Economics

1. 1987. Impact of intensive forestry practices on net stand values in British Columbia. B.C. Ministry of Forests FRDA-Report 014. 109 p.

Keywords: release treatments
fertilization
thinning
yield
economics

Abstract: Yield responses to major silvicultural treatments (regeneration method, brushing and weeding, spacing and thinning and fertilizer use) are analysed in relation to growth and yield theory, and their translation into operational use of treatments to increase merchantable vol. is considered. Data from coastal Douglas fir (Pseudotsuga menziesii), western hemlock (Tsuga heterophylla) and western hemlock/Abies amabilis stands and interior white spruce (Picea glauca), lodgepole pine (Pinus contorta) and wet belt Douglas fir stands are used to quantify the net present value of treatments in terms of improvement in net stand values and merchantable vol. Potentially viable treatment options are identified for each stand type present.

OSU Link
Non-OSU Link

2. Anderson, H.W. and M. Hyatt. 1981. Feasibility of hand application of urea to forest land in western Washington. In Proceedings: Forest Fertilization
Conference, University of Washington, Seattle, Washington, USA. Eds. S.P. Gessel, R.M. Kenady and W.A. Atkinson.pp. 205-208.

Keywords: fertilization
economics

Abstract: A large scale pilot study to determine the potential of hand fertilizing forest stands in western Washington was undertaken by the Department of Natural Resources in 1976. Tests were conducted in two major stand types of Douglas-fir (juvenile stands with voids and openings and older open growh stands), where two hand spreading techniques (broadcast and individual tree fertilization) and two types of work crews (contract and DNR) were evaluated. During the study manhours of the various job-related activities were recorded and costs determined. A total of 634 acres was treated and costs ranged from $36.95 to $125.42 per acre and averaged $81.74 per acre (1976 dollars). Costs varied because of stand type which influenced the fertilizer rate and crew type which influenced the application cost. Based on units treated in this study and assuming similar conditions, estimates of hand fertilization costs for an operational fertilization project where stand conditions would allow for a reduced fertilizer rate (individual tree fertilization) would be approximately $52 per acre at the rate of 330 pounds of urea and $42 per acre at the rate of 220 pounds of urea. This compares to costs of $61 per acre for hand broadcast application at 440 pounds of urea and $56 per acre for aerial application at the same rate. Therefore, where stand conditions allow for a reduced rate of fertilizer, hand application could be a more inviting alternative to the normal procedure of aerial application.

OSU Link
Non-OSU Link

3. Atkinson, W.A. 1981. Preliminary guidelines for fertilizing less than fully stocked stands and mixed species stands. In Conference Proceedings: Forest Fertilization
Conference, University of Washington, Seattle, Washington, USA. Eds. S.P. Gessel, R.M. Kenady and W.A. Atkinson. pp. 59-61.

Keywords: fertilization
economics

Abstract: Foresters engaged in selecting areas for operational fertilization rarely encounter the fully stocked pure-species Douglas-fir stands that are studied by researchers. Most often the question is one of establishing minimal standards for choosing stands to fertilize. This paper offers preliminary guidelines for fertilizing less than fully stocked stands and mixed-species stands. Results are presented by age and site, and consist of a table showing minimal basal area stocking required to earn a given interest rate.

OSU Link
Non-OSU Link

4. Aubry, C.A., W.T. Adams and T.D. Fahey. 1998. Determination of relative economic weights for multitrait selection in coastal Douglas-fir. Canadian-Journal-of-Forest-Research 28(8): 1164-1170.

Keywords: genetic tree improvement
yield
wood quality
economics

Abstract: Relationships between tree traits and tree value for lumber production were investigated. For the purposes of estimating relative economic weights for use in multitrait selection in coastal Douglas fir (Pseudotsuga menziesii var. menziesii), tree height, diameter at breast height, and branch diameter were measured on 164 trees (ages 36-66 yr) sampled from 11 intensively managed stands with a wide range of site attributes, growing conditions, ages and stocking histories in western Washington and Oregon. Increment cores from asubsample (92) of these trees were assayed by X-ray densitometry to determine wood density. Bole volume was derived by summing the log volumes of all logs from each tree. Value of lumber recovered from each tree was determined in a separate mill study using both visual and machine stress rated (MSR) grading rules. Multiple linear regression was used to relate tree value to the growth and wood quality traits. Stem volume and branch diameter significantly influenced tree value under visual grading, with relative economic weights of 0.06dmsuperscript 3 and -5.22 cm, respectively. Wood density significantly influenced tree value under MSR grading (relative economic weights: 0.06 dmsuperscript 3, -6.69 cm, and 0.06 kg/msuperscript 3, respectively), where lumber strength is measured more accurately. These regression coefficients can be used directly as economic weights in selection indices in the development of advanced breeding programmes for Douglas fir.

OSU Link
Non-OSU Link

5. Bare, B.B. 1981. Tax effects of fertilization. In Proceedings: Forest Fertilization Conference, University of Washington, Seattle, Washington, USA. Eds. S.P. Gessel, R.M. Kenady and W.A. Atkinson. pp. 238-242.

Keywords: fertilization
economics

Abstract: This paper describes the sensitivity of investment performance when fertilzization activities are treated as expensed, capitalized, or amortized expenditures. Current Internal Revenue Service policy favors capitalization, but pending revenue rulings are expected to recommend amortization. The impact of these three alternatives on after-tax cash flows is illustrated by a numerical example for the Douglas-fir zone of the USA.

OSU Link
Non-OSU Link

6. Brix, H. 1993. Fertilization and thinning effect on a Douglas-fir ecosystem at Shawnigan Lake: a synthesis of project results. B.C. Ministry of Forests FRDA-Report 196. X + 64 p.

Keywords: fertilization
thinning
growth
tree morphology
tree/stand health
carbon allocation
wood quality
tree physiology
photosynthesis
economics

Abstract: Treatments were initiated in 1970-71 in a 24-year-old Douglas fir (Pseudotsuga menziesii) near Shawnigan Lake, Vancouver Island, British Columbia, to determine the effects of 3 intensities of thinning (removing none, one-third and two-thirds of basal area) and 3 levels of urea fertilizer (0, 224 and 448 kg N/ha) on the growth and biology of the trees. Subsidiary experiments were established during 1972-87 to examine the effects of high doses of urea (672-1344 kg N/ha), ammonium nitrate as an N source instead of urea, understoreyresponse to thinning and fertilizer, and responses to P and S fertilizer.

OSU Link
Non-OSU Link

7. Curtis, R.O., D.D. Marshall and D.S. DeBell. 2004. Silvicultural options for young-growth Douglas-fir forests: the Capitol Forest study - establishment and first results. Pacific Northwest-Research-Station,-USDA-Forest-Service General-Technical-Report PNW-GTR-598. xi + 110 p.

Keywords: thinning
commercial thinning

economics
soil properties

Abstract: This report describes the origin, design, establishment and measurement procedures and first results of a large long term cooperative study comparing a number of widely different silvicultural regimes applied to young-growth Douglas-fir (Pseudotsuga menziesii) stands managed for multiple objectives. Regimes consist of (1) conventional clear felling followed by intermediate thinning; (2) retention of reserve trees to create a two-aged stand; (3) small patch cuts dispersed within a thinned matrix, repeated at approximately 15-year intervals to create a mosaic of age classes; (4) group selection within a thinned matrix on an approximate 15-year cycle; (5) continued thinning on an extended rotation; and (6) an untreated control. Each of these regimes is on operation-size units (approximately 30 to 70 acres each). A LIDAR system was used to scan the surface of the 2 miles2 that encompass the Blue Ridge study site on the Capitol State Forest, near Olympia, Washington, USA. This measurement technology emits laser pulses that are reflected by vegetation, buildings, or the ground surface. Output variables from the study to be evaluated include conventional timber growth and yield statistics, harvest costs, sale layout and administration costs, aesthetic effects and public acceptance, soil disturbance, bird populations, and economic aspects. Descriptive statistics and some initial results are presented for the first replicate, established in 1997-98.

OSU Link
Non-OSU Link

8. Duke, K.M., G.M. Townsend and W.A. White. 1989. An economic analysis of fertilization and thinning effects on Douglas-fir stands at Shawnigan Lake. Canadian-Forest-Service, Pacific and Yukon Region Information-Report BC-X-312. v + 19 p.

Keywords: fertilization
thinning
economics
computer modeling

Abstract: A single-tree density-dependent growth model was used to project, from age 24 to age 120 yr, 9 combinations of thinning and fertilizer application (nitrogen as urea or ammonium nitrate) in Douglas fir (Pseudotsuga menziesii) near Shawnigan Lake, British Columbia. Costs and benefits were estimated as a function of stand diameter, and forestry investment criteria were used to evaluate each treatment on both an incremental and a regime basis. The effect of rising real prices, and the treatment of silvicultural costs as an initial investment or as a harvest cost were also studied.

