

Slow-Release Fertilizer Aids Early Growth of Australian Toon and Queensland-Maple in Hawaii

Osmocote-Treated Seedlings were Significantly Taller Than Other Seedlings After One and Two Years

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Introduction

Most forest soils in Hawaii are strongly acidic and lack essential nutrients. However, soils unable to support thrifty tree growth often support a dense growth of adapted competitors, so tree seedlings may succumb unless they are released from overtopping vegetation. Even with release, tree seedlings may not grow rapidly because of low soil fertility. Therefore, to accelerate tree growth and thereby reduce maintenance, forest managers apply fertilizers.

Many granular, quick-release fertilizers are available, but they have drawbacks. In areas of high rainfall and porous soil, rapid leaching occurs. To be of sustained benefit to the plant, quick-release fertilizers must be applied in large quantities or more often than other types to offset the amounts leached.

Fertilizers such as Osmocote and MagAmp eliminate these drawbacks. Osmocote is a slow-release fertilizer; its resin coating regulates release. Osmocote 14-14-14 releases nutrients over a 3-month period, and Osmocote 18-6-12 releases over an

even longer period. MagAmp is a controlled release fertilizer, regulated by a chemical process. MagAmp is available in two grades, medium and coarse. The medium grade lasts 3 to 5 months, and the coarse grade lasts about two growing seasons, based on U.S. mainland data.

In 1971, this study was initiated to find out if the survival and early growth of field-planted Australian toon (*Toona australis*) and Queensland-maple (*Flindersia brayleyana*) seedlings could be increased by applying fertilizer. The fertilizers tested were Osmocote, MagAmp, and Quick Release (QR). The study was designed to provide information on their application as a potentially beneficial practice, not to determine optimum formulations or application rates.

Materials and Methods

Typical State tree nursery stock of Australian toon and Queenslandmaple seedlings were planted in the Waiakea Forest Reserve, island of Hawaii, at about 2,620 feet elevation. Rainfall averages about 200

inches annually, but varies widely from year to year. Aspect is northeast, and slopes range from 1 to 35 percent. The area is mapped as "aa" lava rockland, with inclusions of small amounts of Akaka and Halemaumau soil. Pahoehoe lava outcrops are common. The soil is strongly acidic, low in potassium, and very low in phosphorus, calcium, and magnesium.

The experimental design for both species consisted of four blocks, with four row-plots within each block. Ten seedlings were planted in each rowplot, with seedlings spaced 6 by 6 feet. No replanting was done.

Seedlings were both planted and fertilized the same day. The weather was cool and cloudy, and the soil was moist. Rain began to fall shortly after planting and continued sporadically for several days afterwards.

The following treatments were randomly assigned to each rowplot:

Control (no fertilizer)
Osmocote 14-14-14 + 18-6-12: 2 ounces of each
MagAmp 7-40-6: 1 ounce of medium grade + 3 ounces of coarse grade
Quick Release (QR) 18-46-0: 4 ounces

The fertilizer was applied in a small hole dug about 3 inches from the planted seedling, and then covered with soil. The entire process took about 30 seconds for each tree.

Seedlings were examined at the time of planting and again after 2, 6, 12, and 24 months. Each seedling's height, measured to the nearest inch, and vigor, based on the condition of the terminal bud and leaves, were determined.

The study area was essentially free of competing vegetation when the seedlings were planted, but the vegetation aggressively invaded in a random pattern. All seedlings were kept free of overtopping vegetation. The potential effect of the broomsedge (*Andropogon virginicus*), palm



Figure 1.—Australian toon seedlings 2 years after planting in Waiakea Forest Reserve, Hawaii. The seedling in front of the technician was not fertilized; seedlings behind him were treated with Osmocote fertilizer.

grass (*Setaria palmifolia*), false staghorn fern (*Dicranopteris linearis*), and tree fern (*Cibotium* spp.) on the seedlings was estimated by comparing their average height with the heights of the seedlings.

Results and Discussion

Australian toon

After 1 year, survival of seedlings in all treatments was 98 percent or

greater (table 1). At the time of planting, they averaged 1.2 feet tall. Seedlings treated with Osmocote fertilizer grew about 2 feet and averaged about 3.2 feet tall after 1 year—more than twice the growth made by seedlings given the other treatments. The height differences between the Osmocote-treated seedlings and seedlings in the other treatments were statistically significant (5 percent level). Height differences

between seedlings fertilized with MagAmp or QR, and the control seedlings were not statistically significant.'

Competing vegetation after 1 year averaged about 2 feet tall. The Osmocote-treated seedlings averaged over 3 feet tall, while the MagAmp and Q11-treated seedlings averaged the same height as the competing vegetation. The percent of seedlings needing release, by treatment, were: Osmocote-35; MagAmp and QR70; control-98.

