# Effect of Controlled-Release Fertilizers on Formation of Mycorrhizae and Growth of Container-Grown Engelmann Spruce[1]

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SUMMARY

Two controlled-release NPK formulations (Osmocote and Nutricote) and one micronutrient formulation (Micromax) were added as supplements to a soluble fertilizer regime and evaluated for their effects on seedling growth and development of naturally occurring mycorrhizae in 1-0 container-grown seedlings of *Picea engelmannii* Parry. Treatments were (all received identical amounts of soluble fertilizer): 1) Osmocote, 2) Nutricote, 3) Osmocote + Micromax, 4) Nutricote + Micromax, S) Micromax, 6) soluble only. Seedlings supplemented with Osmocote or Nutricote had lower root weight, but greater shoot length, stem caliper and total weight compared to controls receiving only soluble fertilizer. Addition of Micromax did not alter growth compared to controls, but Micromax plus Osmocote decreased shoot length aril shoot:root ratio compared to Osmocote alone; Micromax plus Nutricote increased shoot length compared to Nutricote alone. Seedlings receiving a supplement of Micromax alone or given only soluble fertilizer did not meet minimum standards for caliper or shoot length set by the B. C. Forest Service.

Five types of mycorrhizal fungi established naturally during the study. Feeder roots of treatments receiving Osmocote or Nutricote were predominantly colonized by *Thelephora terrestris* at percentages ranging from 72 to 97. This contrasted with nonsupplemented treatments where *Thelephora* was substantially reduced (mean of 38 percent colonization) and E-strain formed a major component of total colonization. Percentage of nonmycorrhizal feeder roots was highest when Osmocote was used (16 percent), but did not exceed six percent in other treatments. Osmocote was also detrimental to mycorrhizal diversity compared to nonsupplemented controls; one fungus was present with Osmocote *(Thelephora terrestris)* compared to four fungal types in nonsupplemented controls.

In two supplemental experiments, effects of different release rates (types) of Nutricote and two rates of one type were examined. Comparison of four types of Nutricote (70, 100, 140, and 180-day release rates) showed few effects of release rate on growth. Compared to the 100-day formulation, the 70-day formulation produced greater stem caliper. Seedlings receiving 70 or 140-day supplements had greater shoot:root ratio, and shoot length was approximately 3 cm greater than trees with 100 or 180-day supplements. Mycorrhizal colonization did not differ substantially among the types, although E-strain colonized at low levels (up to 11 percent) with Types 100 or 140 and was absent in the others.

In a comparison of two rates of Nutricote Type 70 (1.9 and 4.7 Kg $m^{-3}$), little effect on shoot growth was evident (dry weight of roots was higher and shoot:root ratio reduced at the lower rate), but fungal diversity and colonization by E-strain were decreased at the the higher rate.

Data comparing growth of seedlings predominantly colonized by E-strain or *Thelephora* demonstrated that E-strain significantly increased stem caliper, dry weight of roots, total seedling weight, and improved the Dixon Quality Index value.

When supplementing soluble fertilizers with controlled-release NPK formulations for optimizing seedling balance and root development, the rate of the supplement should be the minimum required for obtaining acceptable seedling size and tissue nutrient content.

A detailed report of this study is being prepared for journal publication.

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