Tree/Stand Protection

1. 1994. Annual Report - Forest Research Laboratory, Oregon State University. Forest Research Laboratory, Oregon State University. ii + 29 pp.

Keywords: genetic tree improvement
tree/stand protection
tree phenology
tree physiology

Abstract: Highlights of research conducted during 1993-1994 are presented, including: preliminary results of a 2-year (1992-94) field cold hardiness study of Douglas fir [Pseudotsuga menziesii] in Oregon, USA involving open pollinated progeny of 40 parents at a high and a low elevation; results of a progeny test on the frequency of second flushing of Douglas fir near Orleans, France; and variation in stable carbon isotope ratios (a measure of water use efficiency) among varieties and populations (coastal and Rocky Mountain) of Douglas fir.

2. 1997. PNWTIRC Annual Report 1996-97, Pacific Northwest Tree Improvement Research Cooperative. Oregon State University, Oregon, USA. ii + 29 p.

Keywords: genetic tree improvement
tree/stand protection
tree phenology
growth
wood quality
tree physiology

Abstract: The report describes highlights for 1996-97, current research (3 projects), student project updates (3 projects), planned Douglas fir [Pseudotsuga menziesii] seed orchards for the new millennium and other planned activities of the PNWTIRC, a research cooperative operating in the Pacific Northwest area of North America (USA and Canada). Details are included of publications and finances. Details of the 3 current research projects and the 3 student projects, which all concern Douglas fir, are presented as short papers including brief results: (1) Influence of second flushing on cold hardiness; (2) Seedling drought physiology study; and (3) Quantitative trait loci influencing cold hardiness; (4) Seedling cold hardiness; (5) Growth response of saplings to drought; and (6) Measurement study follow-up: age-age correlations in forking defects.

OSU Link
Non-OSU Link

3. 2000. Annual Report 1999/2000 - Pacific Northwest Tree Improvement Research Cooperative. Oregon State University, Oregon, USA. 31 p.

Keywords: genetic tree improvement
tree/stand protection
tree physiology
reproduction

Abstract: Includes highlights of 1998-1999; a note to the cooperative members from Tom Adams; Introduction; Current research on seedling drought physiology of Douglas fir [Pseudotsuga menziesii], field drought study - genetics of drought sensitivity in older trees, early testing revisited, miniaturized orchard study, pollen contamination study; activities planned for 2000-2001; list of staff publications and abstracts; and a summary of financial support for the fiscal year 1999-2000.

OSU Link
Non-OSU Link

4. 2001. Common insects and diseases of interior Douglas-fir. British Columbia Ministry of Forests SIL471. 8 p.

Keywords: tree/stand protection
tree/stand health

Abstract: This field guide provides information on the different pests and diseases of the interior Douglas fir (Pseudotsuga menziesii) in British Columbia which include: defoliating insects (Douglas fir tussock moth, spruce budworm and rusty tussock moth); dwarf mistletoe; foliar diseases (e.g., caused by the Cooley spruce adelgid); bark beetles; root diseases (Armillaria root disease, blackstain root disease, laminated root rot and blackstain root disease); wood decay (caused by bracket or conk fungi); and various abiotic problems (sunscald, drought or frost). A guideline to control infestations of these given pests is also included.

OSU Link
Non-OSU Link

5. Adams, T., T. Anekonda and C. Lomas. 1999. Annual Report 1998-99, Pacific Northwest Tree Improvement Research Cooperative. 33 p.

Keywords: genetic tree improvement
tree/stand protection
tree/stand health
growth
tree physiology

Abstract: Summaries are given of research projects on improvement of Douglas fir [Pseudotsuga menziesii] in the Pacific Northwest: seedling drought physiology; genetics of dark respiration and its relationship with drought hardiness; response of saplings to drought, as measured by growth ring variables; use of microsatellite marker loci to identify pollen contamination in seed orchards; and evaluation of miniaturized seed orchard designs.

OSU Link
Non-OSU Link

6. Aitken, S.N. and W.T. Adams. 1996. Genetics of fall and winter cold hardiness of coastal Douglas-fir in Oregon. Canadian-Journal-of-Forest-Research 26(10): 1828-1837.

Keywords: genetic tree improvement
tree/stand protection
tree/stand health
tree physiology
genetic relationships

Abstract: Genetic variation in autumn cold hardiness was studied in two western Oregon breeding populations of coastal Douglas fir (Pseudotsuga menziesii var. menziesii), one on the west slope of the Cascade Mountains and the other in the Coastal Range. On six sampling dates (September, October and November 1992 and January, September and October 1993), shoot cuttings from 40 open-pollinated families in each of two progeny test sites for each breeding zone were subject to artificial freezing at two test temperatures. Damage in each shoot was recorded as visible injury to needle, stem and bud tissue separately. Considerable family variation was found for cold injury scores in all tissues in early to mid autumn, but differences were often smaller or nonsignificant in late autumn and midwinter. Individual heritability estimates for needle cold injury were low (<0.40) and generally decreased in late autumn and midwinter. Family rankings for autumn cold hardiness, however, are expected to be relatively consistent over sites and years, although needles appear to display more family-by-site interaction than stems or buds. Genetic correlations between tissues in cold injury varied considerably and were sometimes weak, indicating that the evaluation of a single tissue is probably not adequate for assessing overall cold hardiness of genotypes. Autumn and winter cold hardiness seem to be largely under separate genetic control since genetic correlations between hardiness at these two stages were weak. This study confirms earlier results in Washington breeding populations and shows that coastal Douglas fir families can be effectively ranked for autumn cold hardiness by conducting artificial freeze tests on cut shoots in mid-autumn (October) and scoring damage to stems and at least one other tissue.

OSU Link
Non-OSU Link

7. Aitken, S.N. and W.T. Adams. 1997. Spring cold hardiness under strong genetic control in Oregon populations of Pseudotsuga menziesii var. menziesii. Canadian-Journal-of-Forest-Research 27(11): 1773-1780.

Keywords: genetic tree improvement
tree/stand protection
tree/stand health
tree phenology
tree physiology
genetic relationships

Abstract: Genetic variation in spring cold hardiness of shoots prior to bud break was studied in two Oregon breeding populations of Pseudotsuga menziesii var. menziesii, one on the west slope of the Cascade Mountains and the other in the Coast Range. In March and April 1993, and April 1994, shoot cuttings from 40 open-pollinated families in each of two progeny test sites in each breeding zone were subjected to artificial freezing. Visible cold damage to needle, stem, and bud tissues was recorded. Date of bud burst (all sites), and injury resulting from a 1992 natural frost event (one site), were also recorded. Spring cold injury varied widely among families. Individual heritabilities for spring cold injury scores averaged 0.76 in the Coastal zone and 0.42 in the Cascade zone. Genetic correlations among tissues, sites, sampling dates, and years, and between April cold injury and date of bud burst were high,

in most cases over 0.80. Correlations were also strong between natural frost damage in 1992 and artificial cold injury scores in 1993. Artificial freeze testing stem tissues of cut shoots sampled in April from a single test site should effectively rank families in this region for spring cold hardiness.

OSU Link
Non-OSU Link

8. Aitken, S.N., W.T. Adams, N. Schermann and L.H. Fuchigami. 1996. Family variation for fall cold hardiness in two Washington populations of coastal Douglas-fir (Pseudotsuga menziesii var. menziesii (Mirb.) Franco). Forest-Ecology-and-Management 80(1/3): 187-195.

Keywords: genetic tree improvement
tree/stand protection
tree/stand health
tree physiology
tree phenology
genetic relationships

Abstract: In order to assess the genetics of autumn (fall) cold hardiness in coastal Douglas fir (Pseudotsuga menziesii var. menziesii), shoot cuttings were collected in October from saplings (9-year-old trees) of open-pollinated families in two progeny tests in each of two breeding zones in Washington, one in the Coast range (80 families) and one on the west slope of the Cascade Mountains (89 families). Samples from over 5500 trees were subjected to artificial freezing and visually evaluated for needle, stem and bud tissue injury. The extent to which cold injury is genetically related to tree height and shoot phenology (timing of bud burst and bud set) was also evaluated. Significant family variation was found for all cold hardiness traits; however, individual heritability estimates were relatively low (ranging from 0.09 to 0.22). Significant family-by-test site interaction was detected for needle injury in the Cascade breeding zone, but not in the coastal zone. Genetic correlations (rA) among needle, stem and bud tissues for cold damage were weak (0.16<less or =>rA<less or =>0.58) indicating that genes controlling autumn cold hardening are somewhat different for different tissues. Timing of bud burst and bud set were only weakly correlated with cold injury (rA<less or =>0.49). Thus, bud phenology is a poor predictor of autumn cold hardiness in this species. There was no consistent relationship between tree height and cold injury in the coastal zone. In the Cascade zone, taller trees appeared to be more susceptible to cold injury, but the association was weak (mean rA=0.38, range 0.20-0.72).

OSU Link
Non-OSU Link

9. Anekonda, T.S., M.C. Lomas, W.T. Adams, K.L. Kavanagh and S.N. Aitken. 2002. Genetic variation in drought hardiness of coastal Douglas-fir seedlings from British Columbia. Canadian-Journal-of-Forest-Research 32(10): 1701-1716.

Keywords: genetic tree improvement
tree/stand protection
growth
tree/stand health
genetic relationships
tree physiology

Abstract: Genetic variation in drought hardiness traits and their genetic correlations with growth potential and recovery traits were investigated in 39 full-sib families of coastal Douglas-fir (Pseudotsuga menziesii var. menziesii) from southwestern British Columbia, Canada. Seedlings of these families were grown in raised nursery beds and subjected to three moisture regimes each in the second (well-watered or control, mild, and moderate drought) and third (control, severe drought, and recovery from second-year moderate drought) seasons. Traits assessed included drought hardiness (foliage damage, cavitation of xylem tracheids, xylem hydraulic conductivity, and height and diameter growth increment) in the drought treatments, growth potential (total height and diameter) in the control treatment, and height and diameter growth increments in the recovery treatment. Xylem cavitation in the growth ring produced in a particular year was nearly three times greater under the moderate drought and four times greater under the severe drought than in the control treatment. Xylem hydraulic conductivity of seedlings in the severe drought treatment was 40% lower than conductivity of seedlings under the control treatment. Mean foliage damage in seedlings subjected to severe drought (third season) was much greater (33%) than in seedlings subjected to mild or moderate drought (second season). Families differed significantly in most drought hardiness traits, with individual tree heritabilities averaging 0.19. Thus, much potential exists for identifying drought-hardy families at the seedling stage and using this information for deployment or breeding purposes. In addition, most hardiness traits were strongly intercorrelated (genetic correlations often exceeded |0.80|) indicating that these traits are controlled largely by the same set of genes and that selection for hardiness based on one trait will increase hardiness as reflected in the other traits as well. Genetic correlations were only moderate (0.49) between hardiness traits measured in different years, perhaps due to the large difference in severity of the drought applied in the two seasons. Although injury to seedlings, as reflected in foliage damage and xylem cavitation, was relatively low under the moderate drought of the second season, it did result in reduced growth increment the following (recovery) year. Growth potential under favourable moisture regimes was nearly uncorrelated with drought hardiness, suggesting that drought hardiness could be improved in this southwestern British Columbia breeding population without negatively impacting growth potential in favourable moisture conditions.

OSU Link
Non-OSU Link

10. Antonelli, A.L. and R.L. Campbell. 1991. Cooley spruce gall aphid. College of Agriculture and Home Economics, Washington State University. Extension Bulletin EB0966: 2 p.

Keywords: tree/stand protection
tree/stand health

Abstract: Notes are provided on the biology, injuriousness and chemical control (carbaryl and endosulfan are suggested) of Adelges cooleyi [Gilletteella cooleyi] on certain coniferous trees [including Picea sitchensis, P. engelmannii, P. pungens and Pseudotsuga menziesii] inWashington State.

OSU Link
Non-OSU Link

11. Axelrood, P.E., W.K. Chapman, K.A. Seifert, D.B. Trotter and G. Shrimpton. 1998. Cylindrocarpon and Fusarium root colonization of Douglas-fir seedlings from British Columbia reforestation sites. Canadian Journal of Forest Research 28:1198-1206.

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

Abstract: Poor performance of Douglas fir (Pseudotsuga menziesii) plantations established in 1987 has occurred in southwestern British Columbia. Affected sites were planted with 1-yr-old container stock that exhibited some root dieback in the nursery. A study was initiated in 1991 to assess Cylindrocarpon and Fusarium root infection in planted and naturally regenerating (natural) Douglas fir seedlings from 7 affected plantations. Percentages of seedlings harbouring Cylindrocarpon spp. and percentage root colonization were significantly greater for planted seedlings than natural seedlings. A significant linear trend in Cylindrocarpon root colonization was observed for planted seedlings with colonization levels being highest for roots closest to the remnants of the root plug and decreasing at distances greater than 10 cm from that region. This trend in Cylindrocarpon colonization was not observed for natural seedlings. Cylindrocarpon destructans var. destructans [Nectria radicola var., radicola] and C. cylindroides var. cylindroides were the only species isolated from planted and natural conifer seedlings. For most sites, percentage of seedlings harbouring Fusarium spp. and percentage Fusarium root colonization were less than for Cylindrocarpon. Recovery of Fusarium spp. from seedlings and root colonization levels were not significantly different for planted and natural seedlings from all sites.

OSU Link
Non-OSU Link

12. Axelrood, P.E., M. Neumann, D. Trotter, R. Radley, G. Shrimpton and J. Dennis. 1995. Seedborne Fusarium on Douglas-fir: pathogenicity and seed stratification method to decrease Fusarium contamination. New-Forests 9(1): 35-51.

Keywords: nursery operations
tree/stand protection
tree/stand health
growth

Abstract: Twelve Douglas-fir (Pseudotsuga menziesii) seedlots from coastal British Columbia were assayed for seedborne Fusarium; all of the seedlots were contaminated. The percentage of non-stratified seeds from individual seedlots harbouring Fusarium ranged from 0.3 to 95.4. Sixty-seven percent of the seedlots had Fusarium on less than 2% of the seeds. Post-stratification seedborne Fusarium levels were significantly less for running water imbibition compared with standing water imbibition. However, seedling growth at a container nursery was not consistently different for stratified seed imbibed initially in standing or running water. Fusarium disease symptoms were not observed in the nursery environment. The species of Fusarium isolated from seed were F. acuminatum [Gibberella acuminata], F. avenaceum [G. avenacea], F. lateritium [G. baccata], F. moniliforme [G. fujikuroi], F. oxysporum, F. poae and F. sambucinum [G. pulicaris]. Twelve Fusarium isolates, comprising 6 species, were assessed for pathogenicity. Disease symptoms were observed after 4 weeks incubation and Fusarium isolates ranged in virulence from low to high. Fusarium oxysporum isolates were the most pathogenic.

OSU Link
Non-OSU Link

13. Axelrood, P.E. and R. Radley. 1991. Biological control of Fusarium on Douglas-fir seedlings. Bulletin-SROP 14(8): 85-87.

Keywords: nursery operations
tree/stand protection
tree/stand health

Abstract: A bacterial culture collection was established from the rhizosphere and rhizoplane of Douglas fir (Pseudotsuga menziesii) seedlings collected from nursery and forest locations in British Columbia, Canada. Of the 2000 strains screened, 350 inhibited growth of at least 1 conifer seedling root pathogen (Fusarium, Cylindrocarpon or Pythium) in in vitro antibiosis assays. A total of 96 strains were screened for Fusarium disease control in biological control assays. One strain that inhibited all 3 pathogens in vitro was able to significantly reduce the incidence of disease caused by Fusarium on P. menziesii seedlings. Another strain that tested negative in in vitro antibiosis assays also reduced the disease incidence by a similar amount. This paper was presented at the Second international workshop on plant growth-promoting rhizobacteria - progress and prospects, held in Interlaken, Switzerland, Oct. 14-19, 1990.

14. Bloomberg, W.J. 1988. Modeling control strategies for laminated root rot in managed Douglas-fir stands: model development. Phytopathology 78(4): 403-409.

Keywords: planting operations
site preparation
mechanical preparation
tree/stand protection
tree/stand health

Abstract: A model of laminated root rot caused by Phellinus [Inonotus] weirii was developed to assess potential control strategies in managed Pseudotsuga menziesii stands. The model mimicked key processes in disease initiation and development quantified as functions of time and space. These processes were horizontal and vertical tree root distribution, root contact with inoculum and among root systems, spread of mycelium through root systems, root decay, reduction of diam. growth in infected trees, tree mortality and persistence of inoculum in roots of stumps and killed trees. The processes were expressed as mathematical functions which were integrated in a computer program to calculate spread of the disease and stand-growth loss and mortality. Data for quantification of functions were obtained by experiments and from the literature. Simulated control practices included infected stump removal, sanitation fellings and mixed planting of Douglas fir and resistant species. Accuracy of the model was tested by comparing calculated disease spread and mortality with the following data: (1) spread and damage in two 60-yr-old, 1-ha stands in Oregon, (2) results from a statistically based model for spread and damage that had performed satisfactorily, and (3) observed spread and damage behaviour in stands of different ages and growth rates. Results from the model compared favourably with all of the above situations.

OSU Link
Non-OSU Link

15. Bloomberg, W.J. and G. Reynolds. 1988. Equipment trials for uprooting root-rot-infected stumps. Western-Journal-of-Applied-Forestry 3(3): 80-82.

Keywords: site preparation
mechanical preparation
tree/stand protection
tree/stand health

Abstract: Residual roots from Douglas fir (Pseudotsuga menziesii) and western hemlock (Tsuga heterophylla) were measured following stump-root extraction one yr after harvesting a 55-yr-old, 314 stems/ha, 47% Douglas fir, 17% maple (Acer macrophyllum), 16% red cedar (Thuja plicata), 6% western hemlock stand with 20% infection by Phellinus weirii in the Cowichan valley, Vancouver Island, Canada. Extraction was by a Caterpillar D8H with brush-clearing blade, a 180-hp backhoe or a 115-hp backhoe. All 3 machines recovered more than 90% of root vol. The small backhoe left significantly greater numbers and lengths of root residues per msuperscript 3 soil, though the vol. of residues was greatest for the Caterpillar. An earlier study suggested that a root density of 32 roots/msuperscript 3 was needed to produce one root contact; as the least efficient treatment by the Caterpillar left 23.2 roots/msuperscript 3 in the ground, it is suggested that this would provide insufficient contacts with a new tree crop to transmit infection.

