

ANNUAL REPORT
INTERMOUNTAIN FOREST TREE
NUTRITION COOPERATIVE

By

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Introduction

The following report is submitted in accordance with the study plan for the Intermountain Forest Tree Nutrition Cooperative. Its purpose is to summarize existing fertilization research results, primarily from north Idaho, and extrapolate these results to other physiographic areas of interest to the cooperative. This was accomplished using managed stand yield tables derived from the Prognosis Model for Stand Development (Stage 1973) for different vegetation series and physiographic areas in the Inland Empire region. Yield tables were produced for the various stand and site conditions based on the assumption that on a proportional basis the responses would be similar to those shown in north Idaho.

A net present value economic analysis was also conducted for each yield table using average costs and prices for the region. The results should be of assistance in guiding management decisions regarding fertilization until the results of the cooperative's fertilization trials are available. By providing a range of fertilization responses for different site and stand conditions, cooperators will have an idea of the magnitude of response required to be economically desirable for conditions in their area.

Steps in the Analysis

A. Biological Yields

1) Stand Simulation

The Prognosis Model for Stand Development, a computer-based tree growth simulation model, was used to project the biological yields for the various fertilizer treatments examined in this analysis. Two

important points should be kept in mind when interpreting the results of this analysis: (1) For many of the yield projections (i.e., those for central Washington, eastern Oregon, and western Montana), the Prognosis Model is being extended outside the range for which it was developed. This has been done for other purposes in the past with "good" success, but the "no treatment" yields should be carefully inspected for these physiographic areas. Even with this caution, the current version of Prognosis seems to produce the best yield tables for these areas. Studies are currently underway to extend the Prognosis Model to these new areas of eastern Oregon, eastern Washington and southern Idaho; thus, the ability to predict yields will be greatly improved in the near future. (2) Another important point to remember is that the prognosis model (as used in this analysis) attempts to represent the average growth and development of a particular stand given a specified management regime. Actual stands of similar characteristics can be expected to perform both better and worse than indicated by the case study stands simulated in the analysis.

2) Stand Selection

Four actual stands located in widely separated areas of Idaho, Washington, and Oregon provided the tree inventories (tree records) used in the analysis. All stands were managed stands in that each had been thinned between seven and ten years ago. They ranged from 40 to 80 years old and were predominately (more than 70 percent by basal area) Douglas-fir. Grand fir was the most common other tree species in three of the stands.

These stands were chosen because they fit the criteria that will be used to select future test sites for the fertilization cooperative. In order to produce yield tables for the different physiographic areas, the stands were "moved" around the region by altering certain site descriptive codes in the Prognosis model to approximate different environmental conditions in the Inland Empire.

3) Management Regimes

The fertilizer treatments and assumed responses tested in this analysis were: do-nothing, fertilize once at the beginning of the projection period, fertilize once twenty years into the projection period, and fertilize twice--once at the beginning of the period and again ten years later. Basal growth for the ten-year period after treatment was assumed to increase 25 percent above normal for one set of projections and 30 percent for another set. Thus six combinations of treatment timing and assumed response were projected for each site and stand condition. The assumed growth response values of 25 and 30 percent are within the range of observed responses in north Idaho to 200 pounds of nitrogen per acre (Pers. Comm., Scanlin and Hatch).

B. Economics

1) Analyzing the Costs and Benefits

The economic analysis model subroutine (Medema and Hatch 1979) of the Prognosis Model was used to conduct the financial analysis of the fertilizer treatments and do-nothing management regimes. The revenue produced by a regime is determined by multiplying the volume removed times the stumpage price for that species. Prices used are the region-wide averages for the period 1972-1979. In addition to the costs

directly associated with the fertilization treatment, other costs included in the analysis are the annual costs of protection and administration, and the opportunity cost of capital (the discount rate).

The economic analysis model allows for cost and price appreciation or depreciation over time at some specified rate; thus these rates must also be estimated. Nominal terms (current dollar values) are necessary as a starting point for the cost and revenue items. However, for costs and revenues projected beyond 1980, a real rate of increase was used. By using real terms (net of inflation), one does not need to include the inflation rate in the analysis. Therefore, the rates of cost and revenue appreciation and the discount rate are all in real terms. The values used in the analysis for all economic variables are given in Table 1. Several values were tested for stumpage prices, fertilization treatment costs, discount rate, and stumpage price appreciation rate to determine how sensitive the results were to changes in these economic assumptions.

2) Economic Decision Criteria

If one management regime is said to be "preferred" over another in terms of a treatment versus a nontreatment regime or one treatment versus another, a criterion must be selected upon which to base the decisions. Although numerous criteria are possible, the criterion used in this report will be that of financial optimization. The preferred option will be that regime and rotation age that produces the largest net financial gain. This is the regime that yields the largest net present value (NPV).

Table 1. Economic assumptions used in the financial analysis.

Stumpage prices:	Douglas-fir = \$75, \$85 and \$95/MBF Grand fir = \$55, \$65 and \$75/MBF
Fertilization Costs:	\$65 and \$75/ac currently \$70 and \$80/ac in 10 years \$75 and \$85/ac in 20 years
Administrative Costs:	\$2.00/ac/yr
Protection Costs:	\$0.30/ac/yr
Discount Rates:	4, 5, and 6%
Stumpage price appreciation rates:	1, 2, and 3%

C. Results

The intermountain region was divided into four geographic areas for this analysis. These areas are: northern Idaho and northeastern Washington--physiographic areas III^{1/} and IV; central Idaho and north-eastern Oregon--physiographic areas II and V; central Washington--physiographic area I; and western Montana--physiographic area VII. In each of the four geographic areas four combinations (stands) of site quality and stand ages were projected. These were: a 40-year-old stand on both good and average sites; and a 70-80-year-old stand on both good and average sites. In the northern Idaho and northeastern Washington area, good indicates western redcedar climax types and average sites means grand fir climax. In the other three geographic areas, good indicates true fir climax series and an average site means Douglas-fir series.

The results are summarized in the tables included in the following four sections. Each section pertains to one of the geographic areas. There are three types of tables in each section. The first type provides the net present values for the four stands (combinations of age and site quality) given different fertilization regimes, assumed growth responses, and economic assumptions.

Since each cooperator may have unique economic assumptions, each organization may wish to conduct its own economic analysis. For this reason, a second type of table is included. These are the biological yield tables for each fertilization regime, response assumptions, and site and stand condition included in the above mentioned "financial analysis" tables.

^{1/} Physiographic areas refer to those defined in the study plan for the cooperative.

The third type of table provides the growth of a typical Douglas-fir codominant tree growing in each managed stand yield table described above. This individual tree growth information should make it easier to relate these results to actual fertilization responses observed in the field.

All of this information taken together should give the cooperators a good idea of the magnitude of fertilization response required to be economically desirable for conditions in their area.

Conclusions

If actual growth responses to fertilization are close to the responses assumed in this analysis, then fertilization can be a good investment for managed, predominately Douglas-fir stands growing on a variety of sites across the region.

The following are general conclusions drawn from the analysis:

1. The financially preferred strategy was to fertilize once at about stand age 60 and harvest the stand within 20 years. This regime produced NPV's higher than the no treatment regime more frequently than any other. Until better response information is available, this regime seems to be the safest, although conservative, investment of the fertilization regimes tested.
2. Fertilization was preferred more frequently on the good sites.
3. Fertilization was seldom financially preferred over no treatment in stands 80 years or older.
4. Fertilization in 40-year-old stands was not an economically attractive investment.

Obviously these conclusions depend on the biological response and economic assumptions used in the analysis. Some cooperators may wish to make other assumptions and do their own analysis. Therefore, the information provided on per acre yields and individual tree growth responses should be useful in linking short term field observations with longer term per acre yields and the resultant economic consequences.

Summary Tables
for
Northern Idaho and Northeastern Washington

Definitions of Abbreviations Used in the Tables

Management Regimes

- N.T. = no treatment
- N25 = fertilize now (at the start of the projection) and assume a 25-percent increase in basal area growth over a ten year period.
- N30 = fertilize now (at the start of the projection) and assume a 30-percent increase in basal area growth over a ten year period.
- L25 = fertilize later (20 years into the projection) and assume a 25-percent increase in basal area growth over a ten year period.
- L30 = fertilize later (20 years into the projection) and assume a 30-percent increase in basal area growth over a ten year period.
- T25 = fertilize twice (at the start of the projection and again 10 years later) and assume a 25-percent increase in basal area growth for each of the ten year periods.
- T30 = fertilize twice (at the start of the projection and again 10 years later) and assume a 30-percent increase in basal area growth for each of the ten year periods.

Economic Assumptions

- Base Case = stumpage prices--DF = \$85/MBF, GF = \$65/MBF; fertilization costs = \$65/ac now, \$70/ac 10 years from now, \$75/ac 20 years from now; administrative and protection costs = \$2.30 ac/yr; discount rate = 5%; stumpage price appreciation rate = 2%.

Sensitivity Analysis

- 1 = Discount rate = 4%; other assumptions = base case.
- 2 = Discount rate = 6%; other assumptions = base case.
- 3 = Stumpage price appreciation rate = 1%; other assumptions = base case.

- 4 = Stumpage price appreciation rate = 3%; other assumptions = base case.
- 5 = Stumpage prices up \$10/MBF; appreciation rate = 3%; other assumptions = base case.
- 6 = Stumpage prices down \$10/MBF; appreciation rate = 3%; other assumptions = base case.
- 7 = Fertilization costs up \$10/ac; other assumptions = base case. (Note--this sensitivity analysis should be compared to the base case in the financial tables.)
- 8 = Stumpage prices up \$10/MBF; appreciation rate = 3%; discount rate = 4%; other assumptions = base case. (An optimistic viewpoint.)
- 9 = Stumpage prices down (10/MBF; appreciation rate = 1%; discount rate = 5%; other assumptions = base case. (A pessimistic viewpoint.)