The Osmocote-treated seedlings generally had larger, healthier crowns than the other seedlings. In addition, the percentage of seedlings with high vigor was significantly greater for seedlings given the Osmocote treatment than for seedlings given the other treatments.

After 2 years, 92 percent of all seedlings had survived, but their rate of height growth had decreased and the percentage of those with high vigor had declined (except those treated with QR). The depletion of fertilizer and the increased competition from weeds were probably responsible for this condition. The differences in height and vigor between the Osmocote-treated seedlings and the others were still significant (fig. 1), but height and vigor differences among the other treatments were not significant.

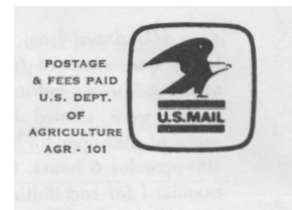
Competing vegetation averaged about 3 feet tall after 2 years. Only the Osmocote-treated seedlings, averaging over 4 feet, were taller. The percent of seedlings needing release, by treatment, were: Osmocote-39; MagAmp-63; QR-76; and control seedlings-95.

Queensland-maple

After 1 year, the differences in survival among seedlings, by treat

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Duncan's Multiple Range test was used to test differences between treatment means, at 5 percent level of statistical significance.



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meat, were not statistically significant, although the control seedlings had the highest survival rate (table 1). At the time of planting, the seedlings averaged 1 foot tall. Seedlings treated with Osmocote fertilizer grew almost 2 feet during the year, and averaged about 2.8 feet tall—more than three times the growth made by the other seedlings. Only the height differences between Osmocote-treated seedlings and other seedlings were significant.

During the year after the seedlings were planted, competing vegetation invaded the area. It averaged 2 feet tall after a year, and 3 feet tall after 2 years. Only the Osmocotetreated seedlings averaged taller than the weeds. About 38 percent of these seedlings would require weeding, compared to between 88 and 97 percent of the seedlings given other treatments.

After 2 years, survival of seedlings in all treatments was lower than at 1 year. The control seedlings had the highest survival, but the differences between treatments were not significant. The Osmocote-treated seedlings averaged 4.1 feet tall—almost twice as tall as most of the other seedlings (table 1), which was a significant difference.

The percentage of seedlings with high vigor decreased during the second year for the Osmocote and MagAmp treatments and increased for the QR treatment and the control, so the differences between treatments

TABLE 1.—Survival, height, and vigor of Australian toon and Queensland-maple seedlings 1 and 2 years after treatment with fertilizers, Waiakea Forest Reserve, Hawaii

Fertilizer	Survival rate ¹		Average height ^{1 2}		High vigor ¹	
	1 yr	2 yr	1 yr	2 yr	1 yr	2 yr
	Percent		Feet		Percent	
Australian toon						
Osmocote	100m	92n	3.2a	4.3c	95c	78g
MagAmp	100m	95n	2.0b	2.6d	73c	55h
Quick Release	98m	92n	2.1b	2.1d	59f	59h
Control	100m	98n	1.6b	1.8d	60f	51h
Queensland-maple						
Osmocote	80m	72n	2.8a	4.2c	97c	90g
MagAmp	80m	75n	1.4b	2.6d	78f	74g
Quick Release	78m	75n	1.5b	2.3d	64f	70g
Control	92m	85n	1.5b	2.3d	62f	76g

¹ By year after planting.

² Average height at planting; Australian toon, 1.2 feet; Queensland-maple, 1 foot.

³ Values not followed by the same letters differ significantly at the 5 percent level.

after 2 years were not significant.

After 2 years, the competing vegetation averaged 3 feet tall. As at 1 year, only the Osmocote-treated seedlings averaged taller than the competition. About 34 percent would require release compared to between 80 and 90 percent for seedlings in the other treatments.

Conclusions and Recommendations

In this study, the Australian toon and Queensland-maple seedlings treated with Osmocote were significantly taller after 1 and 2 years than seedlings given other treatments. The average height of Osmocotetreated seedlings was greater than

competing vegetation at both 1 and 2 years after planting. Generally, less than one-half as many of the Osmocote-treated seedlings were overtopped by other plants after 2 years as seedlings given the other treatments. Application of fertilizer at time of planting takes only about one-half minute per tree compared to about 3 minutes per tree for weeding at a later date, but further research is needed to determine the optimum formulations and application rates.

Application of Osmocote fertilizer at the rate used in this study is recommended as a means of increasing early growth and reducing the need for maintenance in Australian toon and Queensland-maple seedlings.