OSU Link
Non-OSU Link

9. El Kassaby, Y.A. and K. Ritland. 1986. The relation of outcrossing and contamination to reproductive phenology and supplemental mass pollination in a Douglas-fir seed orchard. Silvae-Genetica 35(5/6): 240-244.

Keywords: genetic tree improvement
seed orchard management

tree phenology
genetic relationships
economics
reproduction

Abstract: A study was made using allozyme markers of outcrossing and contamination rates in relation to reproductive phenology and supplemental mass pollination in a Douglas fir seed orchard in British Columbia, Canada. Supplemental mass pollination was applied only to the intermediate reproductive phenology class, which showed a high outcrossing rate and no contamination. Both early and late reproductive phenology classes showed significant contamination, but the outcrossing rate for the former was significantly higher than for the latter. These results show that interpretation of seed crop genetic quality based on outcrossing alone could be misleading. The rate and source of contamination, reproductive phenology and crop size should also be considered. The practicability and economics of supplemental mass pollination in avoiding both selfing and contamination are discussed. It was concluded that waterspray cooling and/or supplemental mass pollination of early and late reproductive phenology classes in moderate or good cone-crop years would be an effective management practice. The option of aborting small cone crops in mature orchards is also discussed.

OSU Link
Non-OSU Link

10. Emmingham, W.L., P. Oester, M. Bennett, F. Kukulka, K. Conrad and A. Michel. 2002. Comparing short-term financial aspects of four management options in Oregon: implications for uneven-aged management. Forestry-Oxford 75(4): 489-494.

Keywords: thinning
commercial thinning
economics
yield

Abstract: Private family forest owners are often more interested in comparing short-term financial outcomes of management options, as opposed to longer time horizons and classical economic analyses including net present value. Therefore, we compared projected 10-year value of timber and land for four theoretical management scenarios starting with stands ripe for thinning. The options were (1) hold for 10 years (i.e. no thinning), (2) thin for even-age, or (3) partial cut for uneven-age and (4) clearcut now. To simulate the outcomes of these scenarios, we marked and measured 2-ha plots in 10 stands typical of private forest ownerships across Oregon and projected timber yields and revenues. The financial analysis included current market values for logs, payment of taxes and typical reforestation costs and computation of net asset values (NAV) at a 7 per cent interest rate. The hold option consistently gave the highest NAV for timber and land after 10 years, and the thin option was within 2 per cent. For the eight western Oregon stands, the partial-cut option averaged about 3 per cent less, and the clearcut option ranged from 8 to 17 per cent less than holding. Pine stands of eastern Oregon showed similar trends; however, all options were within about 6 per cent of the hold option. Thus, using financial criteria typical of those used by private forestowners, we found that there was little short-term financial loss in choosing to thin toward even-age, partial cut toward uneven-age, or the hold approach in well-stocked stands.

OSU Link
Non-OSU Link

11. Feller, M.C., J.P. Kimmins and K.A. Scoullar. 1983. FORCYTE-10: calibration data and simulation of potential long-term effects of intensive forest management on site productivity, economic performance, and energy benefit/cost ratio. *In* I.U.F.R.B. Symposium on.Forest Site and Continuous Productivity; Seattle, Washington; August 22-28, 1982. *Eds.* R. Ballard and S.P. Gessel. Pacific-Northwest-Forest-and-Range-Experiment-Station, USDA-Forest-Service General-Technical-Report PNW-GTR-163 Part B. 179-200 pp.

Keywords: thinning
fertilization
soil properties
economics
computer modeling

Abstract: FORCYTE (FORest nutrient Cycling and Yield Trend Evaluator) is a computer simulation model of forest plant biomass production, litterfall, and decomposition, complete with nutrient cycling, nutrient limitation on growth, and a variety of management interventions. The model is a computerized approach to the estimation of the effects of varying thinning and fertilizer regimes, utilization level, and rotation length on site nutrient budgets, stand productivity, and the economic performance and energy efficiency of management. The model has evolved over 5 years to its present version FORCYTE-10, which is briefly described. Accompanying the development of FORCYTE, there has been a series of field research projects. Detailed biomass and biogeochemical descriptions of age sequences of Douglas-fir stands on both good and poor sites have been prepared for purposes of model calibration and testing. The present report summarizes some of the results of the FORCYTE-10 field studies on Vancouver Island, British Columbia, and presents some examples of the use of the model when calibrated with these data.

OSU Link
Non-OSU Link

12. Fight, R.D., N.A. Bolon and J.M. Cahill. 1993. Financial analysis of pruning Douglas-fir and ponderosa pine in the Pacific Northwest. Western-Journal-of-Applied-Forestry 8(2): 58-61.

Keywords: pruning
economics
computer modeling

Abstract: Recent lumber recovery studies of pruned and unpruned Douglas fir (Pseudotsuga menziesii var. menziesii) and ponderosa pine (Pinus ponderosa var. ponderosa) were incorporated into computer software using lumber grade prices, growth and yield data, the cost of pruning, and interest rates to determine the expected financial return from pruning. Financial analyses showed that the cost of pruning at which the investment would yield an expected 4% real rate of return was positive on sites where individual tree growth is fairly high, pruning is done as early as biologically possible given limitations on crown removal, and the harvest is 30 to 70 yr after pruning. The better situations in Douglas fir showed a break-even cost of up to $21/tree and an internal rate of return

exceeding 9%. The better situations in ponderosa pine showed a break-even cost of up to $11/tree and an internal rate of return of 7%.

OSU Link
Non-OSU Link

13. Fight, R.D., J.M. Cahill and T.D. Fahey. 1992. DFPRUNE users guide. Pacific-Northwest-Research-Station,-USDA-Forest-Service General-Technical-Report PNW-GTR-300. 12 p.

Keywords: pruning
economics
computer modeling

Abstract: The DFPRUNE spreadsheet program is designed to estimate the expected financial return from pruning coast Douglas fir (Pseudotsuga menziesii var. menziesii). It is a significant revision of the PRUNE-SIM program. The PRUNE-SIM program was based on the average product recovery for unpruned logs from a single stand that received frequent light thinnings. The DFPRUNE program incorporates new recovery information for unpruned young-growth Douglas fir and can be used to assess the economic potential of pruning for a wide range of management regimes. Product prices and descriptions of trees at time of pruning and at time of harvest must be supplied by the user. The DFPRUNE program was developed for the Lotus 1-2-3 spreadsheet and should work on versions 2.01 or later.

OSU Link
Non-OSU Link

14. Fight, R.D., J.M. Cahill, T.D. Fahey and T.A. Snellgrove. 1987a. Financial analysis of pruning coast Douglas-fir. Pacific-Northwest-Research-Station,-USDA-Forest-Service Research-Paper PNW-RP-390. ii + 17 p.

Keywords: pruning
fertilization
economics
wood quality
yield
computer modeling

Abstract: Unpruned stands of Douglas fir (Pseudotsuga menziesii) will yield little clear material under current management regimes in western Oregon and western Washington. Data from a recent study of grade recovery from pruned logs were analysed and a spreadsheet program was developed and used to simulate the increase in grade recovery and financial returns from pruning. Results are presented for a range of site indices, ages at time of pruning and time of harvest, product prices and interest rates, and for stands with and without nitrogen fertilizer treatment. Results showed that a 5-yr difference in the time of pruning can make a substantial difference in the financial return. An earlier age at pruning always gave a higher return. At 4 and 8% interest rates, the return was generally greatest when the harvest was 40-50 yr or 30-40 yr, respectively, after pruning. Fertilizer treatment substantially increased the return from pruning, especially on poor sites.

OSU Link
Non-OSU Link

15. Fight, R.D., J.M. Cahill, T.D. Fahey and T.A. Snellgrove. 1988. A new look at pruning coast Douglas-fir. Western-Journal-of-Applied-Forestry 3(2): 46-48.

Keywords: pruning
thinning
fertilization
economics

Abstract: A short account of an evaluation of the financial returns of pruning coast Douglas fir (Pseudotsuga menziesii), using new product-recovery information and computer software, and assuming that: the analysis is for lumber, interest rates are 4 and 8%, stands are fertilized 2 or 3 times and thinned periodically, and that trees were pruned at age 20 yr. Results showed that higher returns from pruning could be achieved by concentrating pruning in younger stands that have a higher site index and that will be fertilized.

OSU Link
Non-OSU Link

16. Fight, R.D., J.M. Cahill, T.A. Snellgrove and T.D. Fahey. 1987b. PRUNE-SIM users guide. Pacific-Northwest-Research-Station,-USDA-Forest-Service General-Technical-Report PNW-GTR-209. 21 p.