Note: *indicates higher NPV than no treatment (i.e., preferred over no treatment).

Table 1-1. Financial analysis of fertilizer treatments in a 40-year-old stand on a good site in northern Idaho and northeastern Washington.

Net present value and harvest age for various economic assumptions and treatments.

	N.T.	Harv. Age	N25	Harv. Age	N30	Harv. Age	L25	Harv. Age	L30	Harv. Age	T25	Harv. Age	T30	Harv. Age
Base Case	784	70	768	70	777	70	* 811	70	* 822	70	719	60	745	60
1	1079	80	1062	80	1071	80	*1107	80	*1120	80	988	80	1012	70
2	584	70	561	60	572	60	* 602	70	* 610	70	577	60	* 598	60
3	574	70	554	60	565	60	* 587	70	* 594	70	565	60	* 587	60
4	1093	80	1077	80	1086	80	*1128	80	*1141	80	1007	80	1027	70
5	1227	80	1216	80	1226	80	*1269	80	*1283	80	1143	80	1165	70
6	960	80	937	80	946	80	* 987	80	* 998	80	871	80	889	70
7	--	--	758	70	767	70	* 807	70	* 818	70	703	60	729	60
8	1934	90	*1936	90	*1948	90	*1988	90	*2005	90	1837	90	1864	90
9	406	60	381	60	389	60	382	60	382	60	381	60	397	60

Table 1-2. Financial analysis of fertilizer treatments in a 40-year-old stand on an average site in northern Idaho and northeastern Washington.

Net present value and harvest age for various economic assumptions and treatments.

	N.T.	Harv. Age	N25	Harv. Age	N30	Harv. Age	L25	Harv. Age	L30	Harv. Age	T25	Harv. Age	T30	Harv. Age
Base Case	592	70	564	70	572	70	* 602	70	* 609	70	561	70	577	70
1	875	90	841	90	847	90	* 880	90	* 888	90	832	80	847	80
2	464	60	442	60	450	60	455	70	451	70	440	60	455	60
3	458	60	436	60	444	60	437	50	437	50	429	60	444	60
4	892	90	858	90	864	90	* 903	90	* 910	90	850	80	865	80
5	999	90	969	90	975	90	*1014	90	*1023	90	965	80	983	80
6	784	90	747	90	752	90	* 791	90	* 797	90	734	80	748	80
7	--	--	554	70	562	70	* 598	70	* 605	70	545	70	560	70
8	1632	90	1623	90	1633	90	*1668	90	*1682	90	*1637	90	*1660	90
9	349	50	325	50	332	50	349	50	349	50	286	50	294	60

Table 1-3. Financial analysis of fertilizer treatments in a 70-year-old stand on a good site in northern Idaho and northeastern Washington.

Net present value and harvest age for various economic assumptions and treatments.

	N.T.	Harv. Age	N25	Harv. Age	N30	Harv. Age	L25	Harv. Age	L30	Harv. Age	T25	Harv. Age	T30	Harv. Age
Base Case	828	100	809	100	817	100	* 847	100	* 856	100	820	90	* 844	90
1	1111	100	1106	100	*1118	100	*1140	100	*1152	100	*1126	100	1074	100
2	662	90	649	90	659	90	639	90	639	90	660	90	* 680	90
3	665	90	641	90	651	90	626	90	626	90	648	90	* 668	90
4	1122	100	1118	100	*1129	100	*1157	100	*1170	100	*1142	100	1090	100
5	1259	100	*1261	100	*1274	100	*1301	100	*1315	100	*1294	100	1235	100
6	986	100	974	100	984	100	*1013	100	*1024	100	* 991	100	944	100
7	--	--	798	100	807	100	* 843	100	* 852	100	803	90	828	90
8	1948	120	1946	120	*1958	120	*1991	120	*2006	120	*1971	120	1893	120
9	490	80	475	80	485	80	490	80	490	80	442	90	456	90

Table 1-4. Financial analysis of fertilizer treatments in an 80-year-old stand on an average site in northern Idaho and northeastern Washington.

Net present value and harvest age for various economic assumptions and treatments.

	N.T.	Harv. Age	N25	Harv. Age	N30	Harv. Age	L25	Harv. Age	L30	Harv. Age	T25	Harv. Age	T30	Harv. Age
Base Case	1650	80	1596	90	1613	90	1650	80	1650	80	1585	80	1585	80
1	1781	100	*1803	100	*1820	100	1775	110	*1788	110	*1837	100	*1870	100
2	1650	80	1585	80	1585	80	1650	80	1650	80	1586	80	1585	80
3	1650	80	1585	80	1585	80	1650	80	1650	80	1585	80	1585	80
4	1790	100	*1813	100	*1830	100	*1796	110	*1809	110	*1851	100	*1885	100
5	2006	100	*2038	100	*2058	100	*2016	110	*2031	110	*2087	100	*2124	100
6	1575	100	*1587	100	*1602	100	*1576	110	*1586	110	*1616	100	*1646	100
7	--	--	1586	90	1603	90	1650	80	1650	80	1575	80	1575	80
8	2781	120	2706	120	2723	120	2745	120	2764	120	2753	120	*2789	120
9	1455	80	1390	80	1390	80	1455	80	1455	80	1390	80	1390	80

Table 2-1. Yield tables for various fertilizer treatments and assumed growth responses on a good site in northern Idaho and northeastern Washington.

AGE	NT			N25			N30			L25			L30			T25			T30		
	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A
40	9.1	1352	3019	9.1	1352	3019	9.1	1352	3019	9.1	1352	3019	9.1	1352	3019	9.1	1352	3019	9.1	1352	3019
50	11.7	2511	8067	12.3	2768	9245	12.4	2820	9466	11.7	2511	8067	11.7	2511	8067	12.3	2768	9245	12.4	2820	9466
60	13.9	3902	15220	14.4	4196	16634	14.5	4254	16906	13.9	3902	15220	13.9	3902	15220	14.9	4477	18021	15.0	4590	18566
70	15.7	5275	23069	16.1	5543	24446	16.2	5594	24705	16.2	5560	24614	16.3	5616	24913	16.5	5398	24026	16.7	5505	24570
80	17.3	6089	28814	17.6	6326	30047	17.7	6371	30284	17.6	6383	30426	17.7	6441	30743	18.0	6140	29361	18.1	6237	29866
90	18.6	6760	33892	18.9	6973	35025	18.9	7015	35240	18.9	7026	35383	19.0	7079	35677	19.3	6763	34152	19.4	6850	34611
100	19.9	7348	38576	20.1	7541	39623	20.1	7579	39822	20.1	7589	39954	20.2	7638	40226	20.5	7311	38579	20.6	7392	39004
110	20.9	7835	42627	21.1	8016	43616	21.2	8051	43803	21.1	8060	43926	21.2	8106	44182	21.5	7769	42429	21.6	7843	42833
120	22.0	8266	46368	22.1	8438	47309	22.2	8470	47489	22.1	8478	47597	22.2	8522	47840	22.5	8176	45998	22.6	8247	46382

Table 2-2. Yield tables for various fertilizer treatments and assumed growth responses on an average site in northern Idaho and northeastern Washington.

AGE	NT			N25			N30			L25			L30			T25			T30		
	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A
40	8.3	1764	4228	8.3	1764	4228	8.3	1764	4228	8.3	1764	4228	8.3	1764	4228	8.3	1764	4228	8.3	1764	4228
50	9.8	2549	7832	10.2	2731	8721	10.2	2767	8877	9.8	2549	7832	9.8	2549	7832	10.2	2731	8721	10.2	2767	8877
60	11.1	3441	12410	11.4	3649	13500	11.5	3690	13697	11.1	3441	12410	11.1	3441	12410	11.7	3836	14427	11.8	3914	14806
70	12.3	4375	17570	12.6	4574	18597	12.7	4612	18801	12.6	4577	18618	12.7	4616	18823	12.9	4782	19720	13.0	4862	20143
80	13.5	5308	23094	13.7	5491	24117	13.7	5527	24313	13.7	5531	24323	13.8	5575	24566	13.9	5690	25196	14.0	5764	25595
90	14.4	6167	28527	14.6	6335	29483	14.7	6368	29667	14.7	6374	29723	14.7	6415	29953	14.9	6521	30527	14.9	6589	30917
100	15.3	6957	33757	15.5	7110	34639	15.5	7139	34822	15.5	7151	34882	15.6	7188	35101	15.7	7060	34579	15.8	7122	34941
110	16.2	7487	37823	16.3	7628	38652	16.4	7656	38814	16.4	7667	38902	16.4	7703	39118	16.5	7565	38494	16.6	7624	38836
120	17.0	7969	41632	17.1	8099	42418	17.1	8125	42574	17.1	8138	42658	17.2	8170	42856	17.3	8027	42196	17.4	8083	42521

Table 2-3. Yield tables for various fertilizer treatments and assumed growth responses on a good site in northern Idaho and northeastern Washington.

AGE	NT			N25			N30			L25			L30			T25			T30		
	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A
70	10.5	1910	5896	10.5	1910	5896	10.5	1910	5896	10.5	1910	5896	10.5	1910	5896	10.5	1910	5896	10.5	1910	5896
80	12.7	2972	11065	13.2	3209	12170	13.3	3257	12387	12.7	2972	11065	12.7	2972	11065	13.2	3209	12170	13.3	3257	12387
90	14.5	4192	17635	14.9	4456	18959	15.0	4509	19215	14.5	4192	17635	14.5	4192	17635	15.3	4705	20247	15.5	4806	20759
100	16.0	5341	24437	16.4	5581	25706	16.4	5628	25950	16.4	5583	25769	16.4	5630	26033	16.7	5846	27132	16.9	5592	26027
110	17.3	6052	29521	17.6	6269	30689	17.7	6311	30915	17.6	6305	30951	17.7	6355	31231	17.9	6510	32034	18.1	6241	30790
120	18.6	6684	34298	18.8	6878	35374	18.9	6916	35580	18.8	6915	35633	18.9	6960	35894	19.1	7097	36619	19.3	6821	35285
130	19.7	7230	38630	19.9	7409	39628	20.0	7443	39819	19.9	7444	39885	20.0	7486	40130	20.1	7611	40799	20.4	7327	39382
140	20.7	7696	42481	20.9	7862	43419	20.9	7894	43599	20.9	7897	43674	20.9	7936	43906	21.1	8053	44534	21.3	7762	43037

Table 2-4. Yield tables for various fertilizer treatments and assumed growth responses on an average site in northern Idaho and northeastern Washington.