OSU Link
Non-OSU Link

16. Brandeis, T.J., M. Newton and E.C. Cole. 2002. Biotic injuries on conifer seedlings planted in forest understory environments. New Forests 24:1-14.

Keywords: planting operations
site preparation
chemical preparation
release treatments
chemical release
thinning
tree/stand protection
growth
tree/stand health

Abstract: The effects of partial overstorey retention, understorey vegetation management, and protective Vexar(R) tubing on the frequency and severity of biotic injuries in a two-storied stand underplanted with western redcedar (Thuja plicata), Douglas-fir (Pseudotsuga menziesii), grand fir (Abies grandis), and western hemlock (Tsuga heterophylla) were investigated. The most prevalent source of damage was browsing by black-tailed deer (Odocoileus hemionis columbiana); deer browsed over 74% of Douglas-fir and over 36% of western redcedar seedlings one or more times over the four years of this study. Neither the spatial pattern of thinning (even or uneven) nor the density of residual overstorey affected browsing frequency. Spraying subplots may have slightly increased browsing frequency, but the resulting reduction of the adjacent understorey vegetation increased the volume of all seedlings by 13%, whether or not they were browsed. Vexar(R) tubing did not substantially affect seedling survival, browsing damage frequency, or fourth-year volume. Greater levels of overstorey retention reduced frequency of second flushing. Chafing by deer and girdling by rodents and other small

mammals began once seedlings surpassed 1 m in height. Essentially all grand fir seedlings exhibited a foliar fungus infection.

OSU Link
Non-OSU Link

17. Campbell, D.L. and J. Evans. 1988. Recent approaches to controlling mountain beavers (Aplodontia rufa) in Pacific Northwest forests. In Proceedings: Thirteenth
Vertebrate Pest Conference, Monterey, California. pp. 183-187.

Keywords: tree/stand protection
tree/stand health

Abstract: Investigations by the Denver Wildlife Research Center into ways of managing mountain beaver (Aplodontia rufa) populations are described. Methods were developed for alleviating mountain beaver damage to conifer trees being grown for timber in the Pacific Northwest. Studies initiated in 1986 indicated that aversive conditioning with Big Game Repellent Powder (BGR-P) dusted on culled Douglas fir (Pseudotsuga menziesii) seedlings placed in burrows significantly reduced mountain beaver damage to planted seedlings treated with BGR-P and to untreated seedlings. Trials also showed that strychnine-sword fern (Polystichum munitum) baits prepared with a 4.9% (active) strychnine paste concentrate were very effective and selective for mountain beaver control. Other topics discussed are the results of several probes with toxic baits and phosphine gas, trials with a drug (reserpine) and a wetting agent to induce hypothermia, and destruction of underground nests to prevent reinvasion.

OSU Link
Non-OSU Link

18. Campbell, S.J. and P.B. Hamm. 1989. Susceptibility of Pacific Northwest conifers to Phytophthora root rot. Tree Planters' Notes 40(1): 15-18.

Keywords: nursery operations
tree/stand protection
tree/stand health

Abstract: One-yr-old bare-rooted seedlings of 11 conifer species were inoculated with (a) Phytophthora cactorum, (b) P. cryptogea, (c) P. drechsleri, (d) P. megasperma or (e) P. pseudotsugae. Development of above-ground symptoms and root disease was followed for 10 wk. Isolates of (a), (b) and (e) caused the most overall mortality and isolates of (d) the least. Pinus contorta, P. ponderosa, P. monticola, Larix occidentalis, Libocedrus decurrens, Picea sitchensis and P. engelmannii showed tolerance to the root disease, Abies grandis and Pseudotsuga menziesii showed intermediate susceptibility and A. magnifica and Tsuga mertensiana were quite susceptible. Results are discussed in relation to management of conifer nurseries in the Pacific Northwest.

OSU Link
Non-OSU Link

19. Carroll, G.C. 1988. Facultative fungal egg-parasites as agents of gypsy moth mortality. Northwest-Environmental-Journal 4(2): 345-346.

Keywords: tree/stand protection
tree/stand health

Abstract: Research on entomogenous fungi attacking the forest pest Lymantria dispar in Oregon is summarized. The pathogenicity of 20 fungi was tested against eggs in the laboratory and Beauveria bassiana, Paecilomyces farinosus, Spicaria coccospora and Verticillium lecanii were shown to be consistently pathogenic. Preliminary studies showed that some of these fungi can invade and persist in bark of Douglas fir [Pseudotsuga menziesii] and oak [Quercus spp.], and subsequently infect egg masses on the bark.

OSU Link
Non-OSU Link

20. Chanway, C.P. 1997. Inoculation of tree roots with plant growth promoting soil bacteria: an emerging technology for reforestation. Forest-Science 43(1): 99-112.

Keywords: nursery operations
tree/stand protection
growth
tree/stand health
mycorrhizal response

Abstract: Results from studies performed with beneficial asymbiotic tree root associated bacteria are reviewed in this article in relation to the possible uses of such microorganisms for artificial forest regeneration. The review includes sections on plant growth promoting bacteria for pine (Pinus spp.), spruce (Picea spp.), Douglas fir (Pseudotsuga menziesii) and hemlock (Tsuga heterophylla). Seedling root systems are colonized heavily by asymbiotic soil bacteria, many of which have the potential to influence plant growth significantly. A heterogeneous group of these microorganisms is well known for their ability to colonize roots and stimulate growth of agricultural plant species, sometimes doubling seedling biomass accumulation only a few weeks after inoculation, but more usually resulting in less spectacular biomass gains (e.g., 15%-30% greater than uninoculated controls within a growing season). Plant growth promoting soil bacteria may exert such effects through a variety of mechanisms, and include microorganisms that stimulate seedling emergence or infection by symbiotic fungi and bacteria. Other plant beneficial soil bacteria possess biological control activity or are capable of transforming plants genetically. Inoculation of tree seedlings with such bacterial before outplanting would be an inexpensive, environmentally benign, and easily applied nursery treatment, but comparatively little work has been performed with these microorganisms in forestry. Recent results with various tree species, however, indicate that seedling performance can be significantly enhanced through bacterial inoculation of root systems: pine and spruce biomass increased 32%-49% 1 yr after inoculation and outplanting at a reforestation site. In addition, infection by desired species of ectomycorrhizal fungi can also be enhanced by inoculation with certain strains of root colonizing bacteria.

OSU Link
Non-OSU Link

21. Chastagner, G.A., R.S. Byther, J.D. MacDonald and E. Michaels. 1984. Impact of Swiss needle cast on postharvest hydration and needle retention of Douglas-fir Christmas trees. Plant-Disease 68(3): 192-195.

Keywords: tree/stand protection
tree/stand health
tree physiology

Abstract: Healthy Douglas-fir (Pseudotsuga menziesii) Christmas trees were compared with those infected by Phaeocryptopus gaeumannii for needle loss and dehydration after cutting. The presence of infected needles increased the rate of dehydration (as measured by changes in xylem water potential) of cut trees placed in water or left dry. Fungicide applications 1 yr before harvest significantly improved retention of 1-yr-old needles on trees displayed either wet or dry, whereas applications during the year of harvest made no difference in retention of either current-season or 1-yr-old needles.

OSU Link
Non-OSU Link

22. Colangeli, A.M., L. McAuley and J.N. Owens. 1990. Seasonal occurrence of potential ice-nucleating bacteria on Douglas fir foliage and seed cones. New-Forests 4(1): 55-61.

Keywords: seed orchard management
tree/stand protection
tree/stand health
reproduction

Abstract: Plant frost damage can involve interactions between certain surface bacteria and low temperatures. The bacteria contain glycoproteins, which can nucleate ice above -5 degrees C, thus making the plants on which they live more susceptible to freezing. Preliminary studies to determine if bacteria were present on Douglas fir (Pseudotsuga menziesii), and whether they exhibited ice-nucleating properties, are reported. Total bacteria and fluorescent Pseudomonas populations were monitored on buds, conelets and foliage of five trees in a Douglas fir seed orchard on Vancouver Island, Canada, in April 1986 and between October 1986 and May 1987, over periods that spanned two pollination seasons. Seasonal variation in bacterial numbers was observed, with highest numbers occurring in late winter and early spring. Bacterial populations active in ice nucleation were found. Bacterial numbers during pollination were higher in 1986 than in 1987. Conelet abortion at pollination was also higher in 1986 (55%) than in 1987 (11%). A relation may exist between bacterial populations and conelet abortion at pollination.

OSU Link
Non-OSU Link

23. Colangeli, A.M., J.N. Owens and S.J. Morris. 1989. Factors affecting cone and seed production in Douglas fir. BC Ministry of Forests FRDA-Report 057. 19 p.

Keywords: seed orchard management
tree/stand protection
reproduction

Abstract: Reduced seed yield in 1986 on 4 Pseudotsuga menziesii trees in a British Columbia seed orchard was associated with inadequate pollination, low pollen vigour or viability, embryo abortion, and early ovule abortion. A study of bacterial populations suggested that there may be a causal relationship between this factor and conelet abortion.

OSU Link
Non-OSU Link

24. Copes, D.L. 1999. Breeding graft-compatible Douglas-fir rootstocks (Pseudotsuga menziesii (MIRB.) FRANCO). Silvae-Genetica 48(3/4): 188-193.

Keywords: genetic tree improvement
tree grafting
tree/stand protection
growth
tree phenology
tree/stand health
genetic relationships

Abstract: A study encompassing 24 years was conducted to determine if a breeding programme could produce highly graft-compatible rootstocks for P. menziesii. A total of 27 trees of apparent high graft compatibility were selected and crossed to produce 226 control-pollinated families. Seedlings were grown, field planted and grafted with test scions. Graft unions from field tests were evaluated anatomically for internal symptoms of incompatibility. Average compatibility of progeny from the 226 crosses was 90.6%, compared with 65% in native populations. Breeding values were calculated for each parent by the best linear prediction (BLP) procedure. Average compatibility resulting from crossing among the top 10 parents was estimated by breeding values as 95.4%. Field-test results of progeny from 34 crosses among the 10 most compatible parents showed 96% compatibility. In addition to field-tests for graft compatibility, nursery tests of seedlings from 124 crosses were evaluated for second-year vegetative bud flush and seedling height. It was possible, while maintaining adequately high levels of graft compatibility, to breed both for resistance to spring frost damage and for increased seedling height.

OSU Link
Non-OSU Link

25. DeYoe, D.R., H.R. Holbo and K. Waddell. 1986. Seedling protection from heat stress between lifting and planting. Western-Journal-of-Applied-Forestry 1(4): 124-126.

Keywords: nursery operations
planting operations
tree/stand protection
tree/stand health

Abstract: Seven protective treatments were evaluated for preventing overheating of 2+0 Douglas fir seedlings in Kraft paper bags. Trials were conducted in May 1982 at Corvallis, Oregon on 3 clear days with max. air temp. of 78 degrees F and a hazy day with max. temp. 66 degrees . Seedlings were

returned to cold storage (35 degrees) overnight. Seedling temp. differed significantly between treatments. Unprotected seedlings (paper bag only) in full sun reached 89 degrees after 7 h. Green canvas caused increased heating rates and higher temp. (104 degrees after 7 h). A white sheet and a crinkled foil wrap performed no better than a paper bag alone. Canvas painted off-white reduced max. temp. to 80 degrees . Heavy shading (2% of full sun) and Mylar with white surface towards the sun were the most effective materials for preventing overheating (max. temp. 59-60 degrees). Mylar with the silver surface facing the sun was less effective (max. temp. 71 degrees).

OSU Link
Non-OSU Link

26. Donald, D.G.M. and D.G. Simpson. 1985. Shallow conditioning and late fertilizer application effects on the quality of conifer nursery stock in British Columbia. B.C.-Ministry-of-Forests Research-Note 99. viii + 36 p.

Keywords: nursery operations
nursery fertilization
tree/stand protection
tree morphology
tree/stand health
growth

Abstract: Eight trials on 2+0 stock of Picea engelmannii, P. glauca, P. sitchensis, Pinus contorta and Pseudotsuga menziesii (var. glauca and var. menziesii) in 4 nurseries were conducted to compare the effects of shallow conditioning (undercutting and wrenching at 10 cm deep) with those of the standard conditioning regime (undercutting and wrenching at 20 cm) on nursery performance, storage and field performance. The application of a complete NPK fertilizer 50 days before lifting was also evaluated. Shallow conditioning and late fertilizer application improved the root growth capacity at lifting, but could not replace cold exposure for hardening Pseudotsuga menziesii. Shallow conditioning had little effect on survival after planting and reduced initial ht. increment of all species. Application of fertilizer just before lifting improved the early growth of the trees without adversely affecting survival. Planting seedlings some 5 cm deeper than they stood in the nursery improved establishment.

OSU Link
Non-OSU Link

27. Dosskey, M.G., L. Boersma and R.G. Linderman. 1993. Effect of phosphorus fertilization on water stress in Douglas fir seedlings during soil drying. Plant-and-Soil 150(1): 33-39.

Keywords: fertilization
tree/stand protection
growth
tree physiology
photosynthesis

Abstract: A growth chamber experiment was conducted to determine if P fertilizing to enhance the P nutrition of otherwise N and P deficient Douglas fir (Pseudotsuga menziesii) seedlings reduces water

stress in the seedlings during drought periods. Seedlings were grown in pasteurized mineral soil under well watered conditions and fertilized periodically with a small amount of nutrient solution containing P at three levels: 0, 20, or 50 mg/litre. By age 6 months, leaf nutrient analysis indicated that N and P were deficient in control (0 mg P/litre) seedlings. The highest level of P fertilizer, which doubled leaf P concentration, did not affect plant biomass, suggesting that N deficiency was limiting growth. When these seedlings were subjected to drought, there was no effect of P fertilizing on leaf water potential or osmotic potential. Furthermore, P fertilized seedlings had lower stomatal conductance and net photosynthesis rate. These results indicate that enhanced P nutrition, in the presence of N deficiency, does not reduce water stress in Douglas fir seedlings during drought periods.

OSU Link
Non-OSU Link

28. Drew, A.P. 1983. Optimizing growth and development of 2-0 Douglas-fir seedlings by altering light intensity. Canadian-Journal-of-Forest-Research 13(3): 425-428.

Keywords: nursery operations
tree/stand protection
growth
tree morphology
carbon allocation

Abstract: Seedlings were grown outdoors in Michigan in pots under 71% of full light the first growing season and full light the second. Another group of seedlings was given full light continuously for 2 yr. At the end of the 1st year, seedlings given initial shade had grown larger in total wt. (root + shoot) than those grown under full light. With removal of shading, the larger plants began to allocate increased dry matter to root development relative to their shoots. By the end of 2 yr, shoot/root ratios for the 2 groups were no different, yet the plants shaded in their 1st year were significantly heavier (dry wt.) By proper use of shading during development, larger 2+0 planting stock with good root development may be produced. Such stock, grown without the use of costly fertilizer, may be better suited to regeneration of droughty sites in the Pacific Northwest USA than the usual 2+0 planting stock, nursery grown under full light.

OSU Link
Non-OSU Link

29. Driessche, R.v.-d. 1991a. Influence of container nursery regimes on drought resistance of seedlings following planting. I. Survival and growth. Canadian-Journal-of-Forest-Research 21(5): 555-565.

Keywords: nursery operations
tree/stand protection
growth
tree morphology
carbon allocation
tree/stand health

Abstract: In a 2 year study, Douglas fir (Pseudotsuga menziesii), lodgepole pine (Pinus contorta) and white spruce (Picea glauca) seedlings, grown in Styroblock containers in a container nursery from February to July 1988, were exposed to three temperatures and three levels of drought stress applied factorially during 18 July to 29 September 1988. Mean temperatures of 13, 16 and 20 degrees C were imposed in growth chambers, in a cooled plastic house, and in an ambient plastic house, respectively. Control, medium and severe levels of drought stress were imposed in a series of eight cycles, resulting in mean xylem pressure potentials of -0.32, -0.50 and -0.99 MPa, respectively. Seedlings were kept in the ambient plastic house until January 1989, when they were lifted and cold-stored until transplanting to covered 0.5-m deep sand beds, which provided hygric, mesic, and xeric conditions for testing all species and treatments. At the end of nursery growth, an increase in nursery temperature increased height and height : diameter ratio in all species and shoot:root dry weight ratio in Douglas fir and lodgepole pine. Increase in temperature also increased the number of seedlings with large well-formed buds in white spruce, but reduced the number in Douglas fir. Drought stress reduced height and dry weight in all species and bud length in lodgepole pine. After 9 weeks in sand beds, low nursery temperature increased survival (19% for lodgepole pine and white spruce grown in the xeric bed), except for Douglas fir grown in the xeric bed. Nursery drought stress also increased survival (16% for Douglas fir and lodgepole pine in the xeric bed), but had little effect on white spruce. Low temperature and drought stress treatments that increased survival also reduced height and dry weight of lodgepole pine and white spruce after one growing season in sand beds. Survival showed significant negative correlations with height, dry weight and height:diameter and shoot : root weight ratios. Low nursery temperature continued to affect growth 16 weeks after planting, increasing relative growth rate and allometric ratio (K) of Douglas fir and reducing K of white spruce.

OSU Link
Non-OSU Link

30. Driessche, R.v.-d. 1991b. Influence of container nursery regimes on drought resistance of seedlings following planting. II. Stomatal conductance, specific leaf area, and root growth capacity. Canadian-Journal-of-Forest-Research 21(5): 566-572.

Keywords: nursery operations
tree/stand protection
tree physiology
tree/stand health

Abstract: Seedlings of Douglas fir (Pseudotsuga menziesii), lodgepole pine (Pinus contorta) and white spruce (Picea glauca) were grown in a container nursery from February to July 1988 and then exposed to three temperatures and three levels of drought stress applied factorially during mid-July to October 1988. Seedlings were retained in a shelter house until January 1989, when they were cold-stored until early May. Measurements of stomatal conductance (gs), transpiration (E), and specific leaf area (SLA) were made at the end of the treatment period in September 1988 and again after growth the following year at the end of June. Root growth capacity (RGC) was tested in early May 1989. Results were considered in conjunction with performance of other samples of the same plants that had been planted in sand beds in April 1989, where irrigation was regulated to provide three levels of moisture stress. Low temperature (13 degrees C) generally reduced gs and E, which were adjusted for xylem pressure potential, and SLA, in all species by the time nursery treatment was completed at the end of September. No effect of nursery temperature treatment on gs or E could be detected when new needles were measured in June and July (after 9 to 12 weeks of growth), but SLA of lodgepole pine increased with

nursery temperature treatment, andSLA of white spruce decreased with treatment. RGC was higher for the 13 degrees C treatment than for the 16 and 20 degrees C treatments. Survival of outplanted seedlings was mainly inversely related to nursery temperature. Low nursery temperature reduced gs, E, andSLA and increased RGC. SLA of planted lodgepole pine increased with level of nursery drought treatment, and severe nursery drought increased gs under stress, when measured in June. No other effects of drought were detected, although drought treatment was effective in increasing survival of planted seedlings. It is suggested that other mechanisms, such as osmotic adjustment, were responsible for the results observed.