Keywords: pruning
economics
computer modeling

Abstract: PRUNE-SIM is a spreadsheet template (program) that allows users to simulate a financial analysis of pruning coast Douglas fir (Pseudotsuga menziesii var. menziesii) in the USA. The program estimates the increase in product value resulting from pruning the butt 17-foot log. Product recovery information is based on actual mill experience with pruned and unpruned logs for both sawn and peeled products. Users must supply tree descriptions from sources of growth and yield information and product prices. The program calculates the difference in value for trees and stands with and without pruning. The present value of this difference represents the maximum amount that could be spent on pruning without reducing the rate of return on the investment below the specified rate. The LOTUS 1-2-3 spreadsheet program was used to develop PRUNE-SIM.

OSU Link
Non-OSU Link

17. Fight, R.D., S. Johnston, D.G. Briggs, T.D. Fahey, N.A. Bolon and J.M. Cahill. 1995. How much timber quality can we afford in coast Douglas-fir stands? Western-Journal-of-Applied-Forestry 10(1): 12-16.

Keywords: pruning
planting operations
wood quality

economics

Abstract: Once site and genetic stock are selected, management of stocking, rotation age, and pruning are the principal means available to foresters to affect wood quality and value in stands of coast Douglas fir (Pseudotsuga menziesii var. menziesii) in the Pacific Northwest. Financial evaluation was used to test whether or not improvements in wood quality and value by these means justify the cost of doing so. This analysis showed in general that improving quality through high levels of stocking or extending rotations were costly ways to improve wood quality while pruning was cost effective.

OSU Link
Non-OSU Link

18. Figueroa, P.F. 1989. Bigleaf maple control: triclopyr thin-line and spot-foliar application treatments using imazapyr, metsulfuron, and glyphosate. Proceedings-of-the-Western-Society-of-Weed-Science (Vol. 42): 104-119.

Keywords: release treatments
chemical release
stand conditions
economics

Abstract: Field trials were conducted to compare the efficacies of March applications of triclopyr thin-line +or- 1 kg/ha Mor-act or 2,4-D (1:1) with June spot-foliar applications of 0.6 or 1.1 kg/ha imazapyr, 0.170 kg/ha metsulfuron and 6.7 kg/ha glyphosate to control Acer macrophyllum in a Pseudotsuga menziesii plantation. All thin-line treatments gave 80% control 2 years later; complete sanding was hindered by stems growing along the ground. Dilution did not affect control. Spot-application success depended on degree of crown coverage. metsulfuron and glyphosate were not effective, but imazapyr control reached 60-70% 2 years after treatment. Only triclopyr and full coverage imazapyr suppressed A. macrophyllum growth to below the height of P. menziesii. Crown volume was held to pre-treatment levels with metsulfuron and glyphosate but decreased with imazapyr. The two treatment methods tested are potentially cost-effective; triclopyr costs are higher but spot-application carries higher labour costs. Application rates of 2 ml triclopyr/ Msuperscript 2 crown area will give 100% control if all stems are banded; with delivery rates of 59 ml/clump a 45% solution can be used.

OSU Link
Non-OSU Link

19. Figueroa, P.F. 1991. Ground applied herbicide methods for red alder control: herbicide efficacy, labor costs, and treatment method efficiency. *In* Proceedings-of-the-Western-Society-of-Weed-Science,12-14-March-1991. pp. 44: 53-68.

Keywords: release treatments
chemical release
economics
stand conditions

Abstract: A study was conducted to develop the cost estimates for ground-applied manual control methods in variable density red alder [Alnus rubra] stands and to evaluate the efficacy of the various herbicide formulations for each system. Field trials were initiated in 3 Douglas fir [Pseudotsuga menziesii] plantations located on Weyerhaeuser Company land located in SW Washington. Two 6-year-old plantations had streamside buffer zones remaining from the previous year's operational herbicide spray programme; the 3rd was a 13-year-old plantation which had not been previously treated with herbicides to control A. rubra. The treatments tested were as follows: 50% triclopyr, 45% glyphosate and 10% imazapyr applied to the cut stump surface; low-vol. basal application of 5, 10 and 15% triclopyr and 2 and 4% imazapyr; thin-line application of 50, 75 and 100% triclopyr and 20 and 40% imazapyr; stream-line application of 10, 30 and 50% triclopyr and 4 and 20% imazapyr; hack-and-squirt application with imazapyr applied to 1 cut at 0.25, 0.5 and 0.75 ml and to 2 cuts at 0.25 and 0.5 ml; and capsule injection of 1 or 2 glyphosate capsules. A discussion of the results is presented and total treatment costs are given. It is concluded that ground application treatments have advantages over aerially applied treatments, including being useful for the treatment of areas of public sensitivity and when other environmental risks need to be minimized.

OSU Link
Non-OSU Link

20. Figueroa, P.F. and V.F. Carrithers. 1993. Bigleaf maple control: thinline basal applications using triclopyr and triclopyr plus picloram. *In* Proceedings-of-the-Western-Society-of-Weed-Science, 9-11-March-1993. pp. 46: 24-30.

Keywords: release treatments
chemical release
stand conditions
economics

Abstract: A field trial was conducted at Mt. St. Helens Tree Farm, Cowlitz county, Washington, in 1988-91 to determine the min. threshold level of herbicide needed to control bigleaf maple [Acer macrophyllum] stump sprouts in Douglas fir [Pseudotsuga menziesii]. Garlon(triclopyr) at 0.24-3 lb/gal was applied on 6 Dec. 1990, 6 Feb. 1991 and 11 Apr. 1991, and triclopyr + picloram at 1 + 0.5 lb was applied on 6 Feb. 1991 using thinline applications to the entire circumference of each stem in the bigleaf maple clump. The threshold level ofGarlon for <more or =>90% control was found to be between 1.1 and 1.7 ml/msuperscript 2 of crown area. Most treatments produced clumps that appeared to be dead during the 1st year but which resprouted in the 2nd year; it is suggested that such inconsistencies in mortality among treatments are due to the inability to completely band every stem. Economic considerations for herbicide costs are discussed.

OSU Link
Non-OSU Link

21. Gessel, S.P. and W.A. Atkinson. 1984. Use of fertilizers in sustained productivity of Douglas-fir forests. *In* Forest soils and treatment impacts: Proceedings, Sixth North American Forest Soils Conference, Department of Forestry, Wildlife and Fisheries, University of Tennessee, Knoxville, TN, June 1983. pp. 67-87.

Keywords: fertilization
growth
economics

Abstract: A review is given of studies leading to the establishment of nitrogen deficiency as a factor reducing growth and the development of N fertilization programmes. Data from several long-term fertilizer trials in Washington and Oregon support the conclusion that N deficiency is frequently a controlling factor in the growth of Douglas fir and that additions of N can result in long-term growth increases. The economics of fertilization and the continued availability of nitrogen fertilizers are discussed.

OSU Link

22. Gessel, S.P., E.C. Steinbrenner and R.E. Miller. 1981. Response of Northwest forests to elements other than nitrogen. In Proceedings: Forest Fertilization
Conference, University of Washington, Seattle, Washington, USA. Eds. S.P. Gessel, R.M. Kenady and W.A. Atkinson. pp. 140-149.

Keywords: fertilization
growth
economics

Abstract: This paper reviews the development of forest tree nutrition research in the Northwest. Field observations, foliar analysis, and greenhouse cultures using both solution and forest soil as media established deficiency symptoms and levels for major and minor elements. Field experimentation with the entire range of essential elements has failed to demonstrate widespread deficiencies of elements other than nitrogen. Certain test areas have shown somewhat better response to combinations of elements; but because of the limitations of experimental design and field variation, the response does not generally have a high statistical significance. In some cases of apparent response, application of fertilizer materials other than nitrogen does not appear to be economic. There is sufficient evidence of response to other elements to suggest that much work needs to be done. Increased utilization of forest materials, shorter rotation, and greater yields with nitrogen fertilization all point to the fact that many of the Northwest forest areas could have future elemental deficiencies, other than nitrogen.

OSU Link
Non-OSU Link

23. Hadfield, J.S. 1988. Integrated pest management of a western spruce budworm outbreak in the Pacific Northwest. Northwest-Environmental-Journal 4(2): 301-312.

Keywords: tree/stand protection
tree/stand health
economics

Abstract: The integrated pest management of the tortricid Choristoneura occidentalis on Douglas fir (Pseudotsuga menziesii) and true fir (Abies spp.) in the Northwest USA is described. Details of the population dynamics and impact of this pest are given. The integrated pest

management programme involves the following steps: monitoring the pest-food plant system to measure populations and damage; evaluating the effects of the outbreak; developing alternative strategies for managing the outbreak; evaluating the economic and environmental consequences of these strategies; selecting a strategy; and monitoring the implemented strategy.

OSU Link

24. Haight, R.G. 1993a. The economics of Douglas-fir and red alder management with stochastic price trends. Canadian-Journal-of-Forest-Research 23(8): 1695-1703.