AGE	NT			N25			N30			L25			L30			T25			T30		
	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A
80	12.6	4493	19559	12.6	4493	19559	12.6	4493	19559	12.6	4493	19559	12.6	4493	19559	12.6	4493	19559	12.6	4493	19559
90	13.9	5418	25269	14.2	5652	26630	14.3	5699	26901	13.9	5418	25269	13.9	5418	25269	14.2	5652	26630	14.3	5699	26901
100	15.1	6427	31744	15.3	6682	33274	15.4	6731	33575	15.1	6427	31744	15.1	6427	31744	15.6	6916	34703	15.7	7013	35285
110	16.1	7353	37965	16.4	7590	39427	16.4	7636	39716	16.4	7579	39369	16.4	7624	39649	16.6	7841	40984	16.7	7936	41577
120	17.1	8256	44225	17.4	8187	44073	17.4	8231	44344	17.4	8210	44212	17.4	8256	44514	17.6	8422	45556	17.7	8513	46129
130	18.1	8821	48756	18.3	8736	48486	18.3	8776	48746	18.3	8759	48641	18.4	8805	48931	18.5	8959	49904	18.6	9041	50440
140	19.0	9334	52978	19.2	9238	52624	19.2	9276	52867	19.2	9261	52782	19.3	9304	53057	19.4	9447	53980	19.5	9527	54493

Table 3-1. Growth response of a typical codominant tree to various fertilizer treatments and response assumptions on a good site in northern Idaho and northeastern Washington.

AGE	NT		N25		N30		L25		L30		T25		T30	
	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT
40	9.97	47.5	* 9.97	47.5	* 9.97	47.5	* 9.97	47.5	9.97	47.5	* 9.97	47.5	* 9.97	47.5
50	12.75	59.6	13.36	60.7	13.48	60.9	12.75	59.6	12.75	59.6	*13.36	60.7	*13.48	60.9
60	14.85	69.0	15.36	69.7	15.46	69.8	*14.85	69.0	*14.85	69.0	15.82	70.6	16.00	70.9
70	16.78	77.3	17.21	77.7	17.29	77.8	17.23	78.1	17.32	78.2	17.58	78.3	17.73	78.4
80	20.42	87.3	20.71	87.4	20.76	87.4	20.72	87.8	20.79	87.9	21.11	87.9	21.2	88.0

*Indicates time(s) of fertilizer treatments.

Table 3-2. Growth response of a typical codominant tree to various fertilizer treatments and response assumptions on an average site in northern Idaho and northeastern Washington.

AGE	NT		N25		N30		L25		L30		T25		T30	
	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT
40	9.20	58.8	* 9.20	58.8	* 9.20	58.8	9.20	58.8	9.20	58.8	* 9.20	58.8	* 9.20	58.8
50	10.66	66.2	11.00	66.9	11.06	67.1	10.66	66.2	10.66	66.2	*11.00	66.9	*11.06	67.1
60	11.38	71.2	11.70	71.9	11.76	72.0	*11.38	71.2	*11.38	71.2	11.87	72.4	11.96	72.6
70	12.64	77.7	12.93	78.1	12.98	78.2	12.94	78.3	13.00	78.4	13.05	78.5	13.13	78.6
80	13.85	83.7	14.10	84.1	14.16	84.1	14.30	84.2	14.18	84.3	14.19	84.3	14.25	84.4

*Indicates time(s) of fertilizer treatments.

Table 3-3. Growth response of a typical codominant tree to various fertilizer treatments and response assumptions on a good site in northern Idaho and northeastern Washington.

AGE	NT		N25		N30		L25		L30		T25		T30	
	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT
70	10.79	56.0	*10.79	56.0	*10.79	56.0	10.79	56.0	*10.79	56.0	*10.79	56.0	*10.79	56.0
80	12.85	66.1	13.32	67.1	13.41	67.3	12.85	66.1	12.85	66.1	*13.32	67.1	*13.41	67.3
90	14.56	74.6	14.95	75.2	15.02	75.3	*14.56	74.6	*14.56	74.6	15.33	76.0	15.48	76.2
100	16.69	83.1	16.96	83.4	17.02	83.5	17.18	83.9	17.28	84.1	17.26	84.0	17.37	84.1
110	17.54	88.3	17.76	88.5	17.81	88.5	18.00	89.0	18.10	89.1	18.03	88.9	18.16	89.0

*Indicates time(s) of fertilizer treatments.

Table 3-4. Growth response of a typical codominant tree to various fertilizer treatments and response assumptions on an average site in northern Idaho and northeastern Washington.

AGE	NT		N25		N30		L25		L30		T25		T30	
	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT
80	13.61	87.4	*13.61	87.4	*13.61	87.4	13.61	87.4	13.61	87.4	*13.61	87.4	*13.61	87.4
90	15.07	93.8	15.42	94.4	15.49	94.6	15.07	93.8	15.07	93.8	*15.42	94.4	*15.49	94.6
100	16.43	99.7	16.75	100.2	16.81	100.3	*16.43	99.7	*16.43	99.7	17.06	100.8	17.18	101.0
110	18.25	106.2	18.50	106.6	18.57	106.7	18.67	106.9	18.76	107.0	18.80	107.1	18.9	107.2
120	18.74	109.6	19.00	110.0	19.05	110.1	19.17	110.3	19.25	110.4	19.27	110.4	19.36	110.6

*Indicates time(s) of fertilizer treatments.

Summary Tables
for
Central Idaho and Northeastern Oregon

Definitions of Abbreviations Used in the Tables

Management Regimes

- N.T. = no treatment
- N25 = fertilize now (at the start of the projection) and assume a 25-percent increase in basal area growth over a ten year period.
- N30 = fertilize now (at the start of the projection) and assume a 30-percent increase in basal area growth over a ten year period.
- L25 = fertilize later (20 years into the projection) and assume a 25-percent increase in basal area growth over a ten year period.
- L30 = fertilize later (20 years into the projection) and assume a 30-percent increase in basal area growth over a ten year period.
- T25 = fertilize twice (at the start of the projection and again 10 years later) and assume a 25-percent increase in basal area growth for each of the ten year periods.
- T30 = fertilize twice (at the start of the projection and again 10 years later) and assume a 30-percent increase in basal area growth for each of the ten year periods.

Economic Assumptions

- Base Case = stumpage prices--DF = \$85/MBF, GF = \$65/MBF; fertilization costs = \$65/ac now, \$70/ac 10 years from now, \$75/ac 20 years from now; administrative and protection costs = \$2.30 ac/yr; discount rate = 5%; stumpage price appreciation rate = 2%.

Sensitivity Analysis

- 1 = Discount rate = 4%; other assumptions = base case.
- 2 = Discount rate = 6%; other assumptions = base case.
- 3 = Stumpage price appreciation rate = 1%; other assumptions = base case.

- 4 = Stumpage price appreciation rate = 3%; other assumptions = base case.
- 5 = Stumpage prices up \$10/MBF; appreciation rate = 3%; other assumptions = base case.
- 6 = Stumpage prices down \$10/MBF; appreciation rate = 3%; other assumptions = base case.
- 7 = Fertilization costs up \$10/ac; other assumptions = base case. (Note--this sensitivity analysis should be compared to the base case in the financial tables.)
- 8 = Stumpage prices up \$10/MBF; appreciation rate = 3%; discount rate = 4%; other assumptions = base case. (An optimistic viewpoint.)
- 9 = Stumpage prices down (10/MBF; appreciation rate = 1%; discount rate = 5%; other assumptions = base case. (A pessimistic viewpoint.)

Note: *indicates higher NPV than no treatment (i.e., preferred over no treatment).

Table 1-1. Financial analysis of fertilizer treatments in a 40-year-old stand on a good site in central Idaho and northeastern Oregon.

Net present value and harvest age for various economic assumptions and treatments.

	N.T.	Harv. Age	N25	Harv. Age	N30	Harv. Age	L25	Harv. Age	L30	Harv. Age	T25	Harv. Age	T30	Harv. Age
Base Case	742	70	725	70	734	70	* 766	70	* 776	70	735	70	* 754	70
1	1031	80	1015	80	1024	80	*1058	80	*1070	80	1021	80	*1045	70
2	553	70	525	60	535	60	* 568	70	* 576	70	538	60	* 559	60
3	542	70	518	60	528	60	* 553	70	* 560	70	527	60	* 548	60
4	1045	80	1029	80	1039	80	*1078	80	*1091	80	1041	80	*1061	80
5	1172	80	1163	80	*1174	80	*1213	80	*1227	80	*1181	80	*1204	80
6	917	80	896	80	904	80	* 943	80	* 954	80	901	80	* 919	80
7	--	--	715	70	724	70	* 762	70	* 772	70	719	70	738	70
8	1867	90	*1871	90	*1884	90	*1919	90	*1936	90	*1899	90	*1926	90
9	382	60	355	60	362	60	358	60	359	70	353	60	368	60

Table 1-2. Financial analysis of fertilizer treatments in a 40-year-old stand on an average site in central Idaho and northeastern Oregon.

Net present value and harvest age for various economic assumptions and treatments.

