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A Guide for Comparing Height Growth of Advance Reproduction and Planted Seedlings

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Abstract

This guide can be used in evaluating the height growth potential of planted seedlings and advance reproduction. An equation and tables are presented, with an example of their use.

Keywords: Increment (height), advance growth, seedling growth.

Many conifer forests are two layered, consisting of a mature or overmature overstory and a well-stocked understory of saplings and/or poles. In such stands, one silvicultural alternative is to clearcut the entire stand and plant seedlings. If the understory consists of vigorous advance reproduction, another alternative is to carefully remove the overstory, leaving sufficient saplings or poles to form the new stand.

One factor that must be considered when evaluating clearcutting and planting versus saving the advance reproduction is the height that will be attained by each type of regeneration at some time in the future. A height advantage for planted trees would be an indication that the clearcutting and planting alternative might be desirable, whereas greater height of the advance reproduction would suggest this alternative.

To make such an evaluation, managers must know the average height of the planted seedlings and the advance reproduction and the average height growth rates of both classes of regeneration. From this information, the annual growth rate required of planted seedlings to equal the height of the advance reproduction at the end of a given period can be estimated as follows:

$$A = \frac{B - E}{D} + C;$$

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where,

A = annual height growth of planted seedlings needed to equal height of advance reproduction at the end of a given period,
B = average height of advance reproduction after the overstory is removed,
C = average annual height growth of advance reproduction after release,
D = number of years in growth period, and
E = average height of planted seedlings.

With this equation, the required height growth of planted seedlings can be estimated for any combination of the variables B, C, D, and E. Tables 1 through 6 give solutions for selected values of the variables within the range commonly found in the field. The tables show annual height growth for planted seedlings needed to equal height of advance reproduction 5, 10, and 15 years after overstory removal. The reader can interpolate within the tables for values not given or use the equation to estimate required seedling height growth for other combinations of variables.

An example of use of the tables follows: Assume the average height of the advance reproduction to be 9 feet,[2] with the potentia of growing 0.5 foot per year after release. Planted seedlings averaging 0.5 foot tall would then have to grow in height at the rate of 2.2 feet per year to equal the height of the advance reproduction after 5 years (table 1).

The average height of advance reproduction and planted seedlings can easily be obtained from measurements before logging and from nearby plantations. An estimate of height growth of the advance reproduction after release may be more difficult to obtain. Since growth response varies--depending on site, species, and spacing--local observations and measurements in stands where the understory has been released should be used if possible. If no local information is available, published results can be used to estimate growth response, but such data are strictly applicable only to conditions under which the study was conducted. Some estimates of growth response of ponderosa pine (*Pinus ponderosa* Dougl. ex Laws) and true fir (*Abies* spp.) advance reproduction after release are available (Barrett 1973, 1979; Seidel 1977, 1980; Ferguson and Adams 1979).

Decisions on the appropriate silvicultural prescription for a given stand are based on many factors, and the height growth relationships of planted seedlings and advance reproduction must be balanced against the other constraints. For example, it may be desirable to save the advance reproduction in areas where seedling establishment is difficult because of animal damage

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[2] 1 foot = 0.03048 meter.

Table 5--Average annual height growth of planted seedlings averaging 1.0 foot tall needed to equal height of advance reproduction after 10 years

Height growth of advance reproduction	Height of advance reproduction after overstory removal (feet)						
	3	5	7	9	11	13	15
Feet per year	Feet per year						
0.25	0.45	0.65	0.85	1.05	1.25	1.45	1.65
.5	.70	.90	1.10	1.30	1.50	1.70	1.90
1.0	1.20	1.40	1.60	1.80	2.00	2.20	2.40
1.5	1.70	1.90	2.10	2.30	2.50	2.70	2.90
2.0	2.20	2.40	2.60	2.80	3.00	3.20	3.40
2.5	2.70	2.90	3.10	3.30	3.50	3.70	3.90
3.0	3.20	3.40	3.60	3.80	4.00	4.20	4.40

Table 6--Average annual height growth of planted seedlings averaging 1.0 foot tall needed to equal height of advance reproduction after 15 years

Height growth of advance reproduction	Height of advance reproduction after overstory removal (feet)						
	3	5	7	9	11	13	15
Feet per year	Feet per year						
0.25	0.38	0.52	0.65	0.78	0.92	1.05	1.18
.5	.63	.77	.90	1.03	1.17	1.30	1.43
1.0	1.13	1.27	1.40	1.53	1.67	1.80	1.93
1.5	1.63	1.77	1.90	2.03	2.17	2.30	2.43
2.0	2.13	2.27	2.40	2.53	2.67	2.80	2.93
2.5	2.63	2.77	2.90	3.03	3.17	3.30	3.43
3.0	3.13	3.27	3.40	3.53	3.67	3.80	3.93