OSU Link
Non-OSU Link

31. Driessche, R.v.-d. 1992b. Changes in drought resistance and rootgrowth capacity of container seedlings in response to nursery drought, nitrogen, and potassium treatments. Canadian-Journal-of-Forest-Research 22(5):740-749.

Keywords: nursery operations
nursery fertilization
tree/stand protection
tree/stand health
growth
carbon allocation
tree physiology

Abstract: Douglas fir (Pseudotsuga menziesii), lodgepole pine (Pinus contorta), and white spruce (Picea glauca) seedlings, each represented by two seed lots, were grown in Styroblock containers in a greenhouse and plastic shelter house from February 1989 to January 1990. The seedlings were exposed to two N treatments (20 and 200 mg/litre) and three K treatments (5, 25 and 100 mg/litre) arranged factorially within three drought treatments. After winter storage, seedlings from a complete set of treatments were planted into hygric, mesic and xeric sand beds during 12-14 March. Increasing nursery drought stress increased survival of Douglas fir and lodgepole pine after planting, and high N treatment level increased survival of lodgepole pine and white spruce. Under xeric conditions, combined nursery drought and high N treatments increased survival of lodgepole pine by 33%, indicating the importance of nursery cultural regime for stock quality. Increase in nursery drought stress did not decrease seedling size by much; increase in N increased seedling size one season after planting. A positive relation between shoot : root ratio and survival in lodgepole pine and white spruce indicated that increase in N increased both shoot growth and drought resistance over the N range investigated. Only Douglas fir showed an interaction between drought and N treatment and a small response in both survival and dry weight to K application. Root growth capacity, measured at the time of planting, showed an approximate doubling in all species due to high N treatment, and was also increased in white spruce by drought stress. Survival and root growth capacity were poorly correlated, but dry-weight growth in sand beds was well correlated with root growth capacity. Shoot dry weight and percentage N in shoots measured after nursery growth were correlated with root growth capacity. Manipulation of root growth capacity by changing nursery treatment was possible without altering resistance to drought stress after planting.

OSU Link
Non-OSU Link

32. El Kassaby, Y.A., D.G.W. Edwards and C. Cook. 1990a. Impact of crop management practices on seed yield in a Douglas-fir seed orchard. Silvae-Genetica 39(5-6): 226-230.

Keywords: seed orchard management
tree/stand protection
reproduction
tree/stand health

Abstract: The impact of two crop-management practices, supplemental mass pollination (SMP) and overhead cooling, on seed yield in a 13-yr-old Douglas fir (Pseudotsuga menziesii) seed orchard was studied in Saanichton, British Columbia. A 2x2 factorial trial of SMP/no SMP and cooling/no cooling was applied. There were no significant differences in potential seed yield per cone, average number of successful fertilizations, and average number of filled seeds per cone between cooling or SMP treatments or combinations. Results indicated that within-orchard pollen cloud was not a factor limiting seed yield. Average number of seeds infested by the Douglas fir seed wasp (Megastigmus spermotrophus) larvae was significantly ($P<0.05$) less when cooling was applied, indicating that the treatment was effective in disrupting the synchrony between the presence of ovipositing females and developing cones.

OSU Link
Non-OSU Link

33. Entry, J.A., K. Cromack, Jr., R.G. Kelsey and N.E. Martin. 1991. Response of Douglas-fir to infection by Armillaria ostoyae after thinning or thinning plus fertilization. Phytopathology 81(6): 682-689.

Keywords: thinning
fertilization
tree/stand protection
growth
tree morphology
carbon allocation
tree/stand health
tree physiology

Abstract: Second-growth stands of Douglas-fir (Pseudotsuga menziesii) were thinned to a 5- x 5-m spacing (TT); additional plots were thinned and fertilized once with 360 kg of N (as urea)/ha (TF). An unthinned, unfertilized stand (UT) served as a control. Ten years after treatment, trees were inoculated with 2 isolates of A. ostoyae. Trees receiving the TF and TT treatments produced greater diameter growth, leaf area, and wood production/msuperscript 2 leaf area per year than did those under the UT treatment. Rates of infection by A. ostoyae were highest in trees that received the TF and lowest in trees that received the TT treatment. Concn of sugar, starch and cellulose in root bark tissue were highest in trees receiving the TF treatment and lowest in trees receiving TT treatment. Concn of lignin, phenolics and protein-precipitable tannins were highest in root bark from TT trees and lowest in root bark from TF trees. Biochemical parameters of root bark tissue were regressed with incidence of infection; coefficients of determination (rsuperscript 2) ranged from 0.07 (starch) to 0.57 (phenolic compounds). Ratios of the energetic costs of phenolic and of lignin degradation to the energy available from sugars (Epd:Eas and Eld:Eas) were correlated with incidence of infection (rsuperscript 2 = 0.77 and 0.70, respectively). It is concluded that thinning combined with fertilization may predispose P. menziesii trees

to infection by A. ostoyae by lowering concn of defensive compounds in root bark and increasing the energy available to the fungus to degrade them.

OSU Link
Non-OSU Link

34. Erickson, R.D. 1995. Douglas-fir tussock moth. *In* Forest Pest Leaflet 09. Pacific-Forestry-Centre,-Canadian-Forest-Service.

Keywords: tree/stand protection
tree/stand health

Abstract: The recognition, biology, host plants, injuriousness, distribution and control of the lymantriid Orgyia pseudotsugata, especially on Douglas fir (Pseudotsuga menziesii), in British Columbia are discussed. Natural controls, such as parasitoids, predators and a nuclear polyhedrosis virus, normally control endemic populations, and a list is provided of 3 species of parasitic Diptera and 17 Hymenoptera that have been reared from the lymantriid in British Columbia.

OSU Link
Non-OSU Link

35. Fashler, A.M.K. and Y.A. El-Kassaby. 1987. The effect of water spray cooling treatment on reproductive phenology in a Douglas-fir seed orchard. Silvae-Genetica 36(5-6): 245-249.

Keywords: genetic tree improvement
seed orchard management
tree/stand protection
genetic relationships
reproduction
tree/stand health

Abstract: The effectiveness of reproductive bud cooling on genetic efficiency in a Douglas fir seed orchard in British Columbia, Canada, was tested by comparing the reproductive bud phenology in 3 cooled and 3 uncooled years. The cooling system was found to affect 2 major elements affecting seed orchard genetic efficiency, namely pollen contamination levels and panmictic equilibrium, as well as insect infestation, frost damage, seed yield and management effectiveness. Based on these results, a permanent irrigation/cooling system isrecommended for Douglas fir seed orchards.

OSU Link
Non-OSU Link

36. Ferris, R.L. and H.A. Woensdregt. 1983. Western false hemlock looper in British Columbia. In Pest-Leaflet. Pacific-Forest-Research-Centre, Canada.

Keywords: tree/stand protection
tree/stand health

Abstract: The infestation history, hosts, distribution, appearance, life history, damage and control of Nepytia freemani are described.

OSU Link
Non-OSU Link

37. Filip, G.M. and L.M. Ganio. 2004. Early thinning in mixed-species plantations of Douglas-fir, hemlock, and true fir affected by Armillaria root disease in Westcentral Oregon and Washington: 20 year results. Western-Journal-of-Applied-Forestry 19(1): 25-33.

Keywords: thinning
precommercial thinning
tree/stand protection
growth
tree/stand health

Abstract: Four 10- to 20-year-old plantations were treated to determine the effects of precommercial thinning on tree growth and mortality caused by Armillaria root disease in the Cascade Range of western Oregon and Washington, USA. One plantation was Douglas-fir (Pseudotsuga menziesii) and noble fir (Abies procera), one Douglas-fir and western hemlock (Tsuga heterophylla), one Douglas-fir alone, and one Shasta red fir (Abies magnifica var. shastensis) and mountain hemlock (Tsuga mertensiana). After 20 years, differences in crop tree mortality between thinned and unthinned plots were not significant (P=0.9768). Quadratic mean diameter growth of crop trees, however, was significantly (P=0.0053) greater in thinned than in unthinned plots. Crop tree basal area/ac growth was significantly (P=0.0008) greater in thinned plots. There were no significant (P=0.6647) differences in basal area/ac growth of all trees between thinned and unthinned plots. Apparently, from a root-disease perspective, precommercial thinning does not affect incidence of crop-tree mortality after 20 years, but individual and per acre tree growth of crop trees increase significantly.

OSU Link
Non-OSU Link

38. Filip, G.M. and D.J. Goheen. 1995. Precommercial thinning in Pseudotsuga, Tsuga, and Abies stands affected by armillaria root disease: 10-year results. Canadian-Journal-of-Forest-Research 25(5): 817-823.

Keywords: thinning
precommercial thinning
tree/stand protection
growth
tree/stand health

Abstract: Four 10- to 20-year-old stands were pre-commercially thinned to determine the effects of thinning on tree growth and mortality caused by armillaria root disease (Armillaria ostoyae) in the Cascade Range of western Oregon and Washington, USA: one stand of Douglas fir (Pseudotsuga menziesii var. menziesii) and noble fir (Abies procera), one of Douglas fir and western hemlock (Tsuga heterophylla), one of Douglas fir alone, and one of Shasta red fir (Abies magnifica var. shastensis) and mountain hemlock (Tsuga mertensiana). After 10 years, differences in crop-tree mortality between

thinned and unthinned plots were not significant in any of the four stands. Tree radial growth was significantly increased by thinning in 6 of 15 plots. Crop-tree basal area (per hectare) growth was significantly greater in thinned plots. Basal area (per hectare) growth of all trees was significantly greater in unthinned plots. Apparently, from a root-disease perspective, pre-commercial thinning does not affect the incidence of crop-tree mortality after 10 years, but tree growth increases significantly.

OSU Link
Non-OSU Link

39. Fraser, R.G., J.D. Beale and R.J. Nevill. 1995. Reduction of Phellinus weirii inoculum in Douglas-fir stumps by the fumigant Telone II-B. Canadian-Journal-of-Forest-Research 25(1): 63-68.

Keywords: tree/stand protection
tree/stand health

Abstract: Two dosages of Telone II-B (1,3-dichloropropene) at 3.4 and 6.7 mL/kg of stump and root biomass were tested to determine the efficacy in reducing Phellinus weirii inoculum in infected Douglas fir (Pseudotsuga menziesii), stumps. After 21 months, both doses of Telone II-B proved equally effective and significantly reduced residual P. weirii mycelium in infected roots. Fumigation reduced residual endotrophic P. weirii in the large-diameter root classes nearest the stump, but survival of the fungus was less affected with increasing distance from the stump and in the smaller root diameter classes. Treated stumps also had significantly fewer roots with ectotrophic mycelium than untreated stumps. Four weeks after application, soil samples taken near treated stumps revealed no evidence of the fumigant. These findings suggest that application of Telone II-B could be used as an effective control measure for P. weirii.

OSU Link
Non-OSU Link

40. Gourley, M., M. Vomocil and M. Newton. 1990. Forest weeding reduces the effect of deer-browsing on Douglas fir. Forest-Ecology-and-Management 36(2-4): 177-185.

Keywords: release treatments
chemical release
tree/stand protection
growth
tree/stand health

Abstract: In January and February 1981, three-year-old bare-root Douglas fir (Pseudotsuga menziesii) transplants were established in four clear-felled locations in the Oregon Coast Range where browsing by black tail deer (Odocoileus hemionus columbiana) was expected. Protection was provided against browsing by 5 physical (rigid protection tube 7.5x75 cm; protective netting, paper budcaps; leather guard 20x5 cm; and 'Remae' budcaps) and one chemical ('Deer Away') treatment, each of which was tested with and without complete wood control with glyphosate. After five years, none of the protective treatments provided any growth advantages; some even caused growth losses. In contrast, weed control, with or without additional protective measures, consistently improved growth. By the 5th year, weeded trees averaged twice the biomass of unweeded trees, regardless of browsing. Average tree size

was largest in the treatment with no weed competition and with no barriers to prevent browsing. Advantages of weeding were greatest on the poorest site. Weed control, in conjunction with the large size of transplants, appeared to prevent most loss due to damage from moderate deer-browsing.

OSU Link
Non-OSU Link

41. Haase, D.L. and R. Rose. 1993. Soil moisture stress induces transplant shock in stored and unstored 2+0 Douglas-fir seedlings of varying root volumes. Forest-Science 39(2): 275-294.

Keywords: nursery operations
tree/stand protection
growth
tree morphology

Abstract: Transplant stock was induced by applying a range of soil water contents (6, 12, 18 or 24%) to unstored and cold-stored 2-yr-old (2 + 0) bareroot Douglas fir (Pseudotsuga menziesii) seedlings graded by root volume. Moisture stress had the greatest influence on morphological characteristics that express transplant shock. Seedling terminal shoot growth, stem diameter growth, and needle length increased with increased soil moisture content. In addition, number of needles per centimeter on the terminal shoot greatly increased with increasing drought stress. Under high drought stress, seedlings with relatively high root volumes tended to exhibit reduced early growth, but later showed significantly increased overall growth regardless of soil water content. In every case, seedlings grown in the driest soil had the lowest dry weight components. Similarly, seedlings with the smallest initial root volumes had the lowest dry weights, and those with the largest root volumes had the greatest dry weights. The results indicate that drought stress is a cause of transplant shock, and that increased seedling root volume may enable seedlings to avoid shock following outplanting to a specific site.

OSU Link
Non-OSU Link

42. Haase, D.L. and R. Rose. 1994. Effects of soil water content and initial root volume on the nutrient status of 2+0 Douglas-fir seedlings. New-Forests 8(3): 265-277.

Keywords: nursery operations
tree/stand protection
tree physiology
growth
tree morphology

Abstract: Two-year-old bareroot Douglas fir (Pseudotsuga menziesii) seedlings from a NW Oregon provenance were graded on the basis of four root-volume categories - 5 to 8, 9 to 10, 11 to 13, and 14 to 20 cmsuperscript 3 - and transplanted into pots and subjected to one of four moisture-stress treatments (6, 12, 18, and 24% soil water content) for 16 weeks. Macronutrient concentrations and contents of both old (i.e. nursery-grown) and new (i.e. grown during moisture stress treatment) foliar tissue were determined. A reduction in soil water content resulted in high concn of phosphorus, potassium, and particularly nitrogen in both old and new foliar tissue. This was attributed to reduced growth,

translocation, metabolic activity, and nutrient requirement in response to moisture stress. Seedlings with relatively greater root volumes exhibited higher nutrient concn and contents, as well as increased growth. Thus, increased total root biomass per unit of soil area with increasing seedling root volume may have resulted in greater nutrient use, supply, uptake, and storage. It is suggested that relations between initial root volume and water stress can be applied to nursery cultural practices in order to increase seedling adaptation to a specific stress.

OSU Link
Non-OSU Link

43. 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

44. Hadfield, J.S. and P.T. Flanagan. 2000. Dwarf mistletoe pruning may induce Douglas-fir beetle attacks. Western-Journal-of-Applied-Forestry 15(1): 34-36.

Keywords: tree/stand protection
tree/stand health

Abstract: Fresh attacks by Douglas fir beetles (Dendroctonus pseudotsugae) to Douglas fir (Pseudotsuga menziesii) trees growing in a camp site in Wenatchee National Forest, central Washington, USA, were found following pruning to remove dwarf mistletoe (Arceuthobium douglasii) infections. All Douglas fir trees with a diameter at breast height (dbh) of at least 12.7 cm were examined. Beetle attacks were found on 41% of pruned trees and 5% of unpruned trees. Among pruned trees, both the average number of branches pruned and the average dbh were greater in trees attacked by Douglas fir beetles than in unattacked trees.

OSU Link
Non-OSU Link

45. Haglund, W.A., K.W. Russell and R.C. Holland. 1981. Moss control in container-grown conifer seedlings. Tree-Planters' Notes 32(3): 27-29.

Keywords: nursery operations
tree/stand protection
tree/stand health

Abstract: Seedlings grown in styroblock containers were sprayed with 8 surfactants, or combinations of surfactant and the fungicide captan. Phytotoxicity and moss control were recorded 7 and 14 days after treatment and trees were measured after 30-60 days. The least phytotoxic surfactant was X77; this had no significant effect on ht., stem diam. and total wt. of Pseudotsuga menziesii or Tsuga heterophylla seedlings. Almost complete moss control was achieved with 40-80 lb captan and 2.5-10 gal X77 in 100 gal water applied to Abies procera seedlings; treatment with the highest concn. (80 lb captan and 10 gal X77) was only phytotoxic when the seedlings already had foliar injury. In Tsuga heterophylla treatment with captan and X77 at various concn. caused tree injury only at 80-90 degrees F, but not at 60-65 degrees F.

OSU Link
Non-OSU Link

46. 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

47. 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

48. Hamm, P.B., S.J. Cooley and E.M. Hansen. 1984. Response of Phytophthora spp. to metalaxyl in forest tree nurseries in the Pacific Northwest. Plant-Disease 68(8): 671-673.

Keywords: nursery operations
tree/stand protection
tree/stand health

Abstract: In tests on Douglas fir (Pseudotsuga menziesii) at 2 commercial forest tree nurseries in Ore., 1 application of Subdue (metalaxyl) suppressed root rot. Of 3 P. spp. isolated from treated seedlings (P. megasperma, P. drechsleri and P. pseudotsugae), only P. pseudotsugae decreased in isolation frequency because of the fungicide. Survival of P. spp. in infected seedlings remained high after treatment. At 1 nursery, 10 months after the first application, P. spp. were isolated from 92% of the seedlings across fungicide treatments, whereas at the 2nd isolation frequencies from seedlings were 77, 70, 29 and 13%, respectively, after 0, 1, 2 and 3 applications. P. was recovered from previously healthy seedlings 8 wk after they were transplanted into naturally infested, metalaxyl-treated soil.