	N.T.	Harv. Age	N25	Harv. Age	N30	Harv. Age	L25	Harv. Age	L30	Harv. Age	T25	Harv. Age	T30	Harv. Age
Base Case	672	70	629	60	646	60	* 707	70	*720	70	669	60	* 703	60
1	905	80	841	70	857	70	* 953	70	* 971	70	880	70	* 914	70
2	501	60	* 506	60	* 521	60	* 524	70	* 534	70	* 535	60	* 564	60
3	495	60	* 500	60	* 514	60	* 509	70	* 519	70	* 524	60	* 552	60
4	918	80	851	70	867	70	* 970	70	* 987	70	894	70	* 929	70
5	1031	80	963	70	981	70	*1091	70	*1111	70	1017	70	*1056	70
6	805	80	738	70	753	70	* 848	70	* 863	70	772	70	803	70
7	--	--	619	60	636	60	* 703	70	* 716	70	652	60	* 687	60
8	1611	90	1534	90	1553	90	*1679	90	*1700	90	1580	90	*1618	90
9	355	60	341	60	351	60	332	60	332	60	351	60	372	60

Table 1-3. Financial analysis of fertilizer treatments in a 70-year-old stand on a good site in central Idaho and northeastern Oregon.

Net present value and harvest age for various economic assumptions and treatments.

	N.T.	Harv. Age	N25	Harv. Age	N30	Harv. Age	L25	Harv. Age	L30	Harv. Age	T25	Harv. Age	T30	Harv. Age
Base Case	776	100	755	100	763	100	* 792	100	* 801	100	763	90	* 786	90
1	1096	110	1035	100	1047	100	1067	100	1079	100	1052	100	1075	100
2	623	90	606	90	616	90	600	90	600	90	614	90	* 632	90
3	616	90	599	90	608	90	589	80	589	80	602	90	* 621	90
4	1111	110	1046	100	1057	100	1084	100	1096	100	1067	100	1091	100
5	1247	110	1181	100	1194	100	1219	100	1232	100	1210	100	1236	100
6	976	110	911	100	921	100	949	100	959	100	924	100	945	100
7	--	--	745	100	753	100	* 788	100	* 797	100	747	90	770	90
8	1942	120	1845	120	1858	120	1888	120	1902	120	1868	120	1894	120
9	469	80	450	80	460	80	469	80	469	80	411	80	422	90

Table 1-4. Financial analysis of fertilizer treatments in a 70-year-old stand on an average site in central Idaho and northeastern Oregon.

Net present value and harvest age for various economic assumptions and treatments.

	N.T.	Harv. Age	N25	Harv. Age	N30	Harv. Age	L25	Harv. Age	L30	Harv. Age	T25	Harv. Age	T30	Harv. Age
Base Case	678	90	* 683	90	* 697	90	650	90	650	90	* 707	90	* 735	90
1	838	100	* 845	90	* 862	80	* 847	100	* 855	100	* 878	90	* 912	90
2	558	90	* 565	80	* 580	80	557	80	* 557	80	* 567	90	* 590	90
3	554	80	* 562	80	* 576	80	554	80	554	80	* 556	90	* 579	90
4	848	100	* 851	100	* 868	90	* 862	100	* 871	100	* 889	90	* 923	90
5	952	100	* 963	100	* 982	90	* 971	100	* 981	100	*1010	90	*1048	90
6	744	100	740	90	* 755	90	* 753	100	* 761	100	* 768	90	* 798	90
7	--	--	673	90	* 687	90	646	90	646	90	* 691	90	* 719	90
8	1424	120	*1435	120	*1451	120	*1441	120	*1452	120	*1467	120	*1498	120
9	442	80	435	80	* 447	80	442	80	442	80	396	80	408	80

Table 2-1. Yield tables for various fertilizer treatments and assumed growth responses on a good site in central Idaho and northeastern Oregon.

AGE	NT			N25			N30			L25			L30			T25			T30		
	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A
40	9.1	1352	3019	9.1	1352	3019	9.1	1352	3019	9.1	1352	3019	9.1	1352	3019	9.1	1352	3019	9.1	1352	3019
50	11.5	2425	7735	12.1	2665	8792	12.2	2712	9001	11.5	2425	7735	11.5	2425	7735	12.1	2665	8792	12.2	2712	9001
60	13.6	3725	14378	14.1	4005	15711	14.1	4060	15975	13.6	3725	14378	13.6	3725	14378	14.5	4269	17031	14.7	4376	17563
70	15.4	5043	21885	15.8	5305	23228	15.8	5357	23489	15.8	5315	23344	15.9	5370	23631	16.2	5593	24717	16.3	5702	25267
80	16.9	5861	27586	17.3	6099	28845	17.3	6144	29087	17.3	6147	29153	17.4	6203	29466	17.6	6355	30227	17.7	6453	30743
90	18.3	6553	32743	18.6	6769	33911	18.6	6812	34138	18.6	6813	34218	18.7	6865	34510	18.9	7002	35197	19.0	7090	35673
100	19.6	7167	37554	19.9	7363	38641	19.9	7402	38853	19.9	7405	38925	19.9	7452	39196	20.1	7576	39826	20.2	7657	40271
110	20.8	7680	41766	21.0	7864	42792	21.0	7900	42994	21.0	7903	43064	21.0	7947	43318	21.2	8062	43908	21.2	8137	44328
120	21.9	8139	45676	22.1	8311	46650	22.1	8346	46843	22.1	8348	46906	22.1	8389	47146	22.2	8498	47708	22.3	8568	48108

Table 2-2. Yield tables for various fertilizer treatments and assumed growth responses on an average site in central Idaho and northeastern Oregon.

AGE	NT			N25			N30			L25			L30			T25			T30		
	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A
40	9.1	1352	3019	9.1	1352	3019	9.1	1352	3019	9.1	1352	3019	9.1	1352	3019	9.1	1352	3019	9.1	1352	3019
50	11.3	2326	7447	11.7	2611	8890	11.8	2669	9192	11.3	2326	7447	11.3	2326	7447	11.7	2611	8890	11.8	2669	9192
60	13.1	3466	13462	13.5	3790	15236	13.6	3855	15598	13.1	3466	13462	13.1	3466	13462	13.9	4094	16964	14.1	4221	17689
70	14.7	4589	19907	15.1	4496	19970	15.2	4554	20318	15.1	4892	21692	15.2	4954	22054	15.5	4806	21786	15.6	4929	22513
80	16.2	5211	24379	16.6	5095	24277	16.6	5149	24610	16.5	5521	26235	16.6	5584	26614	16.8	5376	25986	17.0	5487	26669
90	17.5	5730	28373	17.9	5603	28175	17.9	5653	28492	17.8	6013	30117	17.8	6072	30476	18.1	5859	29764	18.2	5962	30408
100	18.8	6187	32048	19.2	6050	31760	19.2	6097	32057	19.0	6448	33675	19.0	6500	34009	19.4	6285	33235	19.5	6378	33839
110	19.9	6557	35144	20.3	6411	34770	20.3	6455	35053	20.1	6797	36669	20.1	6848	36984	20.5	6628	36151	20.5	6717	36723
120	21.0	6887	38036	21.4	6734	37584	21.4	6775	37854	21.1	7113	39474	21.2	7159	39769	21.5	6938	38886	21.6	7020	39429

Table 2-3. Yield tables for various fertilizer treatments and assumed growth responses on a good site in central Idaho and northeastern Oregon.

AGE	NT			N25			N30			L25			L30			T25			T30		
	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A
70	10.5	1910	5896	10.5	1910	5896	10.5	1910	5896	10.5	1910	5896	10.5	1910	5896	10.5	1910	5896	10.5	1910	5896
80	12.5	2874	10624	12.9	3089	11625	13.0	3131	11822	12.5	2874	10624	12.5	2874	10624	12.9	3089	11625	13.0	3131	11822
90	14.2	3993	16636	14.6	4237	17865	14.6	4286	18104	14.2	3993	16636	14.2	3993	16636	14.9	4467	19053	15.1	4559	19529
100	15.6	5065	22967	16.0	5297	24192	16.0	5342	24427	16.0	5291	24211	16.0	5337	24458	16.3	5546	25533	16.4	5640	26032
110	16.9	6081	29413	17.2	5971	29028	17.3	6013	29248	17.2	6000	29219	17.3	6047	29482	17.5	6200	30301	17.6	6287	30776
120	18.1	6712	34183	18.4	6580	33636	18.5	6617	33844	18.4	6607	33833	18.5	6651	34083	18.7	6790	34839	18.8	6872	35284
130	19.2	7263	38530	19.5	7115	37870	19.6	7151	38068	19.5	7143	38064	19.6	7184	38301	19.8	7313	39008	19.8	7385	39431
140	20.2	7737	42440	20.5	7578	41680	20.6	7610	41864	20.5	7603	41869	20.6	7642	42095	20.7	7761	42763	20.8	7832	43162

Table 2-4. Yield tables for various fertilizer treatments and assumed growth responses on an average site in central Idaho and northeastern Oregon.

AGE	NT			N25			N30			L25			L30			T25			T30		
	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A
70	10.5	1910	5896	10.5	1910	5896	10.5	1910	5896	10.5	1910	5896	10.5	1910	5896	10.5	1910	5896	10.5	1910	5896
80	12.2	2735	10023	12.6	2978	11283	12.7	3027	11539	12.2	2735	10023	12.2	2735	10023	12.6	2978	11283	12.7	3027	11539
90	13.8	3658	14970	14.1	3926	16447	14.2	3981	16747	13.8	3658	14970	13.8	3658	14970	14.4	4177	17859	14.6	4281	18450
100	15.1	4221	18642	15.4	4469	20078	15.5	4518	20365	15.4	4354	19545	15.5	4380	19727	15.7	4728	21566	15.8	4829	22163
110	16.3	4706	22023	16.6	4934	23392	16.7	4981	23669	16.6	4846	22969	16.7	4873	23162	16.9	5173	24812	17.0	5267	25378
120	17.6	5148	25303	17.8	5361	26606	17.8	5403	26868	17.8	5273	26186	17.9	5298	26364	18.0	5582	27954	18.1	5668	28488
130	18.7	5533	28273	18.9	5730	29507	18.9	5769	29754	18.9	5644	29080	19.0	5666	29245	19.1	5937	30784	19.1	6018	31292
140	19.7	5854	30885	19.9	6040	32059	19.9	6078	32296	19.9	5953	31625	20.0	5974	31778	20.0	6235	33278	20.1	6311	33759

Table 3-1. Growth response of a typical codominant tree to various fertilizer treatments and response assumptions on a good site in central Idaho and northeastern Oregon.