Table 3--Average annual height growth of planted seedlings averaging 0.5 foot tall needed to equal height of advance reproduction after 15 years

Height growth of advance reproduction	Height of advance reproduction after overstory removal (feet)						
	3	5	7	9	11	13	15
Feet per year	Feet per year						
0.25	0.42	0.55	0.68	0.81	0.94	1.07	1.20
.5	.67	.80	.93	1.06	1.19	1.32	1.45
1.0	1.17	1.30	1.43	1.56	1.69	1.82	1.95
1.5	1.67	1.80	1.93	2.06	2.19	2.32	2.45
2.0	2.17	2.30	2.43	2.56	2.69	2.82	2.95
2.5	2.67	2.80	2.93	3.06	3.19	3.32	3.45
3.0	3.17	3.30	3.43	3.56	3.69	3.82	3.95

Table 4--Average annual height growth of planted seedlings averaging 1.0 foot tall needed to equal height of advance reproduction after 5 years

Height growth of advance reproduction	Height of advance reproduction after overstory removal (feet)						
	3	5	7	9	11	13	15
Feet per year	Feet per year						
0.25	0.65	1.05	1.45	1.85	2.25	2.65	3.05
.5	.90	1.30	1.70	2.10	2.50	2.90	3.30
1.0	1.40	1.80	2.20	2.60	3.00	3.40	3.80
1.5	1.90	2.30	2.70	3.10	3.50	3.90	4.30
2.0	2.40	2.80	3.20	3.60	4.00	4.40	4.80
2.5	2.90	3.30	3.70	4.10	4.50	4.90	5.30
3.0	3.40	3.80	4.20	4.60	5.00	5.40	5.80

Table 1--Average annual height growth of planted seedlings averaging 0.5 foot tall needed to equal height of advance reproduction after 5 years

Height growth of advance reproduction	Height of advance reproduction after overstory removal (feet)						
	3	5	7	9	11	13	15
Feet per year	Feet per year						
0.25	0.75	1.15	1.55	1.95	2.35	2.75	3.15
.5	1.00	1.40	1.80	2.20	2.60	3.00	3.40
1.0	1.50	1.90	2.30	2.70	3.10	3.50	3.90
1.5	2.00	2.40	2.80	3.20	3.60	4.00	4.40
2.0	2.50	2.90	3.30	3.70	4.10	4.50	4.90
2.5	3.00	3.40	3.80	4.20	4.60	5.00	5.40
3.0	3.50	3.90	4.30	4.70	5.10	5.50	5.90

Table 2--Average annual height growth of planted seedlings averaging 0.5 foot tall needed to equal height of advance reproduction after 10 years

Height growth of advance reproduction	Height of advance reproduction after overstory removal (feet)						
	3	5	7	9	11	13	15
Feet per year	Feet per year						
0.25	0.50	0.70	0.9	1.10	1.30	1.50	1.70
.5	.75	.95	1.15	1.35	1.55	1.75	1.95
1.0	1.25	1.45	1.65	1.85	2.05	2.25	2.45
1.5	1.75	1.95	2.15	2.35	2.55	2.75	2.95
2.0	2.25	2.45	2.65	2.85	3.05	3.25	3.45
2.5	2.75	2.95	3.15	3.35	3.55	3.75	3.95
3.0	3.25	3.45	3.65	3.85	4.05	4.25	4.45

problems even though a height growth comparison favors the planted seedlings. On the other hand, planting may be favored because of potential disease problems such as dwarf mistletoe or heart rots in the advance reproduction, although the advance reproduction may have a height advantage. Regardless of the other factors involved in selecting silvicultural prescriptions, the height growth relationships among planted seedlings and advance reproduction are important and should always be considered when such decisions are made.

Literature Cited

Barrett, James W.
1973. Latest results from the Pringle Falls ponderosa pine spacing study. USDA For. Serv. Res. Note PNW-209, 22 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Barrett, James W.
1979. Silviculture of ponderosa pine--the state of our knowledge. USDA For. Serv. Gen. Tech. Rep. PNW-97, 106 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Ferguson, Dennis E., and David L. Adams.
1979. Guidelines for releasing advance grand fir from overstory competition. Univ. Idaho For., Wildl. and Range Exp. Stn., Stn. Note 35, 3 p. Moscow.

Seidel, K. W.
1977. Suppressed grand fir and Shasta red fir respond well to release. USDA For. Serv. Res. Note PNW-288, 7 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Seidel, K. W.
1980. Diameter and height growth of suppressed grand fir saplings after overstory removal. USDA For. Serv. Res. Pap. PNW-275. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

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