OSU Link
Non-OSU Link

49. Hansen, E.M., J.K. Stone, B.R. Capitano, P. Rosso, W. Sutton, L. Winton, A. Kanaskie and M.G. McWilliams. 2000. Incidence and impact of Swiss needle cast in forest plantations of Douglas-fir in coastal Oregon. Plant-Disease 84(7): 773-778.

Keywords: tree/stand protection
growth
tree/stand health

Abstract: An epidemic of Swiss needle cast, caused by the ascomycete Phaeocryptopus gaeumannii, is causing defoliation and growth reductions in Douglas-fir forest plantations along the Oregon Coast. The area of symptomatic plantations has been monitored annually since 1996 by aerial survey; in spring 1999, 119,500 ha were affected. Pathogen and symptom development have also been monitored on nine permanent plots in stands of differing disease severity. Infection levels and symptom severity are greatest in low elevation plantations close to the coast. In areas of severe disease, trees retain only current year needles. Defoliation is proportional to the number of stomata occluded by pseudothecia of the fungus, with needles being shed when about 50% of stomata are occupied, regardless of needle age. Fungus sporulation and premature needle abscission are greatest on the upper branches of trees. Annual application of fungicides increases needle retention significantly. Tree height and diameter growth and total tree volume are reduced by disease, and tree volume is significantly correlated with needle retention on our plot trees. The epidemic continues to be most severe in Douglas-fir plantations established on sites where Sitka spruce and western hemlock or red alder predominated in earlier times.

OSU Link
Non-OSU Link

50. Harper, P.A. and A.S. Harestad. 1986. Vole damage to coniferous trees on Texada Island. Forestry-Chronicle 62(5): 429-432.

Keywords: thinning
precommercial thinning
tree/stand protection
tree/stand health
growth

Abstract: Microtus townsendii injured trees by removal of bark and cambium from stems, branches and roots of Douglas fir, western hemlock and, rarely, Pinus monticola on Texada Island, British Columbia. Damage occurred more frequently in precommercially thinned stands <40 yr old than in unspaced stands. Trees with d.b.h. <less or =>19 cm were damaged by voles, but there was no selection by diam. or age class. No trees of ht. >16 m were damaged. For trees <16 m, damage increased as ht. decreased. There were n.s.d. in growth rates of trees damaged by voles when comparing the 2-yr av. before spacing and vole damage with the av. after these events. Stands should continue to be monitored to evaluate long-term effects of vole damage. On the basis of these results, control of voles is not recommended.

OSU Link
Non-OSU Link

51. Hedlin, A.F., J. Weatherston, D.S. Ruth and G.E. Miller. 1983. Chemical lure for male Douglas-fir cone moth, Barbara colfaxiana (Lepidoptera: Olethreutidae). Environmental-Entomology 12(6): 1751-1753.

Keywords: tree/stand protection
stand conditions

Abstract: Field trapping in British Columbia indicated that males of Barbara colfaxiana (Kearfott), the larvae of which feed in the cones of Pseudotsuga menziesii and damage the seeds, were attracted to mixtures of (Z)-9-dodecen-1-ol and (Z)-9-dodecenyl acetate. Most blends of these compounds were attractive to some extent, but blends containing 15 to 50% acetate were the most consistently attractive.

OSU Link
Non-OSU Link

52. Helgerson, O.T. 1990a. Effects of alternate types of microsite shade on survival of planted Douglas-fir in southwest Oregon. New-Forests 3(4): 327-332.

Keywords: planting operations
tree/stand protection
tree/stand health
growth

Abstract: Five-yr survival of 2+0 bare root Douglas fir (Pseudotsuga menziesii) seedlings was increased by 3 types of shading: cardboard shadecards placed S. or E. of seedlings; and bottomless styrofoam cups inverted around seedling base, on 2 S.-facing sites. On the drier site, seedlings survived well without shading (89% unshaded, 98% shaded), but on the wetter site, where seedlings were more stressed, shading was more beneficial (62% unshaded, 89% shaded). Shading did not affect growth. Seedlings grew more in 5 yr on the drier than the wetter site, possibly because of better handling and planting practices, less browsing by deer, and better weed control.

OSU Link
Non-OSU Link

53. Helgerson, O.T., S.D. Tesch, S.D. Hobbs and D.H. McNabb. 1992. Effects of stocktype, shading, and species on reforestation of a droughty site in southwest Oregon. Northwest-Science 66(2): 57-61.

Keywords: nursery operations
planting operations
tree/stand protection
tree/stand health
growth

Abstract: On hot, dry sites, shading may differentially increase survival of planted Douglas fir (Pseudotsuga menziesii) according to seedling size, and Douglas fir may differ from ponderosa pine (Pinus ponderosa) in early survival and growth. The survival and growth of Douglas fir seedlings (1+0 container-grown plugs and 2+0 bare-rooted seedlings, unshaded or shaded with cardboard shadecards

at planting) and unshaded 2+0 bare-rooted ponderosa pine were compared on a droughty south facing clear felling in Oregon. The site was clear felled and burned in 1982 and the seedlings were planted in 1983. Shading did not significantly increase survival of plugs, possibly because of a wetter than normal first summer, nor did shading affect growth of either Douglas fir stocktype 5 yr after planting. Bare-rooted Douglas fir remained significantly larger than plugs, but relative growth rates for the initially smaller plugs were significantly greater for diameter and volume. Survival and growth of ponderosa pine tended to be better than those of Douglas fir. It was concluded that both species appeared to be suitable for reforestation after clear felling on sites subject to drought.

OSU Link
Non-OSU Link

54. Hermann, R.K. and D.P. Lavender. 1999. Douglas-fir planted forests. New-Forests 17(1/3): 53-70.

Keywords: genetic tree improvement
nursery operations
planting operations
site preparation
release treatments
fertilization
thinning
pruning
tree/stand protection
growth
yield

Abstract: A combination of superior wood quality and high productivity has made Douglas fir (Pseudotsuga menziesii) one of the premier timber trees in the world. As such, it is grown as a plantation species in several countries in Europe and South America, and in New Zealand and Australia, as well as throughout its extensive natural range in western North America. Decades of experience with the silviculture of young stands have demonstrated that practices such as planting, the use of genetically improved seedlings, precommercial and commercial thinning, and fertilizing may dramatically increase the yield of industrial products over that of natural forests. Further, such silviculture is compatible with the production of desired amenities. Vigorous implementation of such practices wherever Douglas fir is cultivated will increase the world's timber resources, and be an effective strategy for reducing the pressure, occasioned by the world's rapidly increasing population, to harvest the fragile tropical and boreal forests.

OSU Link
Non-OSU Link

55. Hessburg, P.F., D.J. Goheen and H. Koester. 2001. Association of black stain root disease with roads, skid trails, and precommercial thinning in Southwest Oregon. Western-Journal-of-Applied-Forestry 16(3): 127-135.

Keywords: thinning
precommercial thinning

tree/stand protection
tree/stand health

Abstract: The incidence and severity of black stain root disease (BSRD), caused by Leptographium wageneri, were evaluated in a two-stage sample of 500 precommercial-aged Douglas-fir (Pseudotsuga menziesii) plantations on 5 Resource Areas of the Medford District, Bureau of Land Management in Oregon, USA. Black stain was widely distributed throughout the western half of the District. Nearly 19% of the susceptible-aged (10- to 30-year-old) plantations were infected with black stain, but mortality losses were low. In both the extensive and intensive surveys, BSRD was more often distributed in precommercially thinned than unthinned plantations. Black stain occurred with significantly greater frequency adjacent to roads and major skid trails than in the main body of plantations. Roadside strips displayed significantly more injured trees and recent soil disturbance than the main body of plantations. BSRD incidence was high in comparison with other root diseases, but there was minimal impact to precommercial stand management. Low disease severity is somewhat unique among managed forests within this area of known high BSRD hazard. The lack of widespread damage from BSRD was associated with a lack of extensive tractor yarding and an apparent lack of precommercial thinning. Forest managers within high BSRD hazard areas can maintain low mortality levels by minimizing site disturbance and tree injury associated with timber harvesting, road building, and road maintenance activities and by timing precommercial thinning to avoid vector insect emergence and flight periods. Increased disturbance and injury to precommercial-aged stands will likely result in increased disease.

OSU Link
Non-OSU Link

56. Hildebrand, D.M., J.K. Stone, R.L. James and S.J. Frankel. 2004. Alternatives to preplant soil fumigation for Western forest nurseries. Pacific-Northwest-Research-Station,-USDA-Forest-Service General-Technical-Report PNW-GTR-608. ii + 27 p.

Keywords: nursery operations
nursery fertilization
tree/stand protection
tree/stand health
growth

Abstract: Field trials were conducted at six bare-root forest tree (Pinus ponderosa, Pseudotsuga menziesii, Pinus contorta and Abies magnifica var. shastensis) nurseries in the Western United States: Bend Pine Nursery in Bend and J. Herbert Stone Nursery in Central Point (Oregon), Coeur d'Alene Nursery and Lucky Peak Nursery in Idaho, and Humboldt Nursery near McKinleyville and Placerville Nursery near Camino (California). These field experiments compared cultural treatments including timing and depth of sowing; bare fallow (with and without periodic tilling); organic amendments including sawdust, composts, and cover crops; mulches including pine needles, sawdust, and rice straw; and fumigation with methyl bromide/chloropicrin or dazomet. Measured effects included population levels of potential soil-borne pathogens (species of Fusarium and Pythium), disease incidence, seedbed density, and sizes of conifer seedlings. Several non-fumigation treatments resulted in production of seedlings with densities and sizes similar to or better than those produced in beds treated with chemical fumigation. Results varied within the nurseries depending on conifer species, field history, and disease presence. Beneficial cultural practices included: (1) incorporation of slowly decomposing organic soil

amendments, e.g., aged sawdust with additional nitrogen provided later to seedlings; (2) bare fallowing with periodic tilling, and bare fallowing without periodic tilling plus supplemental weed control; and (3) sowing of conifer seed earlier and more shallow than sown conventionally, and covering seed with a nonsoil mulch such as aged sawdust or hydromulch.

OSU Link
Non-OSU Link

57. Hulme, M.A. and G.E. Miller. 1988. Potential for control of Barbara colfaxiana (Kearfott): (Lepidoptera: Olethreutidae) using Trichogramma sp. Colloques de l'INRA (43): 483-488.

Keywords: tree/stand protection
stand conditions

Abstract: The efficacy of Trichogramma minutum for the control of the tortricid Barbara colfaxiana on Pseudotsuga menziesii was assessed. T. minutum was obtained from the tortricid Choristoneura fumiferana in Ontario and reared through over 30 laboratory generations in eggs of the gelechiid Sitotroga cerealella. B. colfaxiana eggs were readily parasitized at 25 degrees C. About 3 million parasitized eggs glued to 100 cards were suspended throughout 19 trees (height 4 to 8 m) in British Columbia. Daytime shade temperatures during the following week peaked at 15-20 degrees C. After 1 day, 6% of the parasitoids had emerged. After 5 days, 54% of sampled parasitized S. cerealella eggs had emergence holes, but eggs on half the cards had been eaten by formicids. Of the B. colfaxiana eggs sampled, 2-4%were parasitized by T. minutum, regardless of whether samples were on the same branch as the cards or on remote branches. It is concluded that T. minutum can parasitize B. colfaxiana in the field and that Trichogramma species which are adapted to B. colfaxiana at temperatures of 15-20 degrees C are needed.

58. Humphreys, N. 1995. Douglas-fir beetle in British Columbia. In Forest-Pest-Leaflet 14. Pacific-Forestry-Centre,-Canadian-Forest-Service.

Keywords: tree/stand protection
tree/stand health
stand conditions

Abstract: Notes are provided on the recognition, detection, biology, injuriousness and control of the scolytid Dendroctonus pseudotsugae on Douglas fir (Pseudotsuga menziesii) (and occasionally western larch (Larix occidentalis)) in British Columbia. The damage caused is described under the headings gallery system; effect on the tree; host susceptibility and attack pattern; association with root disease (including Armillaria ostoyae, Phaeolus schweinitzii and Phellinus weirii); and defoliation (by Choristoneura occidentalis and Orgyia pseudotsugata). Control of D. pseudotsugae is discussed under the headings preventive measures (including log and slash disposal, general logging practices), remedial measures (which include the use of trap trees and pheromones) and brood destruction (by burning and similar measures).

OSU Link
Non-OSU Link

59. Ingham, E.R. and W.G. Thies. 1997. Changes in rhizosphere microflora and microfauna 10 years following Douglas-fir live tree injection with chloropicrin or methylisothiocyanate. Canadian-Journal-of-Forest-Research 27(5): 724-731.

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

Abstract: Pseudotsuga menziesii trees in a stand near Apiary, Oregon, were injected in 1981 (age 47 years) with chloropicrin or methylisothiocyanate (MITC) in an effort to control laminated root rot caused by Phellinus weirii. Soil samples were collected in 1991 from around structural roots 0.5, 1 and 2 m from the base of injected or non-injected trees. The activity of fungi and bacteria, total fungal and bacterial biomass, the number of protozoa (flagellates, ciliates, and amoebae), and the number and types of nematodes were evaluated. Active fungal biomass was reduced by both chemicals as compared with non-injected trees 10 years after application. Both active and total bacterial biomass were also significantly lower around roots of chloropicrin- and MITC-treated trees, as were flagellate numbers. The number of bacterial-feeding nematodes was decreased around roots of chloropicrin-treated trees, while other nematode-feeding groups were not changed. The number of root-feeding, bacterial-feeding and fungal-feeding nematodes were significantly greater around MITC-treated roots, while predatory nematode numbers were lower, than around control roots. Reduced bacterial and fungal biomass around MITC-treated trees may be the result, therefore, of increased feeding by nematodes, and thus MITC-treated trees may benefit from more rapid nutrient-cycling rates but may suffer more pest damage from root-feeding nematodes as a result of the chemical application. Since many organism groups were reduced around roots of chloropicrin- and MITC-treated trees, this suggested possible impacts related to reductions in nutrient cycling rates and production of plant-available N around these trees.

OSU Link
Non-OSU Link

60. Jermstad, K.D., D.L. Bassoni, N.C. Wheeler, T.S. Anekonda, S.N. Aitken, W.T. Adams and D.B. Neale. 2001b. Mapping of quantitative trait loci controlling adaptive traits in coastal Douglas-fir. II. Spring and fall cold-hardiness. Theoretical-and-Applied-Genetics 102(8): 1152-1158.

Keywords: genetic tree improvement
tree/stand protection
genetic relationships
tree physiology
tree phenology

Abstract: Quantitative trait loci (QTLs) affecting fall and spring cold hardiness (cold resistance) were identified in a three-generation outbred pedigree of coastal Douglas-fir (Pseudotsuga meniziesii var. menziesii [Pseudotsuga menziesii]) in a field experiment conducted in Washington and Oregon, USA, during 1996-97. Eleven QTLs controlling fall cold hardiness were detected on four linkage groups, and 15 QTLs controlling spring cold hardiness were detected on four linkage groups. Only one linkage group contained QTLs for both spring and fall cold hardiness, and these QTLs tended to map in close proximity to one another. Several QTLs were associated with hardiness in all three shoot tissues assayed in the spring, supporting previous reports that there is synchronization of plant tissues during de-

acclimatization. For fall cold hardiness, co-location of QTLs was not observed for the different tissues assayed, which was consistent with previous reports of less synchronization of hardening in the fall. In several cases, QTLs for spring or fall cold hardiness mapped to the same location as QTLs controlling spring bud flush. QTL estimations, relative magnitudes of heritabilities, and genetic correlations based on clonal data in this single full-sib family, supports conclusions about the genetic control and relationships among cold hardiness traits observed in population samples of Douglas-fir in previous studies.

OSU Link
Non-OSU Link

61. Johnson, D.R., G.P. Markin, R.C. Reardon and W.K. Randall. 1984. Injecting Metasystox-R at three spacing intervals to improve seed yield in Douglas-fir. Journal-of-Economic-Entomology 77(5): 1320-1322.

Keywords: tree/stand protection
reproduction

Abstract: Injecting oxydemeton-methyl into Douglas firs (Pseudotsuga menziesii) using the Mauget Inject-A-Cide technique at 3 spacing intervals in studies in western Oregon in 1982 significantly reduced populations of Contarinia oregonensis and increased filled seed yield when compared with untreated controls. Injectors were placed at intervals of 5, 10 or 15 cm of circumference at breast height and delivered 0.1 g a.i./cm of circumference. The results did not differ among the treatments.

OSU Link
Non-OSU Link

62. Johnson, G.R. 2002. Genetic variation in tolerance of Douglas fir to Swiss needle cast as assessed by symptom expression. Silvae-Genetica 51(2/3): 80-86.

Keywords: genetic tree improvement
tree/stand protection
tree/stand health
growth
genetic relationships

Abstract: The incidence of Swiss needle cast (caused by Phaeocryptopus gaeumannii) on Douglas fir (Pseudotsuga menziesii) has increased significantly in recent years on the Oregon coast. Genetic variation in symptoms of disease infection, as measured by foliage traits, was assessed in two series of progeny trials to determine whether these "crown health" indicators were under genetic control and correlated with tolerance (tolerance being continued growth in the presence of high disease pressure). Foliage traits generally had lower heritabilities than growth traits and were usually correlated with diameter growth. Foliage traits of crown density and colour appeared to be reasonable indicators of disease tolerance. In the absence of basal area data, assessing crown density and colour can help screen for families that show tolerance to the disease.

OSU Link
Non-OSU Link

63. Kamm, J.A., P.D. Morgan, D.L. Overhulser, L.M. McDonough, M. Triebwasser and L.N. Kline. 1983. Management practices for cranberry girdler (Lepidoptera: Pyralidae) in Douglas-fir nursery stock. Journal-of-Economic-Entomology 76(4): 923-926.