Keywords: planting operations
site preparation
prescribed fire
release treatments
chemical release
thinning
precommercial thinning
commercial thinning
tree/stand protection
economics

Abstract: A financial analysis of Douglas fir (Pseudotsuga menziesii) and red alder (Alnus rubra) management was conducted using yield projections from the Stand Projection Simulator for the Pacific Northwest region of the United Sates. The analysis included uncertainty in the price trends and stocking levels of both species following reforestation. Results from a case study in which Douglas fir price is likely to increase faster than red alder price show that (i) on more productive sites, greater regeneration investment is justified to increase the likelihood of Douglas fir establishment, (ii) on less productive sites, low-cost regeneration options that produce mixed-species stands have expected present values close to or greater than a high-cost Douglas fir regeneration effort, (iii) optimal precommercial removal of red alder depends on mid-rotation prices and regeneration success, and in many cases growing a mixed-species stand to maturity produces the highest economic return, and (iv) commercial thinning of Douglas fir increases the expected present value of the most intensive regeneration option by up to 10%. The low-cost regeneration options have relatively high expected returns because of low initial investments and the presence of two species that may have high values in the future. The sensitivity of these results to changes in the probability distributions of regeneration success and price trends is discussed.

OSU Link
Non-OSU Link

25. Haight, R.G. 1993b. Technology change and the economics of silvicultural investment. Rocky-Mountain-Forest-and-Range-Experiment-Station,-USDA-Forest-Service General-Technical-Report RM-GTR-232. ii + 18 p.

Keywords: planting operations
site preparation
prescribed fire

release treatments
chemical release
tree/stand protection
thinning
commercial thinning
precommercial thinning
yield
economics

Abstract: Financial analyses of intensive and low-cost reforestation options are conducted for loblolly pine (Pinus contorta) stands with broadleaved competition in the Southern USA, and Douglas fir with red alder (Pseudotsuga menziesii with Alnus rubra) in the Pacific Northwest. Results show that the expected present values (EPVs) of low-cost options that result in mixtures of conifers and broadleaves are superior in some situations to the EPVs of the intensive options.

OSU Link
Non-OSU Link

26. Han, H., L.D. Kellogg, G.M. Filip and T.D. Brown. 2000. Scar closure and future timber value losses from thinning damage in western Oregon. Forest-Products-Journal 50(1): 36-42.

Keywords: thinning
tree/stand health
economics

Abstract: This study investigated bark growth and decay development after thinning damage at two western Oregon sites, and estimated value loss with a tree growth model. All scars that remained open in western hemlock (Tsuga heterophylla) and Sitka spruce (Piceasitchensis) had advanced decay 13 years after initial wounding. Scars less than 4 inches wide closed in 8 years. Douglas-fir (Pseudotsuga menziesii) was more resistant to decay; no rot was observed in scars less than 21 years old. Advanced decay and pitch rings, however, were observed in 29-year-old scars, both open and closed. Because of these defects, future value loss increased with time after wounding and with higher stand damage levels. Fifty years after thinning, about 2% of the total future log value, or $189/ac. (1997$), could be lost in Douglas-fir stands with 20% stand damage and a 2-inch diameter deduction. This loss could be reduced to $58/ac. if stand damage were minimized to 5% with more careful techniques. The increase in thinning costs ($61/ac. for tractor thinning; $79/ac. for cut-to-length; $124/ac. for skyline; with a 5% increase in production time) that is incurred while trying to minimize stand damage could be justified if it reduced future value losses to crop trees.

OSU Link
Non-OSU Link

27. Hummel, S. and R. Hummel. 2004. Five-year thinning response of an overgrown Douglas-fir Christmas tree plantation. Western-Journal-of-Applied-Forestry 19(3): 171-174.

Keywords: planting operations
thinning

growth
yield
economics

Abstract: A 15-year-old Douglas-fir Christmas tree plantation in western Oregon was thinned in 1996 according to regional sawtimber conversion guidelines. The plantation comprised two strata, distinguished by initial planting density (Area 1=5x5 ft and Area 2=10x10 ft).Unthinned control plots were established in both Area 1 and Area 2 at the time of the thinning treatment. Five years later, the quadratic mean diameter (QMD) in Area 1 (thinned) was 6.4 in. versus 5.2 in. in Area 1 (unthinned), while in Area 2 (thinned) the QMD was 11.4 in. compared to 9.3 in. in Area 2 (unthinned). Over the same period, the volume/ac in Area 1 (thinned) (1,080 ft3/ac) was nearly twice that of Area 1 (unthinned) (576 ft3/ac). In contrast, the volume/ac in Area 2 (thinned) (2,318 ft3/acre) was almost half that of Area 2 (unthinned) (4,264 ft3/ac). These results suggest that while thinning was timely for Area 1, the thinning treatment could have been delayed for Area 2. By plantation age 30, the treated units in Area 1 and Area 2 have estimated yields of 9.6 and 11.6 thousand bd ft (mbf), respectively, with no additional thinning. Given 2002 average prices for #3 sawmill grade logs, gross return at age 30 would range between $5,000 and $6,000/ac.

OSU Link
Non-OSU Link

28. Hunt, J.A. 1995. Commercial thinning a coastal second-growth forest with a Timberjack cut-to-length system. Forest-Engineering-Research-Institute-of-Canada FERIC TN-235. 14.

Keywords: thinning
commercial thinning
economics
tree/stand health

Abstract: In the summer of 1994, after 2 years operation, FERIC monitored a thinning operation of second-growth forest dominated by Douglas fir [Pseudotsuga menziesii] near Cowichan Lake, Vancouver Island, to determine productivities, costs and impacts to sites and residual stands. The thinning treatment was carried out with a Timberjack 1270 harvester and a Timberjack 910 forwarder.

Non-OSU Link

29. Johnson, G.R., N.C. Wheeler and S.H. Strauss. 2000. Financial feasibility of marker-aided selection in Douglas-fir. Canadian-Journal-of-Forest-Research 30(12): 1942-1952.

Keywords: genetic tree improvement
economics

Abstract: The paper addresses the financial feasibility of using molecular marker-aided selection (MAS) as a tool to supplement phenotypic selection during population improvement of quantitative traits, which is the predominant focus for the breeding of Douglas fir (Pseudotsuga menziesii) and most other tree species. The land area required for a MAS programme to break even (i.e., have equal costs and benefits) was estimated using computer simulation for coastal Douglas fir in the Pacific Northwest USA.

The selection efficiency obtained when using an index that included the phenotype and the marker score was compared with that obtained using only the phenotype. It was assumed that MAS was restricted to within-family selection, that the rotation age was 50 years, and that growth rate (heritability, h2 = 0.25), tree form (h2 = 0.25), and (or) wood density (h2 = 0.45) were the objects of improvement. Several population quantitative trait loci (QTL) models, selection population sizes, and interest rates were considered. When large selection population sizes were employed (500 trees per family) MAS gave considerable increases in efficiency of within-family selection; however, results showed that the combination of small selection population sizes (100 trees per family) and many QTL of moderate effect could lead to losses in gain from MAS compared with phenotypic selection. For many reasonable selection scenarios and the simplified assumptions in the model used, the land base required for breeding programmes to break even is smaller or near to the limit of those in place under operational breeding programmes in the region. Considerably more research is needed to predict reasonably whether MAS would be cost-effective in practice. However, before some of the basic research needed to implement MAS can be done, organizations need to establish large blocks of full-sib families to allow for QTL identification.

OSU Link
Non-OSU Link

30. Kellogg, L.D., G.V. Milota and M. Miller, Jr. 1996. A comparison of skyline harvesting costs for alternative commercial thinning prescriptions. Journal-of-Forest-Engineering 7(3): 7-23.

Keywords: thinning
commercial thinning
economics

Abstract: Harvesting production and costs were examined for three alternative silvicultural prescriptions at two sites in the Coast Range of Oregon, USA. Thirty-three-year-old Douglas fir (Pseudotsuga menziesii) stands were commercially thinned to residual densities of 247, 148, and 74 trees per hectare (tph). Detailed time studies were conducted on manual felling and uphill skyline yarding with small yarders. Separate regression equations were developed to predict delay-free felling cycle time and delay-free yarding cycle time. The 74 tphtreatment had the highest production rate and was the least costly to harvest. Total harvesting costs of the other two treatments averaged from 6.0% (148 tph) to 12.3% (247 tph) more than the 74 tph treatment.

OSU Link
Non-OSU Link

31. Kellogg, L.D., G.V. Milota and B. Stringham. 1998. Logging planning and layout costs for thinning: experience from the Willamette young stand project. Forest-Research-Laboratory Research Contribution 20, Oregon-State-University, Corvaliis, OR.

