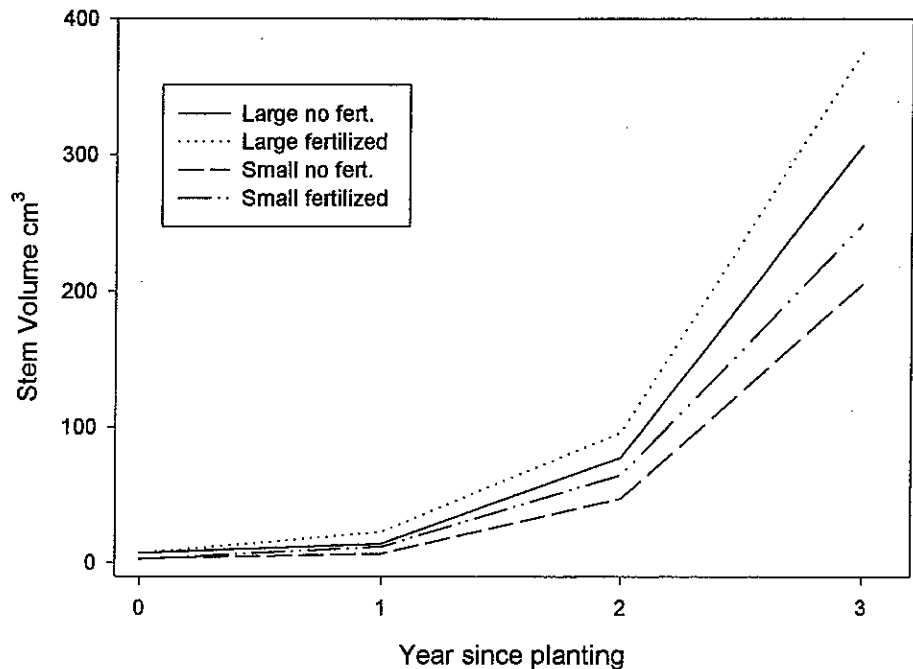
Probably one of the most confusing issues with seedling fertilization is which formulation of fertilizer to use. That is, what ratio of nitrogen, phosphorus and potassium to use. There is little available data on this question and results from both the VMRC and NTC suggest that most measurable responses are more correlated with nitrogen content than with other nutrients. However, a complete blend fertilizer with all the macros and micros is recommended.

#### What are the Gains?

The real issue in most landowner's minds is "How large of a fertilizer response can I expect?" This is probably the least understood aspect of seedling fertilization and the long-term response to early fertilization is still unknown. Preliminary data suggest the best responses will be on relatively high site ground, i.e. those sites where water is less limiting. On poorer, less moist sites, fertilization is likely not a viable option.

On weed free, good sites, the VMRC found up to an 80 percent increase in first-year stem volume of bareroot Douglas-fir stock in response to fertilization (Figure 1). However, by the third year, other site factors became

**Figure 1. Response of Large and Small Caliper Seedlings at the Time of Planting to Fertilization**




The graph illustrates early responses of Douglas-fir seedlings to fertilization at the time of planting in a Vegetation Management Research Cooperative research trial. Seedlings were sorted into either large (10-12 mm caliper) or small (6-8 mm caliper) classes prior to planting. A 10-22-6 Scotts slow release fertilizer was placed in the hole at planting in the fertilized plots. This study was conducted on a relatively high site index located on the western slope of Mt. Rainier at an elevation of 1,700 ft.

more important and the fertilizer response dropped to 20 percent. The NTC has found that container seedlings outplanted with fertilizer in the media had twice as much height and stem diameter growth than unfertilized seedlings after one growing season. What these early responses indicate about future growth is unclear.

Fertilization should be done with forethought. Success depends on carefully choosing the type and rate of fertilizer, application technique and timing to the site conditions. The interaction of all these factors is not fully understood and

any landowner entering into a seedling fertilizer regime should experiment on a small scale before committing to an intensive fertilization program. ■

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