Keywords: nursery operations
tree/stand protection
tree/stand health

Abstract: Chrysoteuchia topiaria (Zell.), a known pest of grasses and cranberries, was shown in field-plot studies in Oregon and Washington State in 1980-81 to be a pest of seedlings of Douglas fir (Pseudotsuga menziesii) grown in nurseries. The pyralid was capable of reproduction in nursery beds where feeding larvae partially or completely girdled the taproot of seedlings. Pheromone-trap collections indicated that grasslands bordering nurseries and not nursery beds were the primary source of adults. In addition to Douglas fir, several species of true fir were damaged by larvae, but no feeding damage was observed on pine, cedar, hemlock or spruce. Insecticides applied to control adults and larvae effectively reduced the incidence of damage. It was suggested that, when possible, a pest management programme should include grasslands bordering the nursery, control of weeds and the use of a non-food-plant cover crop in the nursery.

OSU Link
Non-OSU Link

64. Kastner, W.W., Jr., S.M. Dutton and D.M. Roche. 2001. Effects of Swiss needle cast on three Douglas-fir seed sources on a low-elevation site in the northern Oregon Coast Range: results after five growing seasons. Western-Journal-of-Applied-Forestry 16(1): 31-34.

Keywords: genetic tree improvement
tree/stand protection
growth
tree/stand health

Abstract: Douglas-fir (Pseudotsuga menziesii var. menziesii) seedlings grown from three seed sources were evaluated for 5 years for their relative tolerance to Swiss needle cast (caused by the ascomycete Phaeoxryptopus gaeumannii), on a high-disease-hazard site located approximately 3 miles northeast of Tillamook, Oregon, USA. The seed sources were: (1) seed collected from trees showing an apparent degree of tolerance to Swiss needle cast in natural stands in the coastal fog belt, (2) open-pollinated seed orchard seed collected from random single-pair crosses of parent trees in natural stands outside of the coastal fog belt, but west of the Oregon Coast Range summit, whose progeny demonstrated an apparent degree of disease tolerance in coastal Douglas-fir progeny test sites, and (3) standard reforestation seed purchased from a commercial vendor. There were no significant differences among seed sources in basal diameter and total height for all five growing seasons. Needle retention varied among seed sources over the 5-year period, but current-year needle retention did not vary significantly after the fifth growing season, and retention of 1- and 2-year-old needles was relatively low for all seed

sources. The intense disease pressure on this site may have overwhelmed expression of disease tolerance among seed sources. We do not recommend planting Douglas-fir on such high-hazard sites.

OSU Link
Non-OSU Link

65. Kimball, B.A., G.R. Johnson, D.L. Nolte and D.L. Griffin. 1999. An examination of the genetic control of Douglas-fir vascular tissue phytochemicals: implications for black bear foraging. Forest-Ecology-and-Management 123(2/3): 245-251.

Keywords: genetic tree improvement
tree/stand protection
growth
tree physiology
genetic relationships

Abstract: Silvicultural practices can influence black bear (Ursus americanus) foraging preferences for Douglas fir (Pseudotsuga menziesii) cambial-zone vascular tissues, but little is known about the role of genetics. To study the impact of genetic selection, vascular tissue samples were collected from Douglas fir trees in 6 half-sib families from 5 different sites in north central Oregon. Four replications of 3-tree non-contiguous plots were sampled at each site to examine inter-and intra-site variation. Tree growth was measured as tree diameter at breast height, and the absolute concentrations of 26 different terpenoids were determined by gas chromatography/flame ionization detection from ethyl acetate extracts. The simple carbohydrates fructose, glucose, and sucrose, and the phenolic glycoside coniferin were quantified using anion-exchange chromatography with pulsed amperometric detection. Cluster analysis was used to reduce the number of variables used in analyses of variance. Results for the families studied here indicate that tree growth and some terpenoids were under some level of genetic control. Furthermore, allocation of constitutive terpenoids in vascular tissues was not at the expense of tree growth. The sugars present in vascular tissue were affected by environment (site) and genetics (family) and their interaction.

OSU Link
Non-OSU Link

66. Kimball, B.A., D.L. Nolte, D.L. Griffin, S.M. Dutton and S. Ferguson. 1998a. Impacts of live canopy pruning on the chemical constituents of Douglas-fir vascular tissues: implications for black bear tree selection. Forest-Ecology-and-Management 109(1/3): 51-56.

Keywords: pruning
tree/stand protection
growth
tree physiology
tree/stand health

Abstract: The impact of live canopy pruning (removal of all live and dead whorls between the ground and 5 m height, resulting in removal of ~40% of the live canopy) on the carbohydrate and terpene content of vascular tissue was investigated in the lower bole of Douglas fir (Pseudotsuga menziesii) on 4

sites in NW Oregon. Cambial zone vascular tissue samples were collected from pruned and unpruned trees in the lower bole and within the live canopy. Current year's radial growth was estimated from the mass of vascular tissue removed from the 800 cmsuperscript 2 area sampled from each tree. Chemical analyses were conducted to determine the concentration of carbohydrates and terpenes in the samples. Results indicated that 2 yr following treatment, pruning resulted in reduced growth and decreased carbohydrate content of the vascular tissue. Pruning had no effect on the terpene concentration of the vascular tissue. The impact of pruning on the foraging selection of black bears (Ursus americanus) was evaluated by surveying bear damaged trees in a 50 acre stand of pruned and unpruned timber. Odds ratios indicate that black bears were 4 times more likely to forage unpruned than pruned Douglas fir. Tree selection may be explained in part by the higher availability of carbohydrates in the unpruned tree with respect to the pruned tree.

OSU Link
Non-OSU Link

67. Kimball, B.A., E.C. Turnblom, D.L. Nolte, D.L. Griffin and R.M. Engeman. 1998b. Effects of thinning and nitrogen fertilization on sugars and terpenes in Douglas-fir vascular tissues: implications for black bear foraging. Forest-Science 44(4): 599-602.

Keywords: fertilization
thinning
tree/stand protection
tree physiology
tree/stand health

Abstract: Analyses of vascular tissue samples from Douglas fir (Pseudotsuga menziesii) trees collected in test plots in W. Washington and NW Oregon, USA, showed that both thinning and N fertilizer application caused the sugar concentration of vascular tissues in the lower bole to increase. However, these treatments had no effect on the concentrations of hydrocarbon monoterpenes, oxygenated monoterpenes or sesquiterpenes. These results may explain the observations that black bears (Ursus americanus) prefer to forage in thinned and fertilized stands, as the bears maximize sugar intake and minimize terpene intake while foraging.

OSU Link
Non-OSU Link

68. Knowe, S.A. and W.I. Stein. 1995. Predicting the effects of site preparation and protection on development of young Douglas-fir plantations. Canadian-Journal-of-Forest-Research 25(9): 1538-1547.

Keywords: site preparation
release treatments
tree/stand protection
growth
tree morphology
tree/stand health
stand conditions

Abstract: Diameter prediction models based on the Weibull distribution function and stand-table projection models based on changes in relative diameter were developed for 2- to 10-year-old Douglas fir (Pseudotsuga menziesii) plantations in Oregon. Both modelling approaches incorporated the effects of site preparation, animal protection, and competing vegetation. The diameter distribution approach is appropriate when information on initial diameters is not available. The stand-table projection approach may be applied when tree diameters in a plantation are measured two or more growing seasons after planting. At young ages, the stand-table approach provided more accurate representation of observed diameter distributions than the diameter distribution approach. At age 10 the two methods provided comparable diameter distributions. The equations derived for predicting survival, height growth of dominant trees, height-diameter relationships, and the development of woody vegetation over time will facilitate the study and comparison of stand structure and dynamics after various site-preparation and animal protection treatments.

OSU Link
Non-OSU Link

69. Koerber, T.W. and G.P. Markin. 1984. Metasystox-RReg. injections increase seed yield of Douglas-fir in California, Oregon, and Washington. *In* Proceedings of the cone and seed insects working party conference, Working Party S20701, Southeastern Forest Experiment Station, Asheville, NC. *Ed.* H. Yates, III. pp. 137-146.

Keywords: tree/stand protection
tree/stand health
reproduction

Abstract: Injections of 1.5 g for each 15 cm of tree girth reduced seed damage caused by Contarinia oregonensis and Barbara colfaxiana, but not that by Megastigmus spermatrophus [M. spermotrophus]. On sites with insect populations high enough to cause substantial seed losses, treatment increased seed yield per cone by 38-162%.

OSU Link
Non-OSU Link

70. Lindsey, G.D. and J. Evans. 1983. Evaluation of zinc phosphide for control of pocket gophers on Christmas tree plantations. Tree-Planters' Notes 34(2): 11-14.

Keywords: tree/stand protection
tree/stand health
stand conditions

Abstract: In laboratory tests, pocket gophers (Thomomys and Geomys spp.) were offered 5 kinds of treated bait, including 1% Zn phosphide in oats, 0.75% Zn phosphide in fresh carrots, and 0.5% strychnine in rolled oats (3 mixtures). The carrot bait was found to be as effective for killing gophers as the strychnine mixtures. Plots in a 4-yr-old Pseudotsuga menziesii and Pinus monticola plantation in Washington, with occupied T. mazama burrows, were baited with the carrot or one of the strychnine mixtures in Nov. 1981. Both baits produced only a 63% reduction in gopher activity, possibly because of the availability of abundant alternative vegetative food. It was estimated that tree mortality due to root

pruning by gophers was >10% on this site. It is recommended that the carrot/Zn sulphide bait be registered for special local needs where safety to wildlife and domestic animals is important.

OSU Link
Non-OSU Link

71. Litvak, M.E., J.V.H. Constable and R.K. Monson. 2002. Supply and demand processes as controls over needle monoterpene synthesis and concentration in Douglas fir [Pseudotsuga menziesii (Mirb.) Franco]. Oecologia 132(3): 382-391.

Keywords: nursery operations
nursery fertilization
tree/stand protection
tree/stand health
tree physiology

Abstract: We measured the relative control that resource availability (as a supply-side control) and wounding (as a demand-side control) exert on patterns of monoterpene synthesis and concentration in Douglas fir [Pseudotsuga menziesii (Mirb.) Franco] needles. While supply-side controls should alter monoterpene production due to changes in the availability of substrate (carbohydrates), demand-side controls alter the need for a defensive product. We examined these relationships by measuring constitutive (preformed) and wound-induced rates of monoterpene synthesis and pool sizes in trees grown under ambient and elevated (ambient +200 micro mol mol-1) CO2, ambient and elevated (ambient +4 degrees C) temperature, and in trees grown under four levels of nitrogen fertilization (0, 50, 100 and 200 micro g g-1 N by weight). Monoterpene pool size decreased at elevated CO2, increased at elevated temperature and did not change in response to nitrogen fertilization. Overall, we did not find that foliar nitrogen, carbon balance, or rate of monoterpene synthesis alone were consistent predictors of monoterpene concentration in current-year Douglas fir needles. In addition, despite a wound-induced decrease in monoterpene pool size, we found no evidence for induction of monoterpene synthesis in response to wounding. The influence of either resource availability or wounding on rates of monoterpene synthesis or accumulation cannot be explained by traditional supply-side or demand-side controls. We conclude that monoterpene synthesis in first-year Douglas fir needles is controlled by fairly conservative genetic mechanisms and is influenced more by past selection than by current resource state.

OSU Link
Non-OSU Link

72. Livingston, N.J. and T.A. Black. 1987b. Water stress and survival of three species of conifer seedlings planted on a high elevation south-facing clear-cut. Canadian-Journal-of-Forest-Research 17(9): 1115-1123.

Keywords: planting operations
tree/stand protection
tree physiology
tree/stand health

Abstract: Container-grown seedlings (1+0) of Douglas fir, western hemlock and Abies amabilis were planted in spring 1981 and 1982 at 1150 m alt. on a 30 degrees S.-facing slope on Mt. Arrowsmith, Vancouver Island, British Columbia. Treatments at planting included inclining seedlings to the SW (thus shading the root collar with the foliage) and provision of shade cards and/or irrigation. Control seedlings received no treatment. Seasonal and diurnal courses of twig xylem water potential, turgor potential and osmotic potential were measured and the relation between transpiration and soil water potential was determined. Seedling survival was recorded in April 1982-84. Douglas fir seedlings showed a high degree of drought tolerance by considerable osmotic adjustment that enabled seedlings to maintain turgor throughout the growing season. Douglas fir seedlings thus survived severe drought and maintained daily transpiration rates that were never less than 50% of those of irrigated seedlings. Transpiration rates were reduced, however, on days of high vapour pressure deficits because of stomatal closure. Western hemlock and, especially, A amabilis lacked both stress avoidance and stress tolerance mechanisms and consequently suffered high mortality. In April 1984, untreated Douglas fir seedlings had 72-82% survival, while treated seedlings had 81-95% survival. Shade cards and/or irrigation increased survival of western hemlock and A. amabilis, but not to the rates shown by Douglas fir.

OSU Link
Non-OSU Link

73. Maher, T.F. 1990. Damage appraisal and pheromone trapping studies for the black army cutworm in British Columbia. B.C. Ministry of Forests FRDA-Report 117. iv + 41 p.

Keywords: planting operations
tree/stand protection
tree/stand health
growth

Abstract: Actebia fennica [Dissimactebia fennica] have damaged Picea spp., Pinus contorta, Pseudotsuga menziesii, Larix occidentalis and Populus tremuloides in recently planted stands in British Columbia.

OSU Link
Non-OSU Link

74. Manter, D.K. and K.L. Kavanagh. 2003. Stomatal regulation in Douglas fir following a fungal-mediated chronic reduction in leaf area. Trees: Structure and Function 17(6): 485-491.

Keywords: tree/stand protection
tree physiology
tree/stand health

Abstract: Pathogens can cause chronic premature needle abscission in coniferous species. To assess the potential impacts on tree productivity, stomatal regulation was investigated in Douglas fir with chronic stomatal occlusion and defoliation from varying levels of the Swiss needle cast (SNC) fungus, Phaeocryptopus gaeumannii. Levels of SNC disease and subsequent defoliation were manipulated by choosing six sites with varying levels of disease and by foliar applications of fungicides on six trees per site. Diurnal measurements of leaf water potential (Psi leaf), stomatal conductance (gs) and vapor

pressure deficit (D) were made on six fungicide treated and six control trees per site. In addition, leaf specific hydraulic conductance was calculated on a single branch (KL_B) from three trees per treatment per site. Stomatal conductance at D=1 kPa (gsref) was negatively correlated with fungal colonization (number of fruiting bodies present in needle stomata) and positively correlated with KL_B. Despite reduced needle retention in diseased trees, KL declined due to a reduction in sapwood area and permeability (i.e., increasing presence of latewood in functional sapwood). In general, stomatal sensitivity to D for all foliage was consistent with stomatal regulation based on a simple hydraulic model [gs=KL(Psi soil- Psi leaf)/D], which assumes strict stomatal regulation of Psi leaf. However, when fungal presence reduced maximum gs below the potential maximum supported by hydraulic architecture, stomatal sensitivity was lower than expected based on the theoretical relationship: d gs/dln D=0.6.gsref. The results indicate that losses in productivity associated with physical blockage of stomata and defoliation are compounded by additional losses in KL and a reduction in gs in remaining functional stomata.

OSU Link
Non-OSU Link

75. Mason, R.R. and B.E. Wickman. 1991. Integrated pest management of the Douglas-fir tussock moth. Forest-Ecology-and-Management 39(1-4): 119-130.

Keywords: tree/stand protection
tree/stand health
stand conditions
growth

Abstract: The Douglas-fir tussock moth (Orgyia pseudotsugata) is one of the most destructive forest defoliators of Douglas fir (Pseudotsuga menziesii), grand fir (Abies grandis) and white fir (A. concolor) in western North America. An outline is given of current pest-management programmes used in Oregon, which emphasize the annual monitoring of insects in forests with outbreak histories to determine early changes in population numbers and to predict trends. When outbreaks develop, several environmentally safe chemical and microbial insecticides are effective in reducing larval numbers and preventing serious defoliation. Computer models predicting growth loss, tree mortality, and top-kill during outbreaks are available as aids to making management decisions. Silvicultural practices favouring seral nonhost species on high-risk sites may be the best prescription for reducing the effect of tussock moth outbreaks.

OSU Link
Non-OSU Link

76. Massicotte, H.B., L.E. Tackaberry, E.R. Ingham and W.G. Thies. 1998. Ectomycorrhizae establishment on Douglas-fir seedlings following chloropicrin treatment to control laminated-root rot disease: assessment 4 and 5 years after outplanting. Applied-Soil-Ecology 10(1/2): 117-125.

Keywords: tree/stand protection
mycorrhizal response

Abstract: Laminated-root rot, caused by Phellinus weirii, is a serious disease affecting Douglas fir [Pseudotsuga menziesii] and other commercially important species of conifers in northwestern North America. The effect of chloropicrin (used to control Phellinus weirii) on nontarget organisms, including ectomycorrhizae, is uncertain. A study was carried out to examine ectomycorrhizal development on Douglas firs after the application of chloropicrin. The study was carried out in Matlock, Washington, USA, 4.5 and 5.5 years following chloropicrin application. In areas around stumps treated with 20% and 100% of the labelled dosage and in areas around non-treated stumps, chloropicrin did not adversely affect the formation of ectomycorrhizae on young Douglas fir seedlings by naturally occurring fungi. No significant effect on the abundance or type of mycorrhizas were detected. In this study chloropicrin did not affect these mycorrhizal associations, for at least 5 years following application.

OSU Link
Non-OSU Link

77. McClain, K.M. and D.P. Lavender. 1988. Tissue water relations and survival of conditioned conifer seedlings during drought stress. *In* Proceedings: 10th North American Forest Biology Workshop, 'Physiology and genetics of reforestation', University of British Columbia, Vancouver, British Columbia, July 10-22, 1988. Eds. J. Worrall, J. Loo-Dinkins and D.P. Lester. pp. 177-185.

Keywords: nursery operations
tree/stand protection
tree physiology
tree/stand health

Abstract: Jack pine (Pinus banksiana) and Douglas fir (Pseudotsuga menziesii) 23-week-old seedlings were subjected to an 8-week drought stress period on two soil types (sandy clay loam and loamy sand) in protected cold frames in a nursery in Oregon in July-August 1984. Before transplanting, treatments consisting of daily or weekly irrigations, combined with 0 or 100 p.p.m. KCl, were applied to the seedlings for 6 weeks. The results showed that weekly irrigated (stress conditioned) seedlings maintained higher water potentials than daily irrigated (non-stress conditioned) seedlings. Decreases in water potential were more rapid for seedlings grown on sand than for seedlings grown on loam. By the end of the assessment period, relative water contents of Douglas fir on sand and loam were 88.3% and 91.5%, respectively, and 72.7% and 81.8%, respectively, for jack pine. Turgor pressures were maintained at higher levels in Douglas fir than in jack pine on both soil types. On sand, mortality in both species was dependent on conditioning treatment, indicating that stress conditioning enhanced seedling drought resistance during a period of rapidly increasing soil water deficit. KCl treatment was not implicated in response to drought, but increased mortality of jack pine on sandy clay loam.