Keywords: thinning
commercial thinning
economics

Abstract: Logging planning and layout costs were examined for commercial thinning of 40- to 50-yr-old stands of Douglas-fir (Pseudotsuga menziesii) on the Willamette National Forest in the Cascade Mountains of Oregon. The study consisted of four replications of threesilvicultural treatments. Thinning involved three types of logging systems: mechanized cut-to-length (a combination of single-grip harvester and forwarder), tractor, and skyline. Data for the study came from two sources: activities completed by the Forest Service in preparing sales for bid, and the layout completed by the logging contractor after a contract was awarded. Planning and layout costs showed no consistent relationship to type of silvicultural treatment. Logging contractor layout costs showed a relationship to type of logging system: the mechanized system had the lowest layout cost, followed by the tractor systems, with the skyline systems having the highest costs.

OSU Link
Non-OSU Link

32. Knapp, W.H., T.C. Turpin and J.H. Beuter. 1984. Vegetation control for Douglas-fir regeneration on the Siuslaw National forest: a decision analysis. Journal-of-Forestry 82(3): 168-173.

Keywords: planting operations
site preparation
chemical preparation
mechanical preparation
prescribed fire
release treatments
chemical release
manual release
growth
yield
economics

Abstract: Records from 324 plantations in Oregon were used to calculate the effect on stocking of various methods of controlling competing vegetation before and after plantation establishment. A decision tree analysis using 6 management regimes on 5 stocking classes indicated that if no site preparation or release (other than broadcast burning to reduce fuels) were practised, the forest would produce 63% of the m.a.i. and 35% of the present net worth (PNW) expected if all means of control (chemical, manual and burning) were available and used. If only manual control methods were used 78% of the max. m.a.i. and 57% of the max. PNW would be expected. When all methods except phenoxy herbicides were available, the expected m.a.i. and PNW were reduced to no less than 90%. The yield reduction varied with aspect, and the type of prelogging vegetation. Declines were least on SW-facing sites that were originally predominantly conifers, and greatest on NE-facing slopes that had supported broadleaves. Limitations of the analysis are discussed.

OSU Link
Non-OSU Link

33. Knowe, S.A. 1994c. Silvicultural and economic value of vegetation management in the Pacific northwest. *In* Weed science education: the cost of ignorance: Proceedings of the 47th annual meeting of the Southern Weed Science Society, Dallas, Texas, USA, 17-19 January, 1994. pp. 92-97.

Keywords: planting operations
release treatments
yield
economics

Abstract: Models indicated that the yield and net present value (NPV) of young Pseudotsuga menziesii stands in Oregon varied with site index and planting density. Effects of hardwood competition in 20-year-old plantations were predicted using the Regional Vegetation Management Model (RVMM). A stand table so produced was used for developing ORGANON, which simulated silvicultural treatments and growth for 40-60 years. Output from this was used to evaluate the economic consequences of hardwood competition using ORGECON. It was found that the least impact was observed at low site index with high planting density. Modifications to the models are suggested.

34. Kramer, H. and J.H.G. Smith. 1985. Establishment of Douglas fir stands in British Columbia. Forstarchiv 56(1): 9-13.

Keywords: planting operations
thinning
pruning
growth
yield
economics
wood quality

Abstract: Square spacing trials were established NW of Haney (180 m alt.) at 0.91, 1.83, 2.74, 3.66 and 4.57 m. Growth to age 25 yr, and simulation estimates up to 100 yr are reported. Results indicated that extra costs (incurred by thinning) of stands closer than 4 m spacing are difficult to justify in economic terms, because the market for Douglas fir timber grown in British Columbia is such that only production of large timber is economically viable. The quality of timber from trees grown at wide spacing without thinning is acceptable in relation to Canadian requirements, and could be improved if wide spacing were combined with pruning. It is recommended that close spacings be used only if availability of land is limited or demand for biomass is very strong.

OSU Link
Non-OSU Link

35. LeDoux, C.B., R.D. Fight and T.L. Ortman. 1986. Stump-to-truck cable logging cost equations for young-growth Douglas-fir. Western-Journal-of-Applied-Forestry 1(1): 19-22.

Keywords: thinning
commercial thinning
economics

Abstract: Data on log sizes were generated to simulate young (age 40-120 yr) Douglas fir site III and IV in the Pacific Northwest. The data were used to develop equations for estimating the delay-free costs of: (1) felling, limbing and cross-cutting; (2) yarding; (3) loading; (4) road changing; and (5) moving in and

out and initial rigging up and down. An additional equation estimates the number of logs per 1000 ftsuperscript 3 for logs of d.b.h. 6-24 inch. The equations were developed for 2 small and 1 medium sized yarders and are applicable on slopes of 10-50%. The equations can be used to provide detailed estimates for thinning, partial or shelterwood felling and clearfelling. A BASIC computer program is available from the authors.

OSU Link
Non-OSU Link

36. Marshall, P.L. 1988. A decision analytic approach to silvicultural investment decisions. Forest-Economics-and-Policy-Analysis-Research-Unit, University-of-British-Columbia Working-Paper 110. 28 p.

Keywords: planting operations
thinning
precommercial thinning
economics
growth

Abstract: A brief review of the literature is presented on methods for achieving optimal silvicultural decisions. The methods are generally computationally cumbersome and difficult to convert to simpler approximations required for most silvicultural decisions. An alternative method is presented and illustrated with two examples. The method involves a simple decision analytic structure. Projections were made for pure coastal Douglas fir Pseudotsuga menziesii for several treatments using three previously published growth models. Present NetWorth (PNW) was used as the criterion for choosing the treatment option and rotation age. The first example involved an initial planting density decision. Three planting densities were considered, viz. (1) 2500, (2) 1100 or (3) 750 seedlings/ha. The second example involved the decision to thin a 15-yr-old stand to a spacing similar to that produced by (1). The options were: (a) no treatment; (b) thin to 1100 stems/ha; and (c) thin to 500 stems/ha. The best strategy depended on which growth model was used. The study showed that a simplified decision analytic approach is a useful method to evaluate a decision, when aided by several growth models.

OSU Link
Non-OSU Link

37. Marshall, P.L. 1989. The economic value of additional information about treatment-response information for coastal Douglas-fir. Forest-Economics-and-Policy-Analysis-Research-Unit, University-of-British-Columbia Working-Paper 121. 39 p.

Keywords: planting operations
thinning
precommercial thinning
economics
growth

Abstract: A simple decision analytic approach was applied to initial planting density and precommercial spacing decisions for coastal Douglas fir (Pseudotsuga menziesii) across a range of sites in British Columbia. The range of biological response was represented by the output from 3 growth

and yield models. Recent production costs and product values were applied to obtain value per hectare after delivery of logs to the mill. Future costs and revenues were discounted at 4, 6 and 8%. The best decisions from each growth model are presented by scenario. Limitations of the analysis and managerial implications are discussed.

OSU Link
Non-OSU Link

38. McDonald, P.M. and G.O. Fiddler. 1993. Feasibility of alternatives to herbicides in young conifer plantations in California. Canadian-Journal-of-Forest-Research 23(10): 2015-2022.

Keywords: genetic tree improvement
site preparation
prescribed fire
release treatments
manual release
chemical release
growth
economics

Abstract: A research programme (involving 40 studies) was started in 1980 to compare the effectiveness and cost of various vegetation management techniques used for enhancing growth of 1- to 3-yr-old conifer (Pseudotsuga menziesii, Pinus ponderosa, P. jeffreyi, Abiesmagnifica and A. concolor var. lowiana) plantations in California. The studies were ended after 10 yr when competition became intraspecific. The techniques used included direct methods such as manual manipulation, mulching, herbicides (Garlon 3A [triclopyr], 2,4-D orVelpar [hexazinone]), and grazing for releasing conifer seedlings from undesirable vegetation, and several silvicultural practices (broadcast burning, group selection, genetically improved seedlings) that serve as indirect methods for reducing or avoiding vegetation problems. Manual release and mulching were effective but expensive. Herbicides were effective, applicable to almost all plant communities, and relatively inexpensive. Grazing was good for cattle and sheep, but did not significantly enhance conifer seedling growth. Silvicultural control of weeds was promising, but there was not enough information to evaluate feasibility. It was concluded that in most instances, forests cannot be managed economically without herbicides, if the objective is to grow seedlings at the potential of the site and the plant community includes sprouting broadleaves and shrubs or rhizomatous forbs and ferns. If the objective is to create a forest with several age-classes and variable structure, but with slower seedling growth, longer rotations, and less species diversity in early seral stages, then it is possible to accomplish this using other vegetation management techniques.

OSU Link
Non-OSU Link

39. McDonald, P.M. and G.O. Fiddler. 1996. Development of a mixed shrub-tanoak-Douglas-fir community in a treated and untreated condition. Pacific-Southwest-Research-Station, USDA-Forest-Service Research-Paper PSW-RP-225. iv + 16 p.