AGE	NT		N25		N30		L25		L30		T25		T30	
	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT
40	9.97	47.5	* 9.97	47.5	* 9.97	47.5	9.97	47.5	9.97	47.5	* 9.97	47.5	* 9.97	47.5
50	12.44	58.9	12.98	60.0	13.09	60.2	12.44	58.9	12.44	58.9	*12.98	60.0	*13.09	60.2
60	14.35	68.1	14.82	68.8	14.91	69.0	*14.35	68.1	*14.35	68.1	15.24	69.7	15.41	69.9
70	16.18	76.4	16.58	76.8	16.65	76.9	16.60	77.2	16.69	77.3	16.93	77.4	17.07	77.6
80	19.72	86.5	20.00	86.6	20.05	86.7	20.00	86.9	20.06	87.0	20.23	87.0	20.33	87.0

*Indicates time(s) of fertilizer treatments.

Table 3-2. Growth response of a typical codominant tree to various fertilizer treatments and response assumptions on an average site in central Idaho and northeastern Oregon.

AGE	NT		N25		N30		L25		L30		T25		T30	
	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT
40	9.97	47.5	* 9.97	47.5	* 9.97	47.5	9.97	47.5	9.97	47.5	* 9.97	47.5	* 9.97	47.5
50	12.16	58.0	12.65	60.3	12.75	60.8	12.16	58.0	12.16	58.0	*12.65	60.3	*12.75	60.8
60	13.89	65.7	14.30	67.6	14.39	67.9	*13.89	65.7	*13.89	65.7	14.69	69.2	14.84	69.8
70	15.57	72.8	15.92	74.2	15.99	74.5	15.97	74.3	16.04	74.6	16.24	75.5	16.38	76.1
80	18.91	85.6	19.26	86.9	19.31	87.1	19.18	86.6	19.24	86.8	19.47	87.6	19.57	88.0

*Indicates time(s) of fertilizer treatments.

Table 3-3. Growth response of a typical codominant tree to various fertilizer treatments and response assumptions on a good site in central Idaho and northeastern Oregon.

AGE	NT		N25		N30		L25		L30		T25		T30	
	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT
70	10.79	56.0	*10.79	56.0	*10.79	56.0	10.79	56.0	10.79	56.0	*10.79	56.0	*10.79	56.0
80	12.66	65.7	13.09	66.6	13.17	66.8	12.66	65.7	12.66	65.7	*13.09	66.6	*13.17	66.8
90	14.25	74.0	14.62	74.6	14.69	74.7	*14.25	74.0	*14.25	74.0	14.98	75.4	15.12	75.6
100	16.29	82.4	16.56	82.8	16.62	82.9	16.77	83.3	16.86	83.4	16.85	83.3	16.97	83.5
110	17.13	87.7	17.35	87.9	17.40	87.9	17.58	88.4	17.67	88.5	17.61	88.3	17.72	88.4

*Indicates time(s) of fertilizer treatments.

Table 3-4. Growth response of a typical codominant tree to various fertilizer treatments and response assumptions on an average site in central Idaho and northeastern Oregon.

AGE	NT		N25		N30		L25		L30		T25		T30	
	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT
70	10.79	56.0	*10.79	56.0	*10.79	56.0	10.79	56.0	10.79	56.0	*10.79	56.0	*10.79	56.0
80	12.45	63.8	12.83	65.5	12.90	65.8	12.45	63.8	12.45	63.8	*12.83	65.5	*12.90	65.8
90	13.89	70.2	14.22	71.6	14.28	71.8	*13.89	70.2	*13.89	70.2	14.54	72.9	14.67	73.5
100	15.77	77.9	16.04	79.0	16.10	79.3	16.21	79.7	16.30	80.0	16.32	80.1	16.42	80.5
110	16.57	81.2	16.82	82.2	16.87	82.4	17.00	82.9	17.08	83.2	17.07	83.2	17.16	83.5

*Indicates time(s) of fertilizer treatments.

Summary Tables
for
Central Washington

Definitions of Abbreviations Used in the Tables

Management Regimes

- N.T. = no treatment
- N25 = fertilize now (at the start of the projection) and assume a 25-percent increase in basal area growth over a ten year period.
- N30 = fertilize now (at the start of the projection) and assume a 30-percent increase in basal area growth over a ten year period.
- L25 = fertilize later (20 years into the projection) and assume a 25-percent increase in basal area growth over a ten year period.
- L30 = fertilize later (20 years into the projection) and assume a 30-percent increase in basal area growth over a ten year period.
- T25 = fertilize twice (at the start of the projection and again 10 years later) and assume a 25-percent increase in basal area growth for each of the ten year periods.
- T30 = fertilize twice (at the start of the projection and again 10 years later) and assume a 30-percent increase in basal area growth for each of the ten year periods.

Economic Assumptions

- Base Case = stumpage prices--DF = \$85/MBF, GF = \$65/MBF; fertilization costs = \$65/ac now, \$70/ac 10 years from now, \$75/ac 20 years from now; administrative and protection costs = \$2.30 ac/yr; discount rate = 5%; stumpage price appreciation rate = 2%.

Sensitivity Analysis

- 1 = Discount rate = 4%; other assumptions = base case.
- 2 = Discount rate = 6%; other assumptions = base case.
- 3 = Stumpage price appreciation rate = 1%; other assumptions = base case.

- 4 = Stumpage price appreciation rate = 3%; other assumptions = base case.
- 5 = Stumpage prices up \$10/MBF; appreciation rate = 3%; other assumptions = base case.
- 6 = Stumpage prices down \$10/MBF; appreciation rate = 3%; other assumptions = base case.
- 7 = Fertilization costs up \$10/ac; other assumptions = base case. (Note--this sensitivity analysis should be compared to the base case in the financial tables.)
- 8 = Stumpage prices up \$10/MBF; appreciation rate = 3%; discount rate = 4%; other assumptions = base case. (An optimistic viewpoint.)
- 9 = Stumpage prices down (10/MBF; appreciation rate = 1%; discount rate = 5%; other assumptions = base case. (A pessimistic viewpoint.)

Note: *indicates higher NPV than no treatment (i.e., preferred over no treatment).

Table 1-1. Financial analysis of fertilizer treatments in a 40-year-old stand on a good site in central Washington.

Net present value and harvest age for various economic assumptions and treatments.

	N.T.	Harv. Age	N25	Harv. Age	N30	Harv. Age	L25	Harv. Age	L30	Harv. Age	T25	Harv. Age	T30	Harv. Age
Base Case	638	70	614	70	622	70	* 652	70	* 660	70	614	70	630	70
1	946	90	913	80	922	80	* 953	80	* 963	80	913	80	930	80
2	495	60	477	60	486	60	483	70	489	70	478	60	495	60
3	489	60	470	60	479	60	468	70	474	70	467	60	484	60
4	963	90	927	80	936	80	* 973	80	*983	80	931	80	949	80
5	1078	90	1045	80	1055	80	*1092	80	*1103	80	1055	80	1074	80
6	848	90	809	80	816	80	* 853	80	* 862	80	808	80	823	80
7	--	--	604	70	612	70	* 648	70	* 656	70	598	70	614	70
8	1759	90	1681	90	1693	90	1726	90	1740	90	1700	90	1725	90
9	363	50	342	50	350	50	363	50	363	50	311	60	323	60

Table 1-2. Financial analysis of fertilizer treatments in a 40-year-old stand on an average site in central Washington.

Net present value and harvest age for various economic assumptions and treatments.

	N.T.	Harv. Age	N25	Harv. Age	N30	Harv. Age	L25	Harv. Age	L30	Harv. Age	T25	Harv. Age	T30	Harv. Age
Base Case	430	70	404	70	412	70	* 440	70	* 447	70	402	60	423	60
1	617	80	595	80	579	70	598	70	608	70	575	70	597	70
2	338	60	315	60	323	60	323	70	329	70	315	60	332	60
3	333	60	309	60	318	60	311	50	316	70	305	60	322	60
4	628	80	607	80	587	70	612	70	622	70	588	70	610	70
5	707	80	691	80	668	70	692	70	703	70	674	70	699	70
6	550	80	523	80	506	70	532	70	541	70	502	70	521	70
7	--	--	394	70	402	70	* 436	70	* 444	70	386	60	407	60
8	1113	90	1110	90	1069	90	1090	90	1103	90	1070	90	1095	90
9	246	50	221	50	230	50	246	50	246	50	192	60	204	60

Table 1-3. Financial analysis of fertilizer treatments in a 80-year-old stand on a good site in central Washington.

Net present value and harvest age for various economic assumptions and treatments.

	N.T.	Harv. Age	N25	Harv. Age	N30	Harv. Age	L25	Harv. Age	L30	Harv. Age	T25	Harv. Age	T30	Harv. Age
Base Case	1650	80	1585	80	1585	80	1650	80	1650	80	1585	80	1585	80
1	1650	80	1614	90	1627	90	1650	80	1650	80	1585	80	1586	90
2	1650	80	1585	80	1585	80	1650	80	1650	80	1585	80	1585	80
3	1650	80	1585	80	1585	80	1650	80	1650	80	1585	80	1585	80
4	1650	80	1618	90	1631	90	1650	80	1650	80	1585	80	1599	100
5	1845	80	1820	90	1834	90	1845	80	1845	80	1780	80	1804	100
6	1455	80	1417	90	1428	90	1455	80	1455	80	1390	80	1394	100
7	--	--	1575	80	1575	80	1650	80	1650	80	1575	80	1575	80
8	2266	120	2222	110	2236	110	2248	110	2261	110	2249	110	2278	110
9	1455	80	1390	80	1390	80	1455	80	1455	80	1390	80	1390	80

Table 1-4. Financial analysis of fertilizer treatments in a 70-year-old stand on an average site in central Washington.