Non-OSU Link

78. McKay, H.M. 1994. Frost hardiness and cold-storage tolerance of the root system of Picea sitchensis, Pseudotsuga menziesii, Larix kaempferi and Pinus sylvestris bare-root seedlings. Scandinavian-Journal-of-Forest-Research 9(3): 203-213.

Keywords: nursery operations
tree/stand protection
tree physiology

tree/stand health

Abstract: During the winter of 1990-91, fine roots of 2-year-old, undercut and wrenched Pseudotsuga menziesii, Larix kaempferi [L. leptolepis], Pinus sylvestris, and Picea sitchensis (Alaskan, Queen Charlotte Islands and Oregon provenances) were tested using electrolyte leakage for frost hardiness and tolerance to storage at +1 degrees C for 30 and 90 days as excised roots. Pseudotsuga menziesii and Pinus sylvestris showed only minor changes in root frost hardiness with a maximum of -4 degrees C and -7 degrees C respectively. Larix leptolepis and Picea sitchensis developed much greater root frost hardiness; L. leptolepis had a maximum hardiness of -12 degrees C while Picea sitchensis (Queen Charlotte Islands) reached -13 degrees C during the winter. The root frost hardiness of Picea sitchensis increased with the provenance's latitude. There were clear species and provenance differences in the level of long-term cold-storage tolerance attained, increasing in the order Pseudotsuga menziesii, Pinus sylvestris and Picea sitchensis (Oregon), L. leptolepis, Picea sitchensis (Queen Charlotte Islands), and Picea sitchensis (Alaskan). In spite of highly significant correlations between root electrolyte leakage after cold-storage and frosting tests, root frost hardiness did not accurately indicate all aspects of long-term cold tolerance and has limitations as a means of determining safe cold-storage dates.Tr.

OSU Link
Non-OSU Link

79. Miller, G.E. 1983a. Evaluation of the effectiveness of cold-water misting of trees in seed orchards for control of Douglas-fir cone gall midge (Diptera: Cecidomyiidae). Journal-of-Economic-Entomology 76(4): 916-919.

Keywords: seed orchard management
tree/stand protection
tree/stand health
tree phenology

Abstract: The effectiveness of misting trees with cold water in delaying reproductive bud burst of Douglas fir (Pseudotsuga menziesii) and consequently controlling Contarinia oregonensis Foote was evaluated in tests in seed orchards in British Columbia in 1978-80. The misting treatment reduced the amount of damage to the same degree as was achieved with sprays of dimethoate when a 10-day delay in seed-cone bud burst coincided with the earliest 'flowering' trees being the most heavily attacked. Gall midge damage was not reduced to an acceptable level with less than a 10-day delay or when later-flowering trees were the most heavily attacked. It was not possible to determine the likely effectiveness of cold-water misting before bud burst in a given year, because the period of bud-burst delay varied with weather and because synchrony between presence of adult midges and susceptible host-tree stage was not consistent.

OSU Link
Non-OSU Link

80. 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

81. Miller, G.E. 1986. Damage prediction for Contarinia oregonensis Foote (Diptera: Cecidomyiidae) in Douglas-fir seed orchards. Canadian-Entomologist 118(12): 1297-1306.

Keywords: seed orchard management
tree/stand protection
tree/stand health
reproduction

Abstract: Damage to Douglas fir (Pseudotsuga menziesii) in British Columbia at cone harvest by Contarinia oregonensis was positively correlated with the number of egg-infested scales per conelet in the spring. Reducing the average number of galled seeds per cone by 1.5 increased the average number of filled seeds per cone by 1.0 in insecticide trials. Optimum sample sizes for estimating average densities of egg-infested scales were calculated to be 1 conelet/tree and 150 trees/orchard. The mean crowding variable was linearly related to average density, so a sequential sampling technique relative to a critical density was developed for determining the need for control measures.

OSU Link
Non-OSU Link

82. Miller, J.C. and K.J. West. 1987. Efficacy of Bacillus thuringiensis and diflubenzuron on Douglas-fir and oak for gypsy moth control in Oregon. Journal-of-Arboriculture 13(10): 240-242.

Keywords: tree/stand protection
stand conditions

Abstract: In studies at Corvallis, 20 trees of each of Quercus garryana and Douglas fir [Pseudotsuga menziesii] were sprayed from the ground on 6 May 1986 until foliage dripped. Foliage was collected 1 day before spraying and 1-64 days after spraying and bioassayed with 2nd instar larvae of gypsy moth [Lymantria dispar]. Larval mortality was n.s.d. between tree species or between insecticides. Both B. thuringiensis and diflubenzuron caused high larval mortality and were effective for at least 64 days at the doses applied.

OSU Link
Non-OSU Link

83. Moldenke, A.F., R.E. Berry, J.C. Miller, R.G. Kelsey, J.G. Wernz and S. Venkateswaran. 1992. Carbaryl susceptibility and detoxication enzymes in gypsy moth (Lepidoptera: Lymantriidae): influence of host plant. Journal-of-Economic-Entomology 85(5): 1628-1635.

Keywords: tree/stand protection
stand conditions

Abstract: Toxicity of carbaryl and levels of detoxifying enzymes were determined in larvae of Lymantria dispar reared from hatching on either white alder (Alnus rhombifolia) or Douglas fir (Pseudotsuga menziesii). Foliar chemistry was also examined. Larvae were treated topically with carbaryl 2 days into the 3rd or 5th instar and LD50s were established based on survival 48 h after treatment. Surviving 3rd-instar larvae were fed on their original diet until death or pupation and sublethal effects were assessed. Levels of detoxifying enzymes were determined in larvae of the same age and rearing group. Larvae reared on Douglas fir were significantly more tolerant of carbaryl. Sublethal effects were found only in larvae fed Douglas fir, in which mortality after 48 h and time to pupation were significantly greater in treated larvae than in controls. Levels of detoxification enzymes were generally higher in tissues of larvae raised on Douglas fir, but significantly higher in only a few instances. Nitrogen and phenolic contents were higher in alder than in Douglas fir. Terpenes were abundant in Douglas fir foliage but were not detected in alder.

OSU Link
Non-OSU Link

84. Moldenke, A.F., R.E. Berry, J.C. Miller and J.G. Wernz. 1997. Toxicity of acephate to larvae of gypsy moth as a function of host plant and bioassay method. Entomologia-Experimentalis-et-Applicata 84(2): 157-163.

Keywords: tree/stand protection
stand conditions

Abstract: The toxicity of acephate to 3rd-instar larvae of Lymantria dispar was examined under different conditions of administration method, availability of food to larvae during bioassay, host plant, and activity of detoxifying enzymes. Larvae that had been fed field-collected foliage of white alder (Alnus rhombifolia) were less susceptible 48 h after treatment with topically applied acephate if they were allowed to continue feeding on foliage during the bioassay period (LD50 = 60.6 micro g/g larva) than if they were not (LD50 = 13.5 micro g/g larva). All surviving larvae were replaced on their original food plant after the 48-h bioassay; of these, 14.4% of the larvae not fed during treatment died before pupation, compared with 1.3% of the larvae fed alder during treatment. The LD50 obtained for topically treated larvae reared and treated on Douglas fir (Pseudotsuga menziesii) (51.1 micro g/g larva) was comparable to that obtained for larvae fed alder (60.0 micro g/g larva) throughout treatment. Larvae treated orally with acephate, however, were slightly more susceptible when reared on Douglas fir (LC50 = 20.3 ppm) than when reared on alder (LC50 = 27.0 ppm). Post-treatment mortality in orally treated larvae was 10.3% in those fed alder and 9.5% in those fed Douglas fir. Higher cytochrome P-450 activities in larvae reared on Douglas fir apparently did not enhance tolerance to acephate. Both sexes

of orally treated larvae took significantly longer to pupate than did controls on both foliage types, as did topically treated males fed Douglas fir. Pupal weight generally was slightly, but not always significantly, higher in treated than untreated larvae under all dietary and treatment regimes.

OSU Link
Non-OSU Link

85. Moldenke, A.F., R.E. Berry, J.C. Miller, J.G. Wernz and X.H. Li. 1994. Toxicity of Bacillus thuringiensis subsp. kurstaki to gypsy moth, Lymantria dispar, fed with alder or Douglas-fir. Journal-of-Invertebrate-Pathology 64(2): 143-145.

Keywords: tree/stand protection
stand conditions

Abstract: The response of larvae of Lymantria dispar, reared on either Alnus rhombifolia or Pseudotsuga menziesii following collection of egg masses from the field in Maryland in 1990, to treatment via an artificial diet with Bacillus thuringiensis subsp. kurstaki (Javelin, 5% a.i.) was evaluated in the laboratory. Mortality was independent of dose in both food plant treatments, but was significantly greater for larvae fed the treated P. menziesii diet. Sub-lethal effects and the role of food plant constituents with respect to susceptibility to this biological control agent are also briefly discussed.

OSU Link
Non-OSU Link

86. Morrison, D. 1984. Evaluation of impact - Advances in control. *In* Proceedings of the Sixth International Conference on Root and Butt Rots of Forest Trees, International Union of Forestry Research Organizations (IUFRO) Working Party S2.06.01., Melbourne, Australia, August 25-31, 1983. Ed. G.A. Kile. pp. 359-397.

Keywords: tree/stand protection
stand conditions

Abstract: Five papers

OSU Link
Non-OSU Link

87. Morrison, D.J. and A.L.S. Johnson. 1999a. Annosus root disease in pre-commercially thinned stands in coastal British Columbia. Canadian-Forest-Service Technology Transfer Note 20, Pacific-Forestry-Centre, Victoria, BC.

Keywords: thinning
precommercial thinning
tree/stand protection
tree/stand health

Abstract: An outline is given of the strategic importance of Heterobasidion annosum, detection and recognition, damage to roots, factors affecting infection and colonization of stumps and management implications for spacing in juvenile stands. The relative susceptibilities of different species were: Abies amabilis>Picea sitchensis>Tsuga heterophylla>Pseudotsuga menziesii.

OSU Link
Non-OSU Link

88. Morrison, D.J. and A.L.S. Johnson. 1999b. Incidence of Heterobasidion annosum in precommercial thinning stumps in coastal British Columbia. European-Journal-of-Forest-Pathology 29(1): 1-16.

Keywords: thinning
precommercial thinning
tree/stand protection
tree/stand health

Abstract: Coniferous stumps in 83 stands in coastal British Columbia, Canada, were sampled 3-5 years after precommercial thinning between 1981 and 1986. The percentage of stumps and surface area colonized by H. annosum were determined for 25 stumps of each species, in each 5-cm diameter class present in each stand. There were significant differences among species in the percentages of stumps and surface area colonized, with Douglas-fir (Pseudotsuga menziesii) having the lowest values, amabilis fir (Abies amabilis) and Sitkaspruce (Picea sitchensis) the highest and western hemlock (Tsuga heterophylla) being intermediate. For each species, both the percentage of stumps and surface area colonized increased with increasing diameter. In stumps that were grafted to an adjacent tree, there was decreased incidence of H. annosum for Douglas-fir and Sitka spruce and increased incidence for western hemlock and amabilis fir. There were trends in the percentage of stumps and area colonized for season of thinning and biogeoclimatic subzones, with the values for most species decreasing as the amount of precipitation increased. It is suggested that the increase in inoculum can be minimized by thinning trees when less than 15 years old, by cutting only trees less than 10 cm in diameter and by thinning during low risk seasons.

Non-OSU Link

89. Morrison, D.J., M.D. Larock and A.J. Waters. 1986. Stump infection by Fomes annosus in spaced stands in the Prince Rupert Forest Region of British Columbia. Pacific-Forestry-Centre, Canadian-Forest-Service Information-Report BC-X-285. 12 p.

Keywords: thinning
tree/stand protection
tree/stand health

Abstract: Discs 3-5 cm thick were collected after removal of the top 5-10 cm from stumps left by thinning 1-8 yr previously of 12- to 37-yr-old stands of 5 coniferous species, and the occurrence and area of surface colonization with F. annosus [Heterobasidion annosum] were measured. Based on the % of stumps with more than 10% of their area colonized, susceptibility decreased in the sequence Abies amabilis, Picea sitchensis, Tsuga heterophylla, Pseudotsuga menziesii; Pinus contorta was unaffected. Fewer stumps were colonized in a T. heterophylla/A. amabilis stand thinned in winter than in an

adjacent stand thinned in late spring: the difference was attributed to effects on spore populations of low temp. and heavy precipitation. There was a significant correlation between % stump area colonized and % root vol. colonized by H. annosum for A. amabilis and T. heterophylla. H. annosum had spread from colonized roots on some excavated stumps to or into adjacent roots of reserved trees.

OSU Link
Non-OSU Link

90. Nelson, E.E., M.G. McWilliams and W.G. Thies. 1994. Mortality and growth of urea-fertilized Douglas-fir on a Phellinus weirii-infested site in Oregon. Western-Journal-of-Applied-Forestry 9(2): 52-56.

Keywords: planting operations
fertilization
tree/stand protection
growth
tree/stand health
soil properties

Abstract: Twelve plots were established in 1972 in an 11-yr-old Douglas fir (Pseudotsuga menziesii) plantation infected with Phellinus weirii, the cause of laminated root rot. All plots were thinned and either interplanted with red alder (Alnus rubra) or fertilized at 5- to 10-yr intervals with urea to determine the effect of nitrogen on tree growth and mortality caused by P. weirii, or left untreated. Interplanted alder, however, failed to survive. Mortality was assessed at intervals of 2 to 3 yr. Plots were inventoried (100% cruise) in 1978 and 1990. Growth over 12 yr appeared better on fertilized than nonfertilized plots, but the difference was not significant. Mortality caused by the preferential feeding of black bears [Ursus americanus] on the inner bark of fertilized trees reduced the overall gain. Mortality caused by laminated root rot did not differ significantly among treatments. Three months after the initial application of urea at 448 kg N/ha, soil sampled to a depth of 30 cm was higher in ammonium and nitrate forms of nitrogen on fertilized than nonfertilized plots, but increases were not significant. Numbers of soil bacteria were directly correlated with soil ammonium content (P = 0.1092). Numbers of aerobic actinomycetes were inversely correlated with soil nitrate content (P = 0.0398).

OSU Link
Non-OSU Link

91. O'-Neill, G.A., W.T. Adams and S.N. Aitken. 2001. Quantitative genetics of spring and fall cold hardiness in seedlings from two Oregon populations of coastal Douglas-fir. Forest-Ecology-and-Management 149(1/3): 305-318.

Keywords: genetic tree improvement
tree/stand protection
tree/stand health
genetic relationships

Abstract: Genetics of autumn and spring cold hardiness were investigated in two western Oregon (USA) breeding populations (Coast and Cascade mountains) of Douglas-fir (Pseudotsuga menziesii var.

menziesii). Seedlings from 40 open-pollinated families from each population were grown in raised nursery beds and subjected to two soil moisture regimes (well-watered and mild drought) to evaluate the influence of summer drought on ranking of families for cold hardiness. Artificial freeze testing (AFT) of detached shoots, followed by visual scoring of injury, was used to evaluate needle, stem and bud cold hardiness on three dates in the autumn (September, October and November) after the second growing season, and once in the following spring (March). The Cascade population suffered significantly less cold injury than the Coast population in autumn AFT. However, in spring AFT the Cascade population was less cold hardy, although population differences were seldom significant. Families within both breeding zones varied significantly in cold hardiness, with mean estimates of individual heritabilities greater in spring (hi2=0.57) than autumn (hi2=0.37), greater in the Coast (hi2=0.52) than in the Cascade (hi2=0.42) population, and greater in the wet (hi2=0.54) than in the dry moisture regime (hi2=0.40) (autumn means based on October tests). A single test date seems adequate to assess autumn cold hardiness, because estimated genetic correlations for cold injury between autumn test dates were strong (rA=0.80). Genetic correlations between spring and autumn cold injury, however, were moderately negative (rB=-0.66 and -0.21, Coast and Cascade, respectively), indicating that cold hardiness needs to be managed as two traits (i.e. autumn and spring cold hardiness). Selection for cold hardiness based on a single shoot tissue is expected to increase cold hardiness in the other tissues as well, because genetic correlations between tissues in cold injury were moderately-to-strongly positive in both autumn (rB=0.67) and spring (rB=0.84). Seedlings grown under summer drought incurred significantly less cold injury in the autumn than those that were well-watered; nevertheless, strong genetic correlations in autumn cold injury between moisture regimes (rB=0.91) indicate that summer moisture conditions had little influence on family rankings for autumn cold hardiness. Correlations of injury resulting from a natural frost event in November of the first year with injury from AFT in the autumn of the second year (rA=0.72 and 0.78 for needle and bud injury, respectively) confirmed that AFT reliably predicts cold hardiness to natural frost events.

OSU Link
Non-OSU Link

92. O'-Neill, G.A., S.N. Aitken and W.T. Adams. 2000. Genetic selection for cold hardiness in coastal Douglas-fir seedlings and saplings. Canadian-Journal-of-Forest-Research 30(11): 1799-1807.

Keywords: genetic tree improvement
tree/stand protection
genetic relationships
tree phenology

Abstract: Genetic control of cold hardiness in two-year-old seedlings in a nursery in Oregon, USA, was compared with that in 7-year-old field saplings, for 40 open-pollinated families in each of two low-altitude breeding populations (Coast and Cascade) of coastal Douglas fir (Pseudotsuga menziesii var. menziesii) from western Oregon. The field trials were also in the Coast and Cascade breeding zones of Oregon (7 and 6 sites, respectively). In addition, the efficacy of bud phenology traits as predictors of cold hardiness at the two stages was explored. Autumn and spring cold hardiness were assessed using artificial freeze testing. Similar genetic control of cold hardiness in seedlings and saplings is suggested by strong type-B genetic correlations (rB) between the two ages for autumn and spring cold injury traits (rB<more or =>0.78) and by similar trends in individual tree heritability estimates (hi2), e.g., hi2 was greater in spring (mean 0.73) than in autumn (mean 0.36) and greater in the Coast population (0.69) than in the Cascade population (0.40) at both ages. Strong responses to direct selection are expected for

spring cold hardiness at both ages and for autumn cold hardiness in seedlings, even under mild selection intensities. Similar heritabilities in seedlings and saplings, and strong genetic correlations between ages for cold-hardiness traits, ensure that selection at one age will produce similar gains at the other age. Type-A genetic correlations (rA) between autumn and spring cold hardiness were near zero in the Cascade population (0.08 and -0.14 at ages 2 and 7, respectively) but were moderate and negative in the Coast population (-0.54 and -0.36, respectively). Bud-burst timing appears to be a suitable surrogate to artificial freeze testing for assessing spring cold hardiness in both seedlings and saplings, as is bud set timing for assessing fall cold hardiness in seedlings, but bud set timing is a poor predictor of fall cold hardiness in saplings.