Keywords: release treatments
manual release

chemical release
tree/stand health
growth
tree morphology
stand conditions
economics

Abstract: On a medium site in northern California, a tanoak (Lithocarpus densiflorus)-mixed shrub community in a Douglas fir plantation was given several treatments (manual release two and three times, a combination chainsaw and cut surface herbicide (Garlon 3A [triclopyr]) treatment, two foliar herbicides (2,4-D or Garlon 4), and a tank mix of the two herbicides) to study its development in both a natural (control) and treated condition. The herbicides were each applied twice. Survival of planted Douglas fir (Pseudotsuga menziesii) seedlings was recorded for 11 years and growth was quantified for 9 years after the last treatment application. In addition to Douglas fir, data are presented individually for the two most abundant species (tanoak and snowbrush, Ceanothus velutinus var. hookeri), forgreenleaf manzanita (Arctostaphylos patula), and for the hardwood tree and shrubs combined. At the study's end in 1992, combined vegetation in the control had a mean density of 1800 plants/acre, foliar cover of 23 700 ftsuperscript 2/acre, and height of 11.2 ft. In contrast, combined tree and shrubs in the most effective treatment for controlling them (cut and spray Garlon 3A) had a mean density of 150 plants/acre, foliar cover of 150 ftsuperscript 2/acre and height of 5.9 ft at study end. Because competition for site resources was low, Douglas fir seedlings developed best in this treatment. Mean Douglas fir diameter was 4.6 inches at 12 inches above mean ground line, height averaged more than 21 ft, and mean foliar cover was 39 850 ftsuperscript 2 at the end of the study. The cost was $227 per acre.

OSU Link
Non-OSU Link

40. McDonald, P.M. and G.O. Fiddler. 1999. Ecology and development of Douglas-fir seedlings and associated plant species in a Coast Range plantation. Pacific-Southwest-Research-Station, USDA-Forest-Service Research-Paper PSW-RP-243. ii + 18 p.

Keywords: release treatments
manual release
chemical release
stand conditions
growth
tree morphology
economics

Abstract: On an average site in northern coastal California, USA, a tanoak (Lithocarpus densiflorus)-mixed shrub community was given several treatments (manual release one, two, and three times; a combination chainsaw and cut surface chemical treatment; two foliar chemicals; and a tank mix of the two chemicals) to study its development over an 11-year period (1981-91) in both a broadcast-burned (untreated control) and released (treated) condition. The chemicals were 2,4-D, Garlon [triclopyr] 3A, and Garlon 4, each applied two times. The site had been planted with 2+0 seedlings of Douglas fir (Pseudotsuga menziesii) in 1979. In addition to Douglas-fir , data are presented individually for the four most abundant and well distributed species (tanoak, hairy manzanita (Arctostaphylos columbiana), huckleberries (Vaccinium ovatum and V. parviflorum), and rhododendron

(Rhododendron macrophyllum)), and for these plus two more of the tallest and most abundant (but poorly distributed) species (snowbush (Ceanothus velutinus), elderberry (Sambucus mexicana)) combined. In 1991, combined shrubs in the control had a mean density of 4733 plants per acre, foliar cover of 16 800 ft2 per acre, and height of 9.5 feet. In contrast, combined shrubs in one of the most effective treatments for controlling them (2,4-D) had a mean density of 2000 plant per acre, foliar cover of 2600 ft2 per acre and height of 5.5 feet at the end of the study. Here, mean Douglas-fir diameter was 4.0 inches at 12 inches above mean ground line, height averaged 18.7 feet, and mean foliar cover was 34 800 ft2 per acre. The cost (including chemical) was $77 per acre. The biological and economical data in this paper provide the ecosystem manager, wildlife biologist, and fuels manager with knowledge on how to attain plant communities with different density and development potentials, and the cost of creating them.

OSU Link
Non-OSU Link

41. McLeod, A.A., R.C. Evans and R.K. Scagel. 1993. Conversion of understocked salal sites at Woss Lake, British Columbia. B.C. Ministry of Forests FRDA-Report 194. vi + 15 p.

Keywords: nursery operations
site preparation
mechanical preparation
fertilization
growth
tree/stand health
economics

Abstract: A trial comparing the effect of spot scarification and slow release NPK fertilizer application on stock types of coastal Douglas fir (Pseudotsuga menziesii) was conducted in a 25-year-old backlog site occupied by a thick carpet of salal (Gaultheria shallon) in the CWHxm2 habitat of Vancouver Island, British Columbia. Bare root and container stock types were planted and treated, and mortality and growth were measured for 3 years. Despite the high fertilizer-related mortality of the bare-root stock type in the first year, the 3-year height growth performance of all treatments was better but more variable than that of the untreated seedlings. The value of site preparation and fertilizer for stimulating early growth varied by stock type. Bare-root stock did not respond strongly enough to fertilizer or site preparation to justify the cost of either of these treatments. Container stock types did not respond strongly enough to site preparation alone to justify the high cost of site preparation. The largest growth gains in the container stock types were associated with the combination of site preparation and fertilization.

OSU Link
Non-OSU Link

42. Miller, G.E. 1983b. When is controlling cone and seed insects in Douglas-fir seed orchards justified? Forestry-Chronicle 59(6): 304-307.

Keywords: seed orchard management
tree/stand protection

economics
reproduction

Abstract: Two seed orchards in British Columbia were sprayed with dimethoate in 1981, and the costs of estimating crop size and insect infestation and of dimethoate application were recorded. The cost/tree was $2.31 or $3.68 (including sprayer rental). Benefit/cost ratios were calculated and plotted against number of cones/tree and varying increases in yield (3-24 filled seeds/cone) due to protection. The number of cones a tree must bear and the increased yield/cone required to cover the cost of one dimethoate application are given in graphs for seed values of $150-1000/kg.

OSU Link
Non-OSU Link

43. Miller, R.E. 1981. Response of Douglas-fir to foliar fertilization. *In* Proceedings: Forest Fertilization Conference, University of Washington, Seattle, Washington, USA. *Eds.* S.P. Gessel, R.M. Kenady and W.A. Atkinson. pp. 62-68.

Keywords: fertilization
tree/stand health
growth
economics

Abstract: This paper summarizes past research about spray application of 10 to 32 percent nitrogen solutions to seedlings and established stands of Douglas-fir. These investigations establish that Douglas-fir and associated conifers can be foliarly fertilized with concentrated nitrogen solutions at dosages of 50 to 200 pounds per acre; however, fertilization with these solutions requires more critical selection of nitrogen source, dosage, additives, and, perhaps, time of year than does fertilization with urea prill. Some burning, up to about 30 percent of the needle surface, is visually disturbing but probably has no measurable effects on growth. With low dosages and careful application, gains in cubic volume or height growth per pound of applied nitrogen were similar for both spray and prill. Yet costs per pound of applied nitrogen have been about 25 percent more for 32 percent nitrogen solutions than for prilled urea. Hence, foliar application of concentrated nitrogen solutions is currently less cost effective than conventional use of urea solids for fertilizing Douglas-fir and associated conifers.

OSU Link
Non-OSU Link

44. Miller, R.E. and S.R. Webster. 1981. Fertilizer response in mature stands of Douglas-fir. *In* Proceedings: Forest Fertilization Conference, University of Washington, Seattle, Washington, USA. *Eds.* S.P. Gessel, R.M. Kenady and W.A. Atkinson. pp. 126-132.

Keywords: fertilization
growth
economics

Abstract: Published and unpublished response data from fertilizer trials in mature stands of Douglas-fir (Pseudotsuga menziesii [Mirb.] Franco) in western Washington and Oregon are examined. Stand age ranged from 60 to 120 years. It is concluded that: (1) nitrogen fertilization increased volume growth by 9 to 60 percent in these 60- to 120-year-old stands, (2) sizeable gains occurred in the first decade after fertilization, (d) the economics of high stumpage values and short investment periods make fertilizing mature Douglas-fir economically attractive.

OSU Link
Non-OSU Link

45. Murray, M.D. 1988. Growth and yield of a managed 30-year-old noble fir plantation. Pacific-Northwest-Research-Station,-USDA-Forest-Service Research-Note PNW-RN-475. 8 p.

Keywords: planting operations
growth
yield
economics

Abstract: Yield of noble fir (Abies procera) from a managed (urea application 15 yr after planting, precommercially thinned after 17 and 24 yr) stand in the Doty Hills, western Washington was measured and compared with the simulated yield of a Douglas fir (Pseudotsugamenziesii) plantation of the same age. Noble fir produced 3450 ftsuperscript 3/acre at age 30 yr; more than half this volume was in trees of <more or =>10 inches d.b.h. Current annual increment during the 6 yr after the second thinning (to 300 trees/acre) was 295ftsuperscript 3/acre. Ornamental boughs had been harvested annually for 15 yr. Total noble fir volume was about 5% less than the simulated volume of Douglas fir. The estimated value of noble fir after 48 yr, including sawlogs and boughs, could exceed the value of Douglas fir at the same age grown on the same site.