Net present value and harvest age for various economic assumptions and treatments.

	N.T.	Harv. Age	N25	Harv. Age	N30	Harv. Age	L25	Harv. Age	L30	Harv. Age	T25	Harv. Age	T30	Harv. Age
Base Case	524	90	510	80	521	80	523	80	523	80	503	90	521	90
1	660	100	640	100	649	100	* 668	100	* 677	100	640	100	659	100
2	495	70	457	80	467	80	495	70	495	70	430	70	430	70
3	495	70	454	80	464	80	495	70	495	70	430	70	430	70
4	669	100	649	100	658	100	* 683	100	* 691	100	653	100	* 672	100
5	752	100	737	100	747	100	* 771	100	* 781	100	747	100	* 768	100
6	586	100	560	100	568	100	* 595	100	* 602	100	559	100	576	100
7	--	--	500	80	511	80	523	80	523	80	487	90	505	90
8	1142	120	1130	120	1098	120	*1162	120	1131	120	1095	120	1116	120
9	437	70	372	70	372	70	437	70	437	70	372	70	372	70

Table 2-1. Yield tables for various fertilizer treatments and assumed growth responses on a good site in central Washington.

AGE	NT			N25			N30			L25			L30			T25			T30		
	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A
40	8.3	1764	4228	8.3	1764	4228	8.3	1764	4228	8.3	1764	4228	8.3	1764	4228	8.3	1764	4228	8.3	1764	4228
50	9.8	2616	8155	10.1	2805	9080	10.2	2841	9271	9.8	2616	8155	9.8	2616	8155	10.1	2805	9080	10.2	2841	9271
60	11.0	3576	13164	11.3	3793	14344	11.4	3836	14568	11.0	3576	13164	11.0	3576	13164	11.6	3990	15352	11.7	4070	15782
70	12.2	4569	18792	12.5	4777	19938	12.5	4818	20154	12.5	4778	19956	12.6	4818	20177	12.7	4995	21125	12.8	5078	21574
80	13.3	5565	24849	13.5	5761	25966	13.6	5797	26179	13.6	5795	26173	13.6	5841	26434	13.8	5965	27142	13.9	6043	27579
90	14.3	6467	30654	14.5	6377	30433	14.5	6411	30643	14.5	6413	30662	14.5	6456	30905	14.7	6569	31565	14.8	6640	31990
100	15.1	7034	34943	15.4	6925	34614	15.4	6956	34798	15.4	6961	34830	15.4	7001	35062	15.6	7105	35696	15.6	7171	36093
110	16.0	7557	39069	16.2	7436	38634	16.3	7466	38810	16.3	7470	38846	16.3	7507	39068	16.4	7605	39657	16.5	7667	40033
120	16.8	8024	42837	17.0	7893	42325	17.1	7921	42492	17.1	7926	42529	17.1	7961	42744	17.2	8053	43304	17.3	8112	43666

Table 2-2. Yield tables for various fertilizer treatments and assumed growth responses on an average site in central Washington.

AGE	NT			N25			N30			L25			L30			T25			T30		
	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A
40	9.1	1352	3019	9.1	1352	3019	9.1	1352	3019	9.1	1352	3019	9.1	1352	3019	9.1	1352	3019	9.1	1352	3019
50	10.6	1976	5744	11.0	2159	6607	11.0	2196	6796	10.6	1976	5744	10.6	1976	5744	11.0	2159	6607	11.0	2196	6796
60	12.0	2683	9310	12.3	2890	10369	12.3	2931	10581	12.0	2683	9310	12.0	2683	9310	12.6	3080	11367	12.7	3162	11803
70	13.2	3386	13143	13.4	3587	14230	13.5	3626	14451	13.5	3578	14199	13.5	3617	14412	13.7	3795	15372	13.8	3876	15831
80	14.3	4053	17014	14.5	4246	18118	14.6	4075	17453	14.6	4050	17292	14.6	4092	17524	14.8	4230	18337	14.9	4307	18786
90	15.3	4455	19870	15.5	4637	20941	15.6	4461	20226	15.6	4437	20068	15.6	4476	20291	15.7	4605	21062	15.8	4677	21488
100	16.3	4822	22593	16.5	4991	23615	16.6	4816	22877	16.5	4793	22724	16.6	4830	22938	16.7	4951	23674	16.8	5019	24083
110	17.1	5127	24954	17.3	5288	25942	17.4	5113	25186	17.4	5091	25031	17.4	5124	25237	17.6	5239	25949	17.6	5304	26342
120	18.0	5412	27258	18.2	5566	28210	18.3	5390	27432	18.3	5367	27274	18.3	5399	27471	18.4	5510	28161	18.5	5570	28539

Table 2-3. Yield tables for various fertilizer treatments and assumed growth responses on a good site in central Washington.

AGE	NT			N25			N30			L25			L30			T25			T30		
	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A
80	12.6	4493	19559	12.6	4493	19559	12.6	4493	19559	12.6	4493	19559	12.6	4493	19559	12.6	4493	19559	12.6	4493	19559
90	13.4	5120	23545	13.6	5280	24480	13.7	5313	24663	13.4	5120	23545	13.4	5120	23545	13.6	5280	24480	13.7	5313	24663
100	14.2	5787	27907	14.4	5962	28946	14.5	5996	29150	14.2	5787	27907	14.2	5787	27907	14.6	6121	29924	14.7	6187	30317
110	15.0	6394	32054	15.1	6561	33073	15.2	6593	33274	15.1	6550	33006	15.2	6580	33192	15.3	6733	34130	15.4	6798	34538
120	15.7	6986	36199	15.8	6990	36408	15.9	7022	36599	15.9	7000	36456	15.9	7032	36660	16.0	7155	37433	16.1	7218	37827
130	16.4	7391	39401	16.5	7387	39552	16.6	7417	39739	16.5	7397	39607	16.6	7428	39808	16.7	7545	40559	16.7	7605	40940
140	17.0	7762	42405	17.2	7751	42512	17.2	7781	42693	17.2	7759	42558	17.2	7789	42753	17.4	7902	43483	17.4	7962	43854

Table 2-4. Yield tables for various fertilizer treatments and assumed growth responses on an average site in central Washington.

AGE	NT			N25			N30			L25			L30			T25			T30		
	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A
70	10.5	1910	5896	10.5	1910	5896	10.5	1910	5896	10.5	1910	5896	10.5	1910	5896	10.5	1910	5896	10.5	1910	5896
80	11.7	2455	8597	12.0	2619	9426	12.1	2652	9590	11.7	2455	8597	11.7	2455	8597	12.0	2619	9426	12.1	2652	9590
90	12.9	3056	11741	13.1	3237	12679	13.3	3273	12870	12.9	3056	11741	12.9	3056	11741	13.4	3405	13579	13.5	3474	13954
100	13.9	3622	14905	14.1	3796	15857	14.1	3830	16050	14.1	3785	15804	14.2	3818	15987	14.3	3975	16846	14.4	4047	17249
110	14.8	4155	18048	15.0	4320	18989	15.1	4191	18479	15.0	4328	19021	15.1	4200	18516	15.2	4328	19256	15.3	4395	19690
120	15.7	4503	20517	15.9	4658	21424	16.0	4526	20881	15.9	4668	21459	16.0	4536	20921	16.1	4656	21631	16.2	4718	22004
130	16.6	4811	22774	16.7	4956	23650	16.8	4824	23089	16.7	4965	23686	16.8	4833	23128	17.0	4947	23820	17.0	5006	24176
140	17.3	5075	24815	17.5	5213	25660	17.6	5079	25082	17.5	5220	25693	17.6	5088	25119	17.7	5198	25790	17.8	5255	26134

Table 3-1. Growth response of a typical codominant tree to various fertilizer treatments and response assumptions on a good site in central Washington.

AGE	NT		N25		N30		L25		L30		T25		T30	
	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT
40	9.20	58.8	* 9.20	58.8	* 9.20	58.8	9.20	58.8	9.20	58.8	* 9.20	58.8	* 9.20	58.8
50	10.62	68.0	10.95	68.9	11.02	69.0	10.62	68.0	10.62	68.0	*10.95	68.9	*11.02	69.0
60	11.32	74.2	11.63	74.9	11.69	75.0	*11.32	74.2	*11.32	74.2	11.79	75.5	11.88	75.7
70	14.29	85.2	14.55	85.7	14.59	85.6	14.95	86.2	15.08	86.4	14.61	86.0	14.67	86.1
80	15.57	91.8	15.78	92.1	15.82	92.1	16.20	92.6	16.33	92.7	15.79	92.2	15.84	92.3

*Indicates time(s) of fertilizer treatments.

Table 3-2. Growth response of a typical codominant tree to various fertilizer treatments and response assumptions on an average site in central Washington.

AGE	NT		N25		N30		L25		L30		T25		T30	
	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT
40	9.97	47.5	* 9.97	47.5	* 9.97	47.5	9.97	47.5	9.97	47.5	* 9.97	47.5	* 9.97	47.5
50	11.47	54.8	11.82	56.4	11.89	56.7	11.45	54.8	11.45	54.8	*11.82	56.4	*11.89	56.7
60	12.71	60.5	13.01	61.9	13.07	62.2	*12.71	60.5	*12.71	60.5	13.29	63.1	13.40	63.6
70	13.95	66.1	14.21	67.2	14.27	67.4	14.25	67.3	14.31	67.6	14.46	68.2	14.56	68.6
80	16.53	76.6	16.70	77.3	16.74	77.5	16.76	77.5	16.81	77.7	16.90	78.0	16.98	78.4

*Indicates time(s) of fertilizer treatments.