OSU Link
Non-OSU Link

93. Otvos, I.S., J.C. Cunningham and R.I. Alfaro. 1987. Aerial application of nuclear polyhedrosis virus against Douglas-fir tussock moth, Orgyia pseudotsugata (McDunnough) (Lepidoptera: Lymantriidae); II. Impact 1 and 2 years after application. Canadian-Entomologist 119(7-8): 707-715.

Keywords: tree/stand protection
tree/stand health
stand conditions

Abstract: Following aerial application of a nuclear polyhedrosis virus of Orgyia pseudotsugata against this lymantriid on Douglas fir (Pseudotsuga menziesii) in British Columbia in 1982, the impact of treatment was studied in 1983 and 1984. The virus appeared to have spread from treated plots to adjoining areas in 1982, effectively reducing lymantriid populations. This observation suggests the spraying of alternate swaths to reduce the amount of microbial pesticide used. A naturally occurring viral epizootic reduced lymantriid populations in 2 of 3 check plots in 1983, but severe tree mortality occurred in 2 of these plots, with 60 and 62% of sample trees dead in 1984. The corresponding tree mortality in 2 of 4 treated plots was 4 and 7%.

OSU Link
Non-OSU Link

94. Otvos, I.S. and R.F. Shepherd. 1991. Integration of early virus treatment with a pheromone detection system to control Douglas-fir tussock moth, Orgyia pseudotsugata (Lepidoptera: Lymantriidae), populations at pre-outbreak levels. Forest-Ecology-and-Management 39(1-4): 143-151.

Keywords: tree/stand protection
tree/stand health
stand conditions

Abstract: The development and integration of a pheromone monitoring system with a nuclear polyhedrosis virus treatment is described. Stands of Douglas fir (Pseudotsuga menziesii) in British Columbia susceptible to tussock-moth outbreaks are defined by overlying maps of past outbreaks, forest and habitat types, and climatic zones. Pheromone-baited traps are placed and monitored annually at permanent locations in susceptible areas. Measuring annual trends of moth density indicates time and location of the next outbreak. Trap-catch data provide an early warning of impending outbreaks,

confirmed by ground reconnaissance. Insect density and defoliation are predicted from egg-mass and larval sampling. The virus can then be applied from the air or from the ground into threatened stands to initiate an epizootic to prevent development of an outbreak and to minimize tree damage. The virus appears to spread, and field tests with reduced dosages indicate that the small amount of virus applied can still greatly reduce larval populations and prevent tree mortality, at considerably reduced cost.

OSU Link
Non-OSU Link

95. Overhulser, D.L., J.D. Walstad and R.P. Bowers. 1980. Twig weevil damage to Douglas-fir seedlings and a field test of Dursban for control. Tree-Planters' Notes 31(2): 17-20.

Keywords: tree/stand protection
tree/stand health
stand conditions

Abstract: Damage categories are described for young platations in Oregon mostly 2+1 seedlings, planted in 1975-76 and surveyed in 1977 after attack by Cylindrocopturus furnissi in 1976. A test using Dursban 4E (chlorpyrifos) spray at 0-4% a.i., applied in July 1977, showed n.s.d. in % damaged trees between treated and control areas after 4 months, but this may have been due to a natural decline in weevil numbers. Spraying with 2% a.i. Dursban in Aug. 1977 significantly reduced the numbers of weevils present.

OSU Link
Non-OSU Link

96. Owston, P.W., W.G. Thies and W. Fender. 1986. Field performance of Douglas-fir seedlings after treatment with fungicides. Canadian-Journal-of-Forest-Research 16(6): 1369-1371.

Keywords: nursery operations
tree/stand protection
tree/stand health
growth
mycorrhizal response

Abstract: Douglas fir seedlings grown in containers with pasteurized or unpasteurized potting mixture, and treated in the nursery with benomyl, captan, fenaminosulf or ethazol [etridiazole], or left untreated (control) were planted out in the Cascade Range, western Oregon. The seedlings from all treatments appeared to be in similar condition at the time of planting, except for variations in ht. After 7 yr, seedlings grown in pasteurized potting mixture had better survival than those grown in unpasteurized mixture. Benomyl-treated seedlings in pasteurized potting mixture had significantly better survival than control seedlings in pasteurized mixture and seedlings treated with ethazol and grown in unpasteurized potting mixture had significantly lower survival than control seedlings in unpasteurized mixture. Ht. differences after 7 yr were n.s.d. between treatments. Benomyl, captan and ethazol appeared to have no detrimental effect on the development of mycorrhizas after planting non-mycorrhizal seedlings. There were insufficient seedlings to determine the effects of fenaminosulf on mycorrhizas.

OSU Link
Non-OSU Link

97. Parke, J.L., R.G. Linderman and C.H. Black. 1983a. The role of ectomycorrhizas in drought tolerance of Douglas-fir seedlings. New-Phytologist 95(1): 83-95.

Keywords: nursery operations
tree/stand protection
photosynthesis
tree physiology
mycorrhizal response

Abstract: Pseudotsuga menziesii seedlings were watered daily or conditioned to cyclic drying and re-wetting of the soil. Net photosynthesis rates of mycorrhizal and non-mycorrhizal seedlings watered daily were similar but drought-stressed mycorrhizal seedlings fixed CO2 at a rate 10 times that of non-mycorrhizal ones. Total leaf water potentials of mycorrhizal plants were lower than those of non-mycorrhizal plants but they recovered more rapidly. Non-mycorrhizal seedlings and those inoculated with 4 ectomycorrhizal fungi were allowed to dry, then re-watered and compared for their ability to tolerate and recover from drought. Those inoculated with Rhizopogon vinicolor were the least affected by drought. Net photosynthetic rate of R.-inoculated seedlings 24 h after re-watering was 7 times greater than that of non-mycorrhizal seedlings. The transpiration rate of R.-inoculated seedlings was low before desiccation, declined rapidly during the drought period and, after re-watering, quickly resumed a rate higher than that for other treatments.

OSU Link
Non-OSU Link

98. Peterson, M.J. and J.R. Sutherland. 1990. Controlling gray mold on container-grown Douglas-fir by modified styroblocks and under-bench, forced air ventilation. Western-Journal-of-Applied-Forestry 5(3): 75-79.

Keywords: nursery operations
tree/stand protection
growth
tree/stand health

Abstract: The control of grey mould (Botrytis cinerea) on Douglas fir (Pseudotsuga menziesii) seedlings was investigated in Vancouver, Canada. Incidence of mould on seedlings sown in June 1988 and assessed January 1989 was reduced in 3 treatments of modified styroblocks (vertical holes, allowing air movement from below): vented with heated, forced air; vented with unheated, forced air; and vented with unheated, unforced air. Overall, mould occurred on 25% of 7-month-old seedlings in vented styroblocks, compared with >75% incidence in unmodified styroblocks. No significant differences in seedling height or root collar diameter among treatments were observed. Use of ventilated styroblocks is recommended, to reduce both losses from grey mould and fungicide usage in nurseries.

OSU Link
Non-OSU Link

99. Peterson, M.J. and S.E. Tuller. 1987. Die-back of container-grown Douglas-fir seedlings: associated microclimate. B.C. Ministry of Forests FRDA-Report 035. vii + 43 p.

Keywords: nursery operations
tree/stand protection
tree/stand health

Abstract: Microclimate associated with needle-tip dieback of Pseudotsuga menziesii seedlings in containers was studied in 2 greenhouses in British Columbia. The effects of 2 kinds of grit cover on soil temperature were also examined.

OSU Link
Non-OSU Link

100. Petruncio, M., D. Briggs and R.J. Barbour. 1997. Predicting pruned branch stub occlusion in young, coastal Douglas-fir. Canadian-Journal-of-Forest-Research 27(7): 1074-1082.

Keywords: pruning
tree/stand protection
tree/stand health
wood quality

Abstract: This study examined occlusion of 335 pruned branches from 38 coastal Douglas fir (Pseudotsuga menziesii) trees sampled from 13 stands (5 in British Columbia, 8 in Oregon) that were pruned between age 9 and 22 years. Regression models were developed for predicting number of years to occlude, the width of the occlusion region, and radius-over-occlusion which is the distance from the stem pith to the onset of clear wood production. Study results indicate that years to occlude is a function of stem size, stub length, stem growth rate, live or dead branch condition, and whether pruning produced smooth or nonsmooth cuts. Distance to occlude is a function of stem size, stub diameter, stem growth rate, live or dead branch condition, and whether pruning produced smooth or nonsmooth cuts. Radius-over-occlusion is a function of stem size, stub length, stub diameter, stem growth rate, and whether pruning produced smooth or nonsmooth cuts.

OSU Link
Non-OSU Link

101. Randall, W. and G.R. Johnson. 1998. The impact of environment and nursery on survival and early growth of Douglas-fir, noble fir, and white pine - a case study. Western-Journal-of-Applied-Forestry 13(4): 137-143.

Keywords: nursery operations
planting operations
tree/stand protection
growth
tree/stand health

Abstract: Survival and third-year height were examined on 2383 reforestation units in Cascade Range of western Oregon, USA, from 1983 to 1994, to determine which factors affect reforestation success. The three species examined made up 92% of the total trees planted in the region. Survival of Douglas fir (Pseudotsuga menziesii) varied by as much as 20% from year to year. The most significant factor affecting reforestation success was the nursery that provided the seedlings. Nursery affected both survival and height of Douglas fir and height for noble fir (Abies procera) and white pine (Pinus monticola). No nursery was best for all species. Other factors that were important for all three species were the administrative unit where the seedlings were planted, initial plant height, aspect, and length of storage prior to planting. Other significant factors that were important for Douglas fir were seed origin, planting month, protection, stock type, and aspect. For noble fir, other important factors were planting month and stock type; for white pine, the other important factor was slope. Altitude of the seed source and the planting unit affected Douglas fir survival and height but did not affect the other two species. This supports the smaller altitudinal bands for Douglas fir compared with noble fir and white pine.

OSU Link
Non-OSU Link

102. Rappaport, N.G. and D.L. Wood. 1994. Pityophthorus orarius Bright (Coleoptera: Scolytidae) in a northern California douglas-fir seed orchard: effect of clone, tree vigor, and cone crop on rate of attack. Canadian-Entomologist 126(5): 1111-1118.

Keywords: tree/stand protection
tree/stand health

Abstract: The geographic range of Pityophthorus orarius was extended beyond the original provenance of southern British Columbia to northern California. A survey of 457 Pseudotsuga menziesii trees in 1985 revealed that those with heavy cone crops were more likely to be infested by P. orarius than were those with a light crop. Furthermore, attack rates differed among clones. A 2nd survey in 1987 confirmed the importance of clone and cone crop in attack rate. In this survey, stressed trees were attacked at a higher rate than unstressed trees. The distribution of P. orarius appeared clumped in both surveys, possibly because of semiochemicals or oviposition behaviour.

OSU Link
Non-OSU Link

103. Reddy, M.S., L.M. Funk, D.C. Covert, D.N. He and E.A. Pedersen. 1997. Microbial inoculants for sustainable forests. Journal-of-Sustainable-Forestry 5(1/2): 293-306.

Keywords: tree/stand protection
tree/stand health

Abstract: A bacterial culture collection of 500 strains was assessed for biological control of fungal root pathogens and/or plant growth promotion of conifer seedlings. Seven of these strains showed significant suppressive effects on various soil-borne fungal pathogens. On Douglas fir [Pseudotsuga menziesii], two strains, Burkholderia cepacia RAL3 and Pseudomonas fluorescens 64-3, reduced disease caused by Fusarium by 7-42% in repeated growth room assays. The same strains significantly increased the percentage of healthy white spruce [Picea glauca] seedlings inoculated with Fusarium and Pythium

in a conifer nursery, increased the survival of bare-root white spruce seedlings planted on a reforestation site in Saskatchewan by 19-23%, and increased new root growth and dry weight of Engelmann spruce [Picea engelmannii] seedlings planted in Prince George, British Columbia, and white spruce at 4 sites in Saskatchewan and British Columbia. Strain RAL3 in commercial formulation maintained a viable population of about log 8-9 cfu/ml for over a year when stored at 5 degrees C. Strain survival on seed varied with conifer species. No decreases in bacterial populations were observed on seeds of jack pine [Pinus banksiana] or Douglas fir after 37 to 44 days storage at 5 degrees C, but decreases were observed on seeds of white spruce and Scots pine [Pinus sylvestris].

OSU Link
Non-OSU Link

104. Riley, C.M., C.J. Wiesner, D.W. Scott, J. Weatherby and R.G. Downer. 1992. Evaluating the field efficacy of Bacillus thuringiensis Berliner against the western spruce budworm (Lepidoptera: Tortricidae). *In* Pesticide formulations and application systems: 11th volume.*Eds.* L.E. Bode and D.G. Chasin, ASTM, Philadelphia, USA. pp. 271-290.

Keywords: tree/stand protection
stand conditions
tree/stand health

Abstract: A detailed assessment of spray deposition and efficacy of 2 formulations of Bacillus thuringiensis was carried out as part of a control programme against Choristoneura occidentalis on Pseudotsuga menziesii and Abies grandis in Oregon in 1988. An analysis of covariance model that was used to examine the relationship between deposit density and field efficacy (larval mortality and defoliation) could not be justified, and the relationships between variables were investigated using chi-squared analysis. This paper was presented at a conference on pesticide formulations and application systems, held in San Antonio, USA, on 14-15 November 1991.

OSU Link
Non-OSU Link

105. Ritchie, G.A. 1986. Relationships among bud dormancy status, cold hardiness, and stress resistance in 2+0 Douglas-fir. New-Forests 1(1): 29-42.

Keywords: nursery operations
tree/stand protection
growth
tree/stand health
tree phenology
carbon allocation

Abstract: Seedlings were lifted from a western Washington nursery on six dates spanning the 1980-81 lifting season. On each date samples of seedlings were subjected to the following treatment: tumbling for 5 min, desiccation of roots for 30 min at 30 degrees C and 2.1 kPa vapour deficit, exposure of shoots to temp. of -10 degrees C, -15 degrees C or -20 degrees C for 2 h, and unstressed control. On two lift dates sub-samples of seedlings were placed into -1 degrees C storage and held for 2 months before the

above treatments were administered. Bud dormancy status was determined, using a bud break test, on seedlings from each lift date before and after storage. After one growing season in the field, percent survival, vigour, height growth and shoot and root weight were determined on stressed and unstressed seedlings. Survival and vigour were less affected by treatments than were height and weight. Severity of stress was in the order -20 degrees C>-15 degrees C>desiccation> handling>-10 degrees C. Degree of cold injury was directly related to seedling dormancy status whether dormancy status had been attained in the nursery from natural chilling or in frozen storage. Seedlings in a mid-range of dormancy release (between deep rest and quiescence) were most resistant to all imposed stresses.

OSU Link
Non-OSU Link

106. Ross, D.W. and G.E. Daterman. 1994. Reduction of Douglas-fir beetle infestation of high-risk stands by antiaggregation and aggregation pheromones. Canadian-Journal-of-Forest-Research 24(11): 2184-2190.

Keywords: tree/stand protection
tree/stand health

Abstract: A combination of antiaggregation and aggregation pheromones were tested for protecting stands of Douglas fir (Pseudotsuga menziesii) at high risk for infestation by Douglas fir beetle (Dendroctonus pseudotsugae) at a site in Oregon. The antiaggregation pheromone, 3-methylcyclohex-2-en-1-one (MCH), was applied in a bubble capsule formulation to the perimeter of 1 ha circular plots at a rate of 60 g/plot. Treated plots also had three or four clusters of four Lindgren funnel traps baited with frontalin, seudenol, 1-methylcyclohex-2-en-1-ol, and ethanol located outside of the plot, but within 160 m of the boundary. Mean (+SD) accumulated catches in all traps per plot were 73 658 + 19 721 Douglas fir beetles and 12 892 + 2513 Thanasimus undatulus, a predator of the Douglas fir beetle. The mean percentage of Douglas fir trees with a diameter at breast height (d.b.h.) <more or =>20 cm that were mass attacked was reduced by 80% within the treated plots compared with the untreated plots. However, there was an 8-fold increase in the percentage of trees mass attacked in the area outside the treated plots in the vicinity of the funnel traps. The net effect of the treatment was to concentrate mass attacked trees within a limited area outside of the protected stand. The results indicated that Douglas fir beetle antiaggregation and aggregation pheromones can be used effectively to reduce the probability of infestation in small, high value stands.

OSU Link
Non-OSU Link

107. Ross, D.W., G.E. Daterman and K.E. Gibson. 2002. Elution rate and spacing of antiaggregation pheromone dispensers for protecting live trees from Dendroctonus pseudotsugae (Coleoptera: Scolytidae). Journal-of-Economic-Entomology 95(4): 778-781.

Keywords: tree/stand protection
tree/stand health

Abstract: The antiaggregation pheromone 3-methylcyclohex-2-en-1-one (MCH) is highly effective in preventing the infestation of high-risk trees by Douglas-fir beetle, Dendroctonus pseudotsugae. A large

portion of the cost of an MCH treatment is related to the time applicators spend walking through an area dispersing the formulated pheromone. Application of fewer MCH dispensers eluting at a higher rate than those currently registered for operational use could potentially reduce treatment costs. Two higher elution rates, 6 and 18 mg/d per dispenser, were compared with the current standard of 2 mg/d per dispenser and an untreated control on 1-ha circular plots. Dispensers were spaced 5, 15, and 44 m apart around the plot perimeters eluting 2, 6, and 18 mg/d, respectively. The nominal dose of MCH was 144 mg ha-1 d-1 on all plots. Percentages of Douglas-fir trees <more or =>20 cm diameter at breast height mass attacked by Douglas-fir beetle were significantly lower on plots treated with dispensers eluting 2 and 6 mg/d and spaced 5 and 15 m apart, respectively, compared with the untreated control. Infestation rate on plots treated with dispensers eluting 18 mg/d and spaced 44 m apart was not significantly different from the control. Douglas-fir beetle abundance and host tree availability were similar on all plots. These results indicate that MCH dispensers eluting 6 mg/d (three times the current standard rate) and spaced 15 m apart (three times existing standard distance) can effectively prevent Douglas-fir beetle infestations.