OSU Link
Non-OSU Link

46. Omule, S.A.Y., D.E. Paul and L.M. Darling. 1994. Cost of pruning Douglas-fir in coastal British Columbia. Forestry-Chronicle 70(1): 80-83.

Keywords: pruning
economics

Abstract: Artificial pruning can increase the quantity of high-value clear lumber harvested from Douglas fir (Pseudotsuga menziesii), but the pruning cost per tree is relatively high. To prune a young Douglas fir to 6 metres in one lift and two lifts took, respectively, 9.5 and 10.1 minutes in 14- and 18-year old stands with average spacing between trees of about 3 metres on flat or 0-30% south-facing slopes in coastal British Columbia. The associated costs were $2.09 and $2.22. This included minor travel time between trees, but excluded the cost oftravelling to the site, selecting and marking trees to be pruned, and purchasing and maintaining the pruning equipment. Differences in pruning time between one-lift pruning and two-lift pruning, in one or two passes, were small. A D-handled saw was preferred to the more strenuous snap-cut pruner with ratchet-style pinions, based on observations on a pruning time-study of 5 operators.

OSU Link
Non-OSU Link

47. Potts, S.J., B.R. Hartsough, S.E. Reutebuch and J.L. Fridley. 1997. Manual polesaw pruning of Douglas-fir. Applied-Engineering-in-Agriculture 13(3): 399-405.

Keywords: pruning
economics

Abstract: A time-and-motion study was conducted in British Columbia of second-lift (from 2.8 to 5.6 m) pole saw pruning in a 12-year-old stand of Douglas fir (Pseudotsuga menziesii), to help determine costs. Pruning quality was also assessed, using samples from random plots. Productivity relationships were derived via regression analysis. Production rates using pole saws averaged 8.2 trees per productive hour and varied according to tree and stand characteristics. Cost per tree averaged about $2.80. Both the production rates and quality were lower than for pruning with shears, indicating that pole saw pruning is less desirable in all aspects except one: the work can be done from the ground instead of on a ladder.

OSU Link
Non-OSU Link

48. Ralston, R., J. Buongiorno and J.S. Fried. 2004. Potential yield, return, and tree diversity of managed, uneven-aged Douglas-fir stands. Silva-Fennica 38(1): 55-70.

Keywords: thinning
commercial thinning
economics
yield

Abstract: The effects of different management regimes on uneven-aged Douglas-fir stands in the Pacific Northwest of the United States were predicted with a simulation model. Management alternatives were defined by residual stand structure and cutting cycle. The residual stand structure was set by basal area-diameter-q-ratio (BDq) distributions, diameter-limit cuts (assuming concurrent stand improvement), or the current diameter distribution. Cutting cycles of 10 or 20 years were applied for 200 years. The current diameter distribution was defined as the average of the uneven-aged Douglas-fir stands sampled in the most recent Forest Inventory and Analysis conducted in Oregon and Washington. Simulation results were compared in terms of financial returns, timber productivity, species group diversity (hardwoods vs softwoods), size class diversity, and stand structure. Other things being equal, there was little difference between 10- and 20-year cutting cycles. The highest financial returns were obtained with either a 58.4 cm diameter-limit cut, or a BDq distribution with 8.4 m2 of residual basal area, a 71.1 cm maximum diameter, and a q-ratio of 1.2. Using the current stand state as the residual distribution was the best way to obtain high tree size diversity, and high species group diversity. Several uneven-aged regimes gave net present values comparable to that obtained by converting the initial, uneven-aged stand to an even-aged, commercially thinned, plantation.

OSU Link
Non-OSU Link

49. Risbrudt, C.D. and S.E. McDonald. 1986. How effective are tree improvement programs in the 50 States? North-Central-Forest-Experiment-Station,-USDA-Forest-Service Research-Paper NC-RP-276. 6 p.

Keywords: genetic tree improvement
economics

Abstract: Data were collected from all 50 State Foresters on the extent and cost of activities in producing genetically improved trees for timber production, the use of State and Private Forestry funds for such activities and the species being improved. Future timber volume attributable to genetic improvement and benefit/cost ratios were estimated. Only the benefits of planting on nonindustrial private forest lands are considered. Loblolly pine improvement accounted for 40% of the total annual expenditure of $4 million. Improvement of loblolly pine, Douglas fir, slash pine and ponderosa pine represented 80% of all expenditure. Analysis showed the high sensitivity of the benefit/cost ratios to the discount rate because of the long time before tree improvement benefits are realized. It is concluded, however, that the tree improvement programme is a logical public effort because of the significant long-term benefits of increased timber harvests.

50. Ross, S.D. and R.C. Bower. 1989. Cost-effective promotion of flowering in a Douglas-fir seed orchard by girdling and pulsed stem injection of gibberellin A4/7. Silvae-Genetica 38(5-6): 189-195.

Keywords: seed orchard management
reproduction
economics

Abstract: In a seed orchard in British Columbia, Canada, Douglas fir (Pseudotsuga menziesii) grafts of 5-14 cm diam. received different combinations of partial saw-cut stem girdles and ethanolic solutions of GA4/7 injected into shallow holes drilled around the main stem. Grafts averaged 79 seed-cone buds and 4500 pollen-cone buds each without treatment. Girdling alone increased production per tree of seed- and pollen-cone buds to 325 and 9300 respectively. GA4/7 alone was nearly as effective as girdling alone, the response being marginally greater at the high than low dosage (3.82 vs. 1.27 mg/cmsuperscript 2 of stem cross sectional area), but independent of whether the total dose was applied all at once or over two or three injections at 2-wk intervals. Together, girdling and GA4/7 had an additive effect on flowering, increasing production per tree of seed- and pollen-cone buds to 585 and 18 250. The combined treatment was particularly effective on smaller trees that flowered poorly or not at all without treatment, while also enhancing production significantly on larger trees. The combined treatment was safe and highly cost effective. It cost $63.75 per year to maintain each tree in the orchard, so that without any treatment the cost per seed-cone bud initiated was $0.91. Girdling (at $2.07 per tree) reduced this cost to $0.20, and girdling + GA4/7 (at $7.87 per tree) to only $0.13.

51. Ross, S.D. and R.C. Bower. 1991. Promotion of seed production in Douglas-fir grafts by girdling + gibberellin A4/7 stem injection, and effect of retreatment. New-Forests 5(1): 23-34.

Keywords: seed orchard management
reproduction
economics
tree/stand health

Abstract: In a Douglas fir (Pseudotsuga menziesii) seed orchard in British Columbia, Canada, in 1985, 12- to 17-year-old Douglas fir grafts received no treatment, stem girdles only (G), or girdles plus stem injection of gibberellin A4/7 (G+GA) at vegetative bud burst. In 1987 they were retreated with G+GA or left untreated. Trees were untreated in 1986 and cone production in 1987 was very sparse. G+GA treatment in 1987 increased 1988 production of seed cones from 465 to 1600 per tree, with a comparable increase in frequency of grafts producing a heavy crop of pollen cones. However, induction treatments applied in 1985 adversely affected seed- and pollen-cone production in 1988, independent of treatment in 1987. Cone size, total and filled seed per cone, and seed germination were little affected by treatment in either year. Treatment with G+GA in 1987 only maximized production of filled seeds (48 100/tree), although G+GA in both 1985 and 1987 (31 200/tree) was still effective compared with no treatment in either year (14 700/tree). Application time (about 4.8 minutes per tree for G+GA) and costs are discussed in terms of seed yield (for biennial treatment, about an extra $0.17 per additional 1000 filled seeds). Physiological costs to the tree are noted: the G+GA treatment adversely affected tree condition more severely than previously (or since) experienced, probably as a consequence of prolonged late-summer droughts during each of the treatment years. Additional irrigation and fertilizer treatments are suggested to alleviate such stresses.

OSU Link
Non-OSU Link

52. Sonne, E., E. Turnblom, D. Briggs and G. Becker. 2004. Log and lumber grades and value from a Douglas-fir stand 20 years after thinning and biosolids fertilization. Western-Journal-of-Applied-Forestry 19(1): 34-41.

Keywords: fertilization
thinning
economics
yield
wood quality

Abstract: Three replications of four treatments: biosolids fertilizer application, thinning, thinning plus biosolids fertilizer application, and untreated control were established in 1977 in a dense, low site, 55-year-old Douglas-fir (Pseudotsuga menziesii) stand in western Washington, USA. In 1998, 12 trees from each treatment were harvested, bucked into logs, and sawn into visually graded lumber. Taking into account effects of treatments on stand yield and log grades, biosolid fertilizer application only, thinning only, and thinning combined with biosolids increased log value/ac by $1142 (19%), $3642 (62%), and $9969 (155%), respectively, over the untreated control. When treatment effects were viewed in terms of changes in lumber yield and quality, per acre gains over the control were $2107 (26%), $5683 (70%), and $10 708 (132%), respectively. Willingness to pay analysis indicates that if the landowner intends to manage the stand to a rotation of approximately 75 years, each of the treatments, and especially the combination of thinning and applying biosolids, appears to be financially attractive at both 5 and 9% interest rates. However, if the rotation had been set at 55 years, only the

thinning/biosolids combination at 5% interest rate would entice management to delay immediate harvest.