Table 3-3. Growth response of a typical codominant tree to various fertilizer treatments and response assumptions on a good site in central Washington.

AGE	NT		N25		N30		L25		L30		T25		T30	
	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT
80	13.61	87.4	*13.61	87.4	*13.61	87.4	13.61	87.4	13.61	87.4	*13.61	87.4	*13.61	87.4
90	14.53	93.1	14.75	93.7	14.79	93.8	14.53	93.1	14.53	93.1	*14.75	93.7	*14.79	93.8
100	15.39	98.4	15.60	98.8	15.64	98.9	*15.39	98.4	*15.39	98.4	15.81	99.3	15.89	99.5
110	16.59	104.0	16.77	104.4	16.81	104.5	16.87	104.6	16.93	104.7	16.96	104.8	17.04	105.0
120	16.91	107.1	17.09	107.5	17.13	107.5	17.20	107.6	17.25	107.7	17.27	107.8	17.34	107.9

*Indicates time(s) of fertilizer treatments.

Table 3-4. Growth response of a typical codominant tree to various fertilizer treatments and response assumptions on an average site in central Washington.

AGE	NT		N25		N30		L25		L30		T25		T30	
	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT
70	10.79	56.0	*10.79	56.0	*10.79	56.0	10.79	56.0	10.79	56.0	*10.79	56.0	*10.79	56.0
80	11.96	61.2	12.23	62.8	12.28	63.0	11.96	61.2	11.96	61.2	*12.23	62.8	*12.28	63.0
90	13.01	66.4	13.26	67.5	13.31	67.7	*13.01	66.4	*13.01	66.4	13.51	68.5	13.60	69.0
100	14.46	72.7	14.67	73.6	14.71	73.7	14.80	74.1	14.87	74.4	14.89	74.4	14.97	74.8
110	15.06	75.4	15.26	76.2	15.30	76.4	15.39	76.7	15.45	77.0	15.46	77.0	15.54	77.3

*Indicates time(s) of fertilizer treatments.

Summary Tables
for
Western Montana

Definitions of Abbreviations Used in the Tables

Management Regimes

- N.T. = no treatment
- N25 = fertilize now (at the start of the projection) and assume a 25-percent increase in basal area growth over a ten year period.
- N30 = fertilize now (at the start of the projection) and assume a 30-percent increase in basal area growth over a ten year period.
- L25 = fertilize later (20 years into the projection) and assume a 25-percent increase in basal area growth over a ten year period.
- L30 = fertilize later (20 years into the projection) and assume a 30-percent increase in basal area growth over a ten year period.
- T25 = fertilize twice (at the start of the projection and again 10 years later) and assume a 25-percent increase in basal area growth for each of the ten year periods.
- T30 = fertilize twice (at the start of the projection and again 10 years later) and assume a 30-percent increase in basal area growth for each of the ten year periods.

Economic Assumptions

- Base Case = stumpage prices--DF = \$85/MBF, GF = \$65/MBF; fertilization costs = \$65/ac now, \$70/ac 10 years from now, \$75/ac 20 years from now; administrative and protection costs = \$2.30 ac/yr; discount rate = 5%; stumpage price appreciation rate = 2%.

Sensitivity Analysis

- 1 = Discount rate = 4%; other assumptions = base case.
- 2 = Discount rate = 6%; other assumptions = base case.
- 3 = Stumpage price appreciation rate = 1%; other assumptions = base case.

- 4 = Stumpage price appreciation rate = 3%; other assumptions = base case.
- 5 = Stumpage prices up \$10/MBF; appreciation rate = 3%; other assumptions = base case.
- 6 = Stumpage prices down \$10/MBF; appreciation rate = 3%; other assumptions = base case.
- 7 = Fertilization costs up \$10/ac; other assumptions = base case. (Note--this sensitivity analysis should be compared to the base case in the financial tables.)
- 8 = Stumpage prices up \$10/MBF; appreciation rate = 3%; discount rate = 4%; other assumptions = base case. (An optimistic viewpoint.)
- 9 = Stumpage prices down (10/MBF; appreciation rate = 1%; discount rate = 5%; other assumptions = base case. (A pessimistic viewpoint.)

Note: *indicates higher NPV than no treatment (i.e., preferred over no treatment).

Table 1-1. Financial analysis of fertilizer treatments in a 40-year-old stand on a good site in western Montana.

Net present value and harvest age for various economic assumptions and treatments.

	N.T.	Harv. Age	N25	Harv. Age	N30	Harv. Age	L25	Harv. Age	L30	Harv. Age	T25	Harv. Age	T30	Harv. Age
Base Case	627	70	602	70	610	70	* 639	70	* 648	70	601	70	617	70
1	926	90	896	80	904	80	* 934	80	* 944	80	894	80	911	80
2	488	60	468	60	476	60	473	70	480	70	468	60	485	60
3	482	60	462	60	470	60	459	70	465	70	457	60	474	60
4	943	90	909	80	918	80	* 954	80	964	80	912	80	929	80
5	1055	90	1025	80	1034	80	*1071	80	*1081	80	1033	80	1052	80
6	831	90	794	80	801	80	* 837	80	* 846	80	791	80	807	80
7	--	--	592	70	600	70	* 635	70	* 644	70	585	70	601	70
8	1723	90	1647	90	1659	90	1692	90	1706	90	1665	90	1690	90
9	360	50	337	50	345	50	360	50	360	50	304	60	316	60

Table 1-2. Financial analysis of fertilizer treatments in a 40-year-old stand on an average site in western Montana.

Net present value and harvest age for various economic assumptions and treatments.

	N.T.	Harv. Age	N25	Harv. Age	N30	Harv. Age	L25	Harv. Age	L30	Harv. Age	T25	Harv. Age	T30	Harv. Age
Base Case	443	70	418	70	426	70	* 453	70	* 461	70	416	70	438	60
1	634	80	586	70	597	70	615	70	625	70	594	70	617	70
2	347	60	325	60	333	60	333	70	339	70	327	60	344	60
3	342	60	319	60	328	60	320	70	326	70	317	60	335	60
4	645	80	594	70	605	70	629	70	640	70	607	70	630	70
5	726	80	676	70	688	70	711	70	723	70	696	70	721	70
6	564	80	512	70	522	70	548	70	557	70	519	70	538	70
7	--	--	408	70	416	70	* 449	70	* 457	70	400	70	422	60
8	1141	90	1084	90	1097	90	1118	90	1131	90	1100	90	1126	90
9	251	50	227	50	236	50	251	50	251	50	200	60	213	60

Table 1-3. Financial analysis of fertilizer treatments in an 80-year-old stand on a good site in western Montana.

Net present value and harvest age for various economic assumptions and treatments.

	N.T.	Harv. Age	N25	Harv. Age	N30	Harv. Age	L25	Harv. Age	L30	Harv. Age	T25	Harv. Age	T30	Harv. Age
Base Case	1650	80	1585	80	1585	80	1650	80	1650	80	1585	80	1585	80
1	1650	80	1607	90	1620	90	1650	80	1650	80	1585	80	1585	80
2	1650	80	1585	80	1585	80	1650	80	1650	80	1585	80	1585	80
3	1650	80	1585	80	1585	80	1650	80	1650	80	1585	80	1585	80
4	1650	80	1611	90	1624	90	1650	80	1650	80	1585	80	1585	100
5	1845	80	1812	90	1825	90	1845	80	1845	80	1780	80	1789	100
6	1455	80	1411	90	1422	90	1455	80	1455	80	1390	80	1390	80
7	--	--	1575	80	1575	80	1650	80	1650	80	1575	80	1575	80
8	2241	120	2201	110	2214	110	2227	110	2240	110	2226	110	*2254	110
9	1455	80	1390	80	1390	80	1455	80	1455	80	1390	80	1390	80

Table 1-4. Financial analysis of fertilizer treatments in a 70-year-old stand on an average site in western Montana.

Net present value and harvest age for various economic assumptions and treatments.

	N.T.	Harv. Age	N25	Harv. Age	N30	Harv. Age	L25	Harv. Age	L30	Harv. Age	T25	Harv. Age	T30	Harv. Age
Base Case	512	80	496	80	506	80	512	80	512	80	478	90	495	90
1	630	100	607	100	616	100	* 635	100	* 643	100	603	100	622	90
2	495	70	444	80	453	80	495	70	495	70	430	70	430	70
3	495	70	441	80	450	80	495	70	495	70	430	70	430	70
4	639	100	616	100	624	100	* 650	100	* 658	100	616	100	634	100
5	718	100	700	100	710	100	* 734	100	* 743	100	706	100	* 725	100
6	559	100	531	100	539	100	* 566	100	* 573	100	527	100	542	100
7	--	--	486	80	496	80	512	80	512	80	462	90	479	90
8	1079	120	1025	120	1035	120	1057	120	1067	120	1028	120	1048	120
9	437	70	372	70	372	70	437	70	437	70	372	70	372	70

Table 2-1. Yield tables for various fertilizer treatments and assumed growth responses on a good site in western Montana.