OSU Link
Non-OSU Link

53. Stone, M. 1993. An economic evaluation of commercial thinning Douglas-fir in the coastal region of British Columbia. BC Ministry of Forests FRDA-Working-Paper WP-6-002. x + 146 p.

Keywords: thinning
commercial thinning
economics
growth
yield

Abstract: The economic evaluation of commercial thinning of Douglas fir [Pseudotsuga menziesii] in the coastal region of British Columbia, includes an estimation of the economic effects of the thinning on the final harvest. This was done by simulating the growth and yield impacts of a commercial thinning, estimating the potential costs and revenues derived from the thinning and the final harvest, and determining the net present value of the full impacts of commercial thinning.

Non-OSU Link

54. Sturrock, R.N., E.J. Phillips and R.G. Fraser. 1994. A trial of push-falling to reduce Phellinus weirii infection of coastal Douglas-fir. B.C. Ministry of Forests FRDA-Report 217. vi + 22 p.

Keywords: tree/stand protection
economics
tree/stand health
soil properties

Abstract: In push-falling, whole trees are pushed over by a bucket- and thumb-equipped excavator then grapple skidded to a landing where root masses are cut off and stems are bucked into logs. Harvesting of trees and removal of diseased roots is thus achieved with one stand entry. The productivity and economics of push felling were evaluated in a second-growth Douglas fir (Pseudotsuga menziesii) stand in coastal British Columbia. Results indicated that costs are comparable to those for conventional harvesting alone and that push felling can effectively remove infected roots. Before harvest <80% of the site was undisturbed but disturbed soils occupied 50.6% of the site after harvest. Changes in total bulk densities were relatively minor.

OSU Link
Non-OSU Link

55. Sullivan, T.P. and D.S. Sullivan. 1985. Operational direct seeding of Douglas-fir and lodgepole pine with alternative foods in British Columbia. B.C.-Ministry-of-Forests Research-Note 97. vi + 16 p.

Keywords: planting operations
tree/stand protection
tree/stand health
economics
reproduction

Abstract: Direct sowing of clear-felled areas in temperate coniferous forests of N. America has often been hampered because of seed predation by rodents and birds. In trials in British Columbia, seed predation was considerably reduced when Douglas fir (Pseudotsugamenziesii) seed was mixed with sunflower seed (7:1 sunflower to Douglas fir) or with sunflower seed and oat kernals (5:2:1 sunflower/oats/Douglas fir) or when lodgepole pine (Pinus contorta) seed was mixed with sunflower seed (2:1 sunflower to pine). The economics of providing alternative food for the predators and operational considerations are discussed.

OSU Link
Non-OSU Link

56. Tappeiner, J.C., J.F. Bell and J.D. Brodie. 1982. Response of young Douglas-fir to 16 years of intensive thinning. Forest-Research-Laboratory,-Oregon-State-University

Keywords: thinning
growth
yield
tree/stand health
economics

Abstract: The report of the thinning study in the Oregon Coast Range includes a financial analysis of representative thinning regimes.

OSU Link
Non-OSU Link

57. Tarrant, R.F., B.T. Bormann, D.S. DeBell and W.A. Atkinson. 1983. Managing red alder in the Douglas-fir region: some possibilities. Journal-of-Forestry 81(12): 787-792.

Keywords: planting operations
fertilization
yield
economics

Abstract: An economic comparison of 3 systems for growing Alnus rubra (rotations of 13,20 and 28 yr) in the Pacific Northwest USA, with or without alternating rotations (45 yr) of Douglas fir, and 2 continuous systems for growing Douglas fir (45-yr rotations with or without treatment with N fertilizer). Anticipated stand yield, and costs of site preparation, planting, fertilization etc. were used to estimate m.a.i. (vol.), present net worth and internal rate of return. The 2 most profitable systems were Douglas fir, thinned and treated with fertilizer twice in 45 yr (present net worth $623/acre) and red alder grown to sawlog size (28 yr) alternating with Douglas fir thinned twice in 45 yr (present net worth $578/acre).

The least profitable system was red alder grown continuously in 13 yr rotations (present net worth - $251/acre). Alternate cropping of red alder and Douglas fir or continuous red alder production would be as profitable as growing Douglas fir alone if there were increases in real interest rate, alder stumpage price, or the cost of N fertilizer, or alder sawlog rotation length decreased.

OSU Link
Non-OSU Link

58. Tedder, P.L. 1981. Reforestation of steep sites with skeletal soils - is it economically realistic? *In* Reforestation-of-skeletal-soils. *Eds.* S.D. Hobbs and O.T. Helgerson, Forest Research Laboratory, Oregon State University, Corvallis, OR. pp. 105-108.

Keywords: planting operations
economics

Abstract: The lack of data concerning volume yields from steep sites with skeletal soils precludes any substantive analysis. However, with projections of moderate increases in real stumpage prices of Douglas-fir, regeneration of Sites IV and below indicate that a rate of return less than five percent (real) will be realized.

Non-OSU Link

59. Thomson, T.A. 1989. Evaluating some financial uncertainties of tree improvement using the capital asset pricing model and dominance analysis. Canadian-Journal-of-Forest-Research 19(11): 1380-1388.

Keywords: genetic tree improvement
economics

Abstract: Although uncertainty considerations are of prime importance in capital budgeting, forestry investments are often evaluated without comparing their uncertainty level with their rates of return. An examination was made of some financial uncertainties of a Douglas fir (Pseudotsuga menziesii) tree improvement programme in the US Pacific Northwest with analysis of likely rates of return on investment. Biophysical uncertainties such as amount of genetic gain or uncertainty of site quality were determined by a priori assumption to be non-market; thus, use of expected value adjusted for these risks. The market uncertainties of tree improvement were found to be reasonable in relation to other investments, as sensitivity analysis showed that the financial risks were small or the measured beta (covariance of the assets' returns with the market's returns divided by the variance of the market) was low. It is concluded that the tree improvement investment is worthwhile, considering its risk as well as return.

OSU Link
Non-OSU Link

60. Walstad, J.D., J.D. Brodie, B.C. McGinley and C.A. Roberts. 1986. Silvicultural value of chemical brush control in the management of Douglas-fir. Western-Journal-of-Applied-Forestry 1(3): 69-73.

Keywords: release treatments

chemical release
growth
yield
economics

Abstract: Retrospective analyses were made of 3 Douglas fir plantations (age 12-39 yr) in western Oregon and Washington, to determine the long-term silvicultural effects and economic value of chemical brush control 10-25 yr earlier. Stocking and growth of Douglas fir were significantly greater on areas that received at least one aerial application of 2,4-D or 2,4,5-T than on untreated areas. On two sites, invading Alnus rubra virtually excluded Douglas fir in the absence of brush control. On the third site, Ceanothus velutinus var. laevigatusreduced Douglas fir stocking and diam. growth on untreated areas. On all three sites, projections of mature yield and economic returns based on current stand conditions indicated substantial benefits for areas where brush control treatments were applied.

OSU Link
Non-OSU Link

61. Wilson, J.S. and P.J. Baker. 2001. Flexibility in forest management: managing uncertainty in Douglas-fir forests of the Pacific Northwest. Forest-Ecology-and-Management 145(3): 219-227.

Keywords: planting operations
thinning
yield
tree morphology
economics
tree/stand health

Abstract: Long planning horizons generate substantial uncertainty in forest management, making management flexibility, the ability to choose between multiple options or opportunities, a desirable attribute of managed forests. Flexibility in forest management reflects both the relative rigidity of intervention requirements and the potential range of development pathways for a stand. The wind stability of Pacific Northwest Douglas-fir (Pseudotsuga menziesii) plantations is used to demonstrate the concept of management flexibility. Dense Douglas-fir plantations develop high height to diameter ratios in the dominant trees making them unstable and prone to wind damage. The management of these plantations is inflexible, because without early and timely thinning, the stands do not contain stable trees that could be expected to survive long rotations or late thinnings. A combination of reduced planting densities and site-specific management reduces both the necessity and rigidity of intervention requirements (e.g., thinning) and expands the number of potential developmental pathways for these stands. The cost of greater management flexibility is reduced efficiency of wood volume production; however, greater adaptability to changing markets, labour conditions, and management objectives may be more important for many forest owners. While this approach to management is complex, it frees owners and managers from rigid management requirements and allows for a wider range of future stand conditions.

OSU Link
Non-OSU Link