AGE	NT			N25			N30			L25			L30			T25			T30		
	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A
40	8.3	1764	4228	8.3	1764	4228	8.3	1764	4228	8.3	1764	4228	8.3	1764	4228	8.3	1764	4228	8.3	1764	4228
50	9.8	2597	8071	10.1	2781	8960	10.1	2817	9151	9.8	2597	8071	9.8	2597	8071	10.1	2781	8960	10.1	2817	9151
60	11.0	3532	12959	11.3	3747	14095	11.3	3787	14304	11.0	3532	12959	11.0	3532	12959	11.6	3937	15073	11.7	4017	15494
70	11.0	4504	18441	12.4	4707	19555	12.5	4747	19764	12.4	4707	19556	12.5	4747	19789	12.7	4919	20704	12.8	4999	21152
80	13.2	5476	24322	13.4	5665	25433	13.5	5701	25639	13.5	5699	25620	13.5	5742	25866	13.7	5864	26573	13.8	5938	27002
90	14.1	6345	29921	14.4	6265	29755	14.4	6299	29951	14.4	6300	29972	14.4	6341	30210	14.6	6452	30847	14.6	6523	31261
100	15.0	6901	34105	15.2	6805	33840	15.3	6836	34030	15.3	6838	34045	15.3	6876	34276	15.4	6979	34897	15.5	7046	35290
110	15.9	7413	38122	16.1	7304	37750	16.1	7333	37925	16.1	7338	37951	16.2	7374	38173	16.3	7469	38743	16.3	7531	39119
120	16.7	7868	41765	16.9	7748	41324	16.9	7775	41490	16.9	7780	41519	16.9	7815	41734	17.0	7903	42275	17.1	7963	42639

Table 2-2. Yield tables for various fertilizer treatments and assumed growth responses on an average site in western Montana.

AGE	NT			N25			N30			L25			L30			T25			T30		
	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A
40	9.1	1352	3019	9.1	1352	3019	9.1	1352	3019	9.1	1352	3019	9.1	1352	3019	9.1	1352	3019	9.1	1352	3019
50	10.7	1994	5847	11.0	2181	6736	11.1	2218	6915	10.7	1994	5847	10.7	1994	5847	11.0	2181	6736	11.1	2218	6915
60	12.0	2723	9549	12.3	2934	10626	12.4	2978	10843	12.0	2723	9549	12.0	2723	9549	12.7	3132	11664	12.8	3215	12117
70	13.3	3446	13481	13.5	3652	14603	13.6	3692	14827	13.6	3643	14564	13.6	3683	14783	13.8	3865	15775	13.9	3949	16243
80	14.4	4126	17439	14.7	4107	17648	14.7	4145	17869	14.7	4120	17707	14.7	4163	17943	14.9	4305	18777	15.0	4384	19243
90	15.4	4534	20355	15.7	4500	20487	15.7	4537	20704	15.7	4513	20544	15.7	4553	20774	15.9	4685	21569	16.0	4759	22008
100	16.4	4904	23121	16.7	4861	23194	16.7	4896	23403	16.7	4872	23238	16.7	4908	23462	16.9	5034	24227	16.9	5102	24648
110	17.3	5210	25514	17.6	5161	25536	17.6	5193	25736	17.6	5170	25573	17.6	5205	25789	17.7	5323	26522	17.8	5389	26926
120	18.2	5496	27833	18.4	5439	27805	18.5	5470	27999	18.4	5447	27831	18.5	5479	28039	18.6	5592	28746	18.6	5655	29134

Table 2-3. Yield tables for various fertilizer treatments and assumed growth responses on a good site in western Montana.

AGE	NT			N25			N30			L25			L30			T25			T30		
	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A
80	12.6	4493	19559	12.6	4493	19559	12.6	4493	19559	12.6	4493	19559	12.6	4493	19559	12.6	4493	19559	12.6	4493	19559
90	13.4	5103	23450	13.6	5260	24359	13.7	5291	24536	13.4	5103	23450	13.4	5103	23450	13.6	5260	24359	13.7	5291	24536
100	14.2	5751	27686	14.4	5920	28700	14.4	5954	28902	14.2	5751	27686	14.2	5751	27686	14.6	6075	29644	14.6	6139	30031
110	14.9	6340	31721	15.1	6500	32708	15.1	6533	32902	15.1	6490	32645	15.1	6519	32826	15.3	6667	33737	15.3	6730	34137
120	15.6	6909	35739	15.8	6917	35954	15.8	6947	36145	15.8	6925	36004	15.8	6958	36203	15.9	7077	36947	16.0	7138	37331
130	16.3	7303	38848	16.5	7300	39003	16.5	7329	39187	16.5	7309	39056	16.5	7340	39249	16.6	7452	39967	16.7	7512	40339
140	17.0	7659	41734	17.1	7650	41844	17.2	7678	42022	17.1	7659	41895	17.2	7687	42084	17.3	7796	42777	17.3	7854	43140

Table 2-4. Yield tables for various fertilizer treatments and assumed growth responses on an average site in western Montana.

AGE	NT			N25			N30			L25			L30			T25			T30		
	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A	DBH	CF/A	BF/A
70	10.5	1910	5896	10.5	1910	5896	10.5	1910	5896	10.5	1910	5896	10.5	1910	5896	10.5	1910	5896	10.5	1910	5896
80	11.7	2419	8416	11.9	2572	9194	12.0	2604	9350	11.7	2419	8416	11.7	2419	8416	11.9	2572	9194	12.0	2604	9350
90	12.7	2979	11338	13.0	3147	12209	13.0	3181	12389	12.7	2979	11338	12.7	2979	11338	13.2	3304	13037	13.3	3370	13395
100	13.7	3504	14258	13.9	3666	15145	14.0	3700	15324	13.9	3656	15088	14.0	3686	15254	14.2	3834	16057	14.3	3902	16429
110	14.6	3997	17143	14.8	4001	17380	14.9	4032	17556	14.8	4007	17400	14.9	4040	17579	15.0	4160	18272	15.1	4223	18632
120	15.5	4319	19414	15.7	4314	19599	15.7	4343	19770	15.7	4320	19621	15.8	4350	19795	15.9	4464	20461	16.0	4525	20810
130	16.3	4607	21509	16.5	4595	21655	16.6	4623	21821	16.5	4601	21676	16.6	4629	21844	16.7	4738	22494	16.8	4794	22831
140	17.1	4854	23406	17.3	4836	23517	17.3	4862	23679	17.3	5063	23536	17.3	4868	23700	17.4	4973	24333	17.5	5027	24661

Table 3-1. Growth response of a typical codominant tree to various fertilizer treatments and response assumptions on a good site in western Montana.

AGE	NT		N25		N30		L25		L30		T25		T30	
	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT
40	9.20	58.8	* 9.20	58.8	* 9.20	58.8	9.20	58.8	9.20	58.8	* 9.20	58.8	* 9.20	58.8
50	10.60	67.9	10.93	68.8	10.99	69.0	10.60	67.9	10.60	67.9	*10.93	68.8	*10.99	69.0
60	11.29	74.1	11.59	74.5	11.65	74.9	*11.29	74.1	*11.29	74.1	11.76	75.4	11.85	75.6
70	14.24	85.1	14.48	85.6	14.53	85.6	14.89	86.1	15.01	86.3	14.54	85.9	14.60	86.0
80	15.50	91.6	15.71	91.9	15.74	92.0	16.13	92.4	16.25	92.6	15.71	92.1	15.76	92.2

*Indicates time(s) of fertilizer treatments.

Table 3-2. Growth response of a typical codominant tree to various fertilizer treatments and response assumptions on an average site in western Montana.

AGE	NT		N25		N30		L25		L30		T25		T30	
	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT
40	9.97	47.5	* 9.97	47.5	* 9.97	47.5	9.97	47.5	9.97	47.5	* 9.97	47.5	* 9.97	47.5
50	11.55	55.1	11.91	56.8	11.98	57.2	11.55	55.1	11.55	55.1	*11.91	56.8	*11.98	57.2
60	12.84	61.1	13.15	62.5	13.22	62.8	*12.84	61.1	*12.84	61.1	13.45	63.8	13.57	64.3
70	14.15	66.9	14.42	68.0	14.48	68.3	14.46	68.2	14.52	68.4	14.67	69.1	14.78	69.5
80	16.83	77.8	17.04	78.6	17.08	78.8	17.07	78.7	17.12	78.9	17.20	79.2	17.29	79.6

*Indicates time(s) of fertilizer treatments.

Table 3-3. Growth response of a typical codominant tree to various fertilizer treatments and response assumptions on a good site in western Montana.

AGE	NT		N25		N30		L25		L30		T25		T30	
	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT
80	13.61	87.4	*13.61	87.4	*13.61	87.4	13.61	87.4	13.61	87.4	*13.61	87.4	*13.61	87.4
90	14.55	93.2	14.77	93.7	14.82	93.8	14.55	93.2	14.55	93.2	*14.77	93.7	*14.82	93.8
100	15.43	98.5	15.64	98.9	15.68	99.0	*15.43	98.5	*15.43	98.5	15.86	99.4	15.94	99.6
110	16.65	104.2	16.84	104.5	16.88	104.6	16.94	104.7	17.00	104.8	17.03	105.0	17.11	105.1
120	16.98	107.3	17.17	107.6	17.21	107.7	17.27	107.8	17.33	107.9	17.35	108.0	17.42	108.1

*Indicates time(s) of fertilizer treatments.

Table 3-4. Growth response of a typical codominant tree to various fertilizer treatments and response assumptions on an average site in western Montana.

AGE	NT		N25		N30		L25		L30		T25		T30	
	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT	DBH	HT
70	10.79	56.0	*10.79	56.0	*10.79	56.0	10.79	56.0	10.79	56.0	*10.79	56.0	*10.79	56.0
80	11.93	61.4	12.19	62.6	12.25	62.9	11.93	61.4	11.93	61.4	*12.19	62.6	*12.25	62.9
90	12.96	66.2	13.20	67.3	13.25	67.5	*12.96	66.2	*12.96	66.2	13.45	68.3	13.54	68.7
100	14.39	72.4	14.60	73.3	14.64	73.5	14.73	73.8	14.79	74.1	14.81	74.1	14.90	74.5
110	14.98	75.1	15.19	75.9	15.23	76.1	15.31	76.4	15.38	76.7	15.39	76.7	15.46	77.0

*Indicates time(s) of fertilizer treatments.