OSU Link
Non-OSU Link

108. Ross, D.W., K.E. Gibson, R.W. Thier and A.S. Munson. 1996. Optimal dose of an antiaggregation pheromone (3-methylcyclohex-2-en-1-one) for protecting live Douglas-fir from attack by Dendroctonus pseudotsugae (Coleoptera: Scolytidae). Journal-of-Economic-Entomology 89(5): 1204-1207.

Keywords: tree/stand protection
tree/stand health
stand conditions

Abstract: The Dendroctonus pseudotsugae antiaggregation pheromone, 3-methylcyclohex-2-en-1-one (MCH), was applied to stands of Douglas fir, Pseudotsuga menziesii
in Oregon, Montana, Idaho and Utah, at high risk for infestation to determine the lowest effective dose for protecting live trees. MCH was applied at rates of 50, 100, and 150 bubble capsules per hectare (20, 40, and 60 g/ha, resp.) in 1994, and 15, 30, and 50 bubble capsules per hectare (6, 12, and 20 g/ha, resp.) in 1995. Mean release rates throughout the beetle flight periods in 1994 and 1995 were 1.63 and 1.23 milligrams per capsule per day, resp. For both years, catches of Douglas fir beetles in pheromone-baited traps located at the plot centers were significantly lower on all MCH-treated plots compared with untreated plots, but there were no differences among the 3 doses of MCH. In contrast, MCH had no effect on the numbers of 3 predators (Thanasimus undatulus, Enoclerus sphegeus and Temnochila chlorodia [Temnoscheila chlorodia]) collected in the traps during either year. In 1994, the percentage of Douglas fir <more or =>20 cm diameter at breast height (dbh) that were mass attacked was significantly lower on MCH-treated plots compared with the untreated control, and all 3 doses were equally effective. In 1995, there were no significant differences in the percentage of mass-attacked trees among the treatments. These results demonstrate that MCH applied at rates as low as 20 g/ha (50 bubble capsules per hectare) can reduce the probability that high-risk Douglas fir will become infested.

OSU Link
Non-OSU Link

109. Rosso, P. and E. Hansen. 1998. Tree vigour and the susceptibility of Douglas fir to Armillaria root disease. European-Journal-of-Forest-Pathology 28(1): 43-52.

Keywords: fertilization
thinning
pruning
tree/stand protection
growth
tree/stand health
carbon allocation

Abstract: The effects of thinning, fertilization and pruning on the vigour of Douglas fir (Pseudotsuga menziesii) and its susceptibility to Armillaria root disease were investigated in Oregon, USA. Tree vigour was defined as the relative capacity for tree growth, expressed as the above-ground biomass increment per unit of photosynthetic tissue, or growth efficiency (GE). It has been hypothesized that trees with higher GE can better resist pathogen attack, and that GE can be used as a predictor of tree susceptibility to disease. In a previous study, four P. menziesii plantations were thinned, fertilized and pruned in all combinations, and the effects of these treatments on tree vigour were measured after 10 years. Root disease was not a factor in the initial study design, and mortality was ignored until 8 years after the treatments were applied. The results of an earlier study were utilized and the correlation between Armillaria root disease incidence and the effects of earlier stand treatments on tree growth was investigated. A. ostoyae [A. obscura] was the primary cause of mortality in the study area. The disease incidence of infected subplots ranged from 2 to 20%. A. obscura incidence was the highest at medium tree density (6.1%), slightly lower on the low density (5.6%) and lowest on the unthinned plots (3.8%). There were no significant correlations between disease incidence and previous tree growth. The vigour of trees that became symptomatic or died by 1993 was not significantly different from the vigour of trees that remained asymptomatic in 1983-85. On these sites, in areas of infection, A. obscura was causing mortality of the largest, fastest growing trees, as well as less vigorous trees. It is concluded that Armillaria continues to cause mortality, regardless of the growth efficiency or growth rate of the host.

OSU Link
Non-OSU Link

110. Roth, B.E. and M. Newton. 1996a. Role of Lammas growth in recovery of Douglas-fir seedlings from deer browsing, as influenced by weed control, fertilization, and seed source. Canadian-Journal-of-Forest-Research 26(6): 936-944.

Keywords: planting operations
release treatments
chemical release
fertilization
tree/stand protection
growth
tree/stand health

Abstract: This study examined the effects of weed control, nitrogen fertilizer, and seed source on Lammas growth (second flushing) in Douglas fir (Pseudotsuga menziesii) seedlings on 3 sites in the Oregon Coast Range. It also assessed the occurrence of deer (Odocoileus hemionus columbianus) browsing as related to these silvicultural treatments and examined the role of Lammas growth in seedling recovery and escape from deer browsing. Seedlings (averaging 54 cm tall, 6 mm diameter at 15 cm above ground) were planted in February 1992, and measured at the time of planting and in autumn

1992 and 1993. Complete weed control with hexazinone (annual applications + spot treatments as necessary) significantly increased the occurrence of Lammas growth. Nitrogen fertilizer (220 kg/ha urea) decreased Lammas growth significantly, at least in part by favouring weed growth. Lammas growth was not influenced by seed source (genetically improved from a seed orchard or local wild stock). The increased Lammas growth associated with weed control mediated the effects of deer browsing. Although multiple-year browsing occurred more commonly on weeded than unweeded seedlings, after two growing seasons weeded seedlings that were repeatedly browsed were twice as large as unbrowsed, unweeded seedlings. On one site, stock of wild origin was more heavily browsed than that from a seed orchard.

OSU Link
Non-OSU Link

111. Sandquist, R.E., D.L. Overhulser and J.D. Stein. 1993. Aerial applications of esfenvalerate to suppress Contarinia oregonensis (Diptera: Cecidomyiidae) and Megastigmus spermotrophus (Hymenoptera: Torymidae) in Douglas-fir seed orchards. Journal-of-Economic-Entomology 86(2): 470-474.

Keywords: seed orchard management
tree/stand protection
stand conditions

Abstract: Aerial application of esfenvalerate significantly reduced populations of Contarinia oregonensis and Megastigmus spermotrophus in mature seed orchards of Pseudotsuga menziesii in Oregon. Populations of Oligonychus ununguis increased significantly in treated areas. The results demonstrated that aerial applications can be made under conditions in the Pacific Northwest and can reduce insect damage levels with between 10 to 20-times less insecticide than when high-volume orchard sprayers are used.

OSU Link
Non-OSU Link

112. Schowalter, T.D. 1984. Dispersal of cone and seed insects to an isolated Douglas-fir tree in western Oregon. Canadian-Entomologist 116(10): 1437-1438.

Keywords: seed orchard management
tree/stand protection
tree/stand health

Abstract: An isolated 10-year-old Douglas fir tree (Pseudotsuga menziesii) in Oregon began to produce seed cones in 1983, and the 43 mature cones it produced were removed and dissected. Contarinia oregonensis and Megastigmus spermotrophus were present in 30% of the cones, and undeveloped seeds accounted for 93% of 3059 seeds examined. Of the potentially viable seed (7%), C. oregonensis fused 56% to galled scales, and M. spermotrophus consumed 21%. Ernobius punctulatus and Leptoglossus occidentalis caused seed losses of 8 and 3%, respectively, of the potentially viable seed. These results indicate that C. oregonensis and M. spermotrophus are capable of dispersing to new

resources over distances of at least 85 m. They are discussed in relation to the establishment of buffer zones around seed orchards.

OSU Link
Non-OSU Link

113. Schowalter, T.D. 1987. Abundance and distribution of Lygus hesperus (Heteroptera: Miridae) in two conifer nurseries in western Oregon. Environmental-Entomology 16(3): 687-690.

Keywords: nursery operations
tree/stand protection
tree/stand health

Abstract: Seasonal patterns of abundance and distribution of Lygus hesperus were observed at 2 conifer nurseries in western Oregon during 1985. Abundance differed significantly among conifer seedling types (age class-species combinations) and sampling dates. Highest densities were observed in lodgepole pine (Pinus contorta) and ponderosa pine (P. ponderosa) seedlings germinated during 1985, in Douglas fir (Pseudotsuga menziesii) seedlings germinated in 1984 and in late July samples. Significant interaction between seedling type and sample date reflected a shift in L. hesperus occurrence among seedling types during the growing season, especially from 1984 Douglas fir seedlings early in the season to 1985 seedlings later in the season. This shift coincided with the dispersal of the first L. hesperusgeneration and with pruning of the 1984 seedlings for height control. The results indicate that L. hesperus abundance and distribution in conifer nurseries result from L. hesperus phenology in combination with seasonal changes in the spatial pattern of available resources. The implications for nursery management are discussed.

OSU Link
Non-OSU Link

114. Schowalter, T.D. 1988. Tree breeding and insects: effect of insects on the genetic diversity of Douglas-fir. Northwest-Environmental-Journal 4(2): 346-347.

Keywords: seed orchard management
nursery operations
tree/stand protection
tree/stand health
reproduction
genetic relationships

Abstract: Two studies on the effects of insects on Douglas fir [Pseudotsuga menziesii] seed and seedling production in Oregon are summarized. In the first study, seed losses due to Douglas fir cone gall midge [Cecidomyiidae] and Douglas fir seed chalcid [Megastigmus spermotrophus] were studied. It is suggested that resistance to these pests may be a heritable trait and that tree position within a stand can modify genetically-controlled susceptibility to insect attack. The second study indicated that genetically-controlled susceptibility of seedlings to attack by lygus bug [Lygus sp.] could be modified by their proximity to alternative food plants.

OSU Link
Non-OSU Link

115. Schowalter, T.D. and M.I. Harverty. 1989. Influence of host genotype on Douglas-fir seed losses to Contarinia oregonensis (Diptera: Cecidomyiidae) and Megastigmus spermotrophus (Hymenoptera: Torymidae) in Western Oregon. Environmental-Entomology 18(1): 94-97.

Keywords: genetic tree improvement
seed orchard management
tree/stand protection
genetic relationships
tree/stand health

Abstract: Seed losses due to the cecidomyiid Contarinia oregonensis and the chalcid Megastigmus spermotrophus were measured in a Douglas-fir (Pseudotsuga menziesii) clonal seed orchard and in a Douglas-fir progeny plantation in western Oregon. Seed losses due to both insects differed significantly among clones and among the progeny of selected parental crosses. Seed loss differed more than 3 times between least-infested and most-infested clones or progeny. Seed losses in the progeny plantation indicated that resistance to these 2 insects is a heritable trait, with greater resistance showing a tendency to dominate over lesser resistance. Insect responses to host genotype may be modified by factors associated with the position of the tree within the stand. Implications of these results for tree improvement programmes and seed orchard management are discussed.

OSU Link
Non-OSU Link

116. Schowalter, T.D., M.I. Haverty, S.A. Dombrosky and J. Sexton. 1986. Response of Douglas-fir cone gall midge and Douglas-fir seed chalcid to host plant genotype. In Proceedings of the 2nd Conference of the Cone and Seed Insects Working Party, Station de Zoologie Forestiere, Olivet, France, September 3-5, 1986. Ed. A. Roques. pp. 217-223.

Keywords: genetic tree improvement
seed orchard management
tree/stand protection
genetic relationships
tree/stand health

Abstract: Seed losses due to 2 species of insects were measured from cones of 51 parental crosses (or families, distinct combinations of 6X11 parents) in a 12-year-old progeny plantation of Douglas fir (Pseudotsuga menziesii) in western Oregon. In 1983 and 1984, seed losses due to Contarinia oregonensis were significantly different among host families. During 1984, 4 of 5 families with the highest midge damage (x=79%) shared a common parent and 4 of 5 families with the lowest midge damage (43%) shared a common parent. This indicates that resistance or susceptibility to the cecidomyiid is probably heritable. Losses due to Megastigmus spermotrophus were measured only in 1984 and were also significantly different among host families. Insect responses to host genotype appeared to be influenced by the position of the tree within the plantation, by the size of the cone crop and, in the case of M. spermotrophus, by prior activity of C. oregonensis.

117. Schowalter, T.D., M.I. Haverty and T.W. Koerber. 1985. Cone and seed insects in Douglas-fir, Pseudotsuga menziesii (Mirb.) Franco, seed orchards in the western United States: distribution and relative impact. Canadian-Entomologist 117(10): 1223-1230.

Keywords: seed orchard management
tree/stand protection
tree/stand health

Abstract: Cones of Douglas fir (Pseudotsuga menziesii) were collected from 17 seed orchards in California, Oregon and Washington in the autumn of 1983; they were dissected, and seed losses were ascribed to Contarinia oregonensis, Megastigmus spermotrophus, Barbara colfaxiana and Dioryctria abietivorella. There appeared to be great differences between orchards, but overall C. oregonensis and M. spermotrophus collectively destroyed about 70% of the filled seed. Physiographic province significantly explained variation in damage by all insect species between orchards. In general, damage by all species increased from northern provinces to southern mountainous provinces. Damage by C. oregonensis and B. colfaxiana appeared to be related to land use management factors also.

OSU Link
Non-OSU Link

118. Schowalter, T.D. and J.D. Stein. 1987. Influence of Douglas-fir seedling provenance and proximity to insect population sources on susceptibility to Lygus hesperus (Heteroptera: Miridae) in a forest nursery in western Oregon. Environmental-Entomology 16(4): 984-986.

Keywords: nursery operations
tree/stand protection
tree/stand health

Abstract: The effect of Lygus hesperus feeding on seedlings of Douglas fir (Pseudotsuga menziesii) was measured in seedlings representing 2 elevation zones, for each of 2 seed zones, and each of 2 seedling age classes in a forest nursery in Oregon during 1984. Damage frequency and height reduction both indicated significant effects of seed source. Examination of seedling distance from the nursery's west boundary with a lucerne field (a major source of L. hesperus in the nursery) indicated a significant effect of proximity to alternative hosts. These results suggest that seedling susceptibility to damage by L. hesperus is a function of seedling condition and location within the vegetation matrix.

OSU Link
Non-OSU Link

119. Sexton, J.M. and T.D. Schowalter. 1991. Physical barriers to reduce damage by Lepesoma lecontei (Coleoptera: Curculionidae) to conelets in a Douglas-fir seed orchard in western Oregon. Journal-of-Economic-Entomology 84(1): 212-214.

Keywords: seed orchard management
tree/stand protection
tree/stand health

Abstract: Damage to Douglas fir (Pseudotsuga menziesii) conelets in Oregon by Lepesoma lecontei was significantly reduced by the application of a sticky barrier around the bole of the seed orchard trees. Early conelet injury was reduced from 25% in controls to 6% in sticky barrier treatments. No significant protection was observed in a test of a metal baffle placed around the bole. Significant treatment effects on cone survival could not be detected. Sticky barriers are a low-cost control that is highly pest specific and need be applied only to those trees producing a crop in a particular year.

OSU Link
Non-OSU Link

120. Shepherd, R.F. 1994. Management strategies for forest insect defoliators in British Columbia. Forest-Ecology-and-Management 68(2/3): 303-324.

Keywords: tree/stand protection
growth
tree/stand health
stand conditions

Abstract: A synthesis is presented of outbreak characteristics of common defoliating insects in forests (mainly Pseudotsuga menziesii) in British Columbia. Two types of outbreak are identified: fast-cycling and sustained outbreaks. Species with fast-cycling outbreaks rise quickly to visible defoliation levels, cause significant growth loss, tree deformation and mortality, and disappear just as quickly. Fast-cycle species noted include the Douglas fir tussock moth (Orgyia pseudotsugata), western blackheaded budworm (Acleris gloverana), black army cutworm (Actebia fennica [Ochropleura fennica]), western hemlock looper (Lambdina fiscellaria lugubrosa), false hemlock looper (Nepytia freemani), greenstriped forest looper (Melanolophia imitata), and the saddleback looper (Ectropis crepuscularia). The effect of such outbreaks is closely related to the severity of defoliation during the first year; consequently, the objective of managing these species should be to reduce populations before defoliation occurs, i.e. to prevent the outbreak. To accomplish this objective, identification of susceptible habitats and monitoring with sensitive pheromone traps in areas of expected outbreaks are necessary to detect upwelling populations. Species with sustained outbreaks (typified by the various species of spruce budworms (Choristoneura spp.), e.g., the western spruce budworm, C. occidentalis, the 2-year cycle budworm, C. biennis, and C. orae) cause significant growth losses only after defoliation continues for a number of years. Tree mortality usually is not important except where regeneration is being nurtured under a selective or shelterwood silvicultural system. Impact can be significant over the life of a stand because of the length and frequency of outbreaks, but treatments effective for only 1 year usually cannot be justified except where it is important to retain a full crown. Long-term cultural methods appear to be the preferred management system and, of these, utilizing non-host species or resistant or phenologically asynchronous host species may be the best option. Again, determining the location of expected outbreaks is an important component of a management system and, at present, identifying stands by frequency of outbreak within zones of climatic suitability would be useful in selecting treatment areas.

OSU Link
Non-OSU Link

121. Shepherd, R.F., T.G. Gray, R.J. Chorney and G.E. Daterman. 1985. Pest management of Douglas-fir tussock moth, Orgyia pseudotsugata (Lepidoptera: Lymantriidae): monitoring endemic populations with pheromone traps to detect incipient outbreaks. Canadian-Entomologist 117(7): 839-848.

Keywords: tree/stand protection
tree/stand health
stand conditions

Abstract: The numbers of adults of Orgyia pseudotsugata caught in sticky delta-shaped pheromone traps baited with different concentrations of synthetic lures were compared with egg-mass densities and subsequent tree defoliation throughout a population cycle in British Columbia. A lure containing 0.01% pheromone by weight in the form of a 3 x 5-mm poly(vinyl chloride) rod provided more consistent catches than pheromone concentrations of 0.0001, 0.001, 0.1 or 1.0%. Trap saturation occurred when over 40 moths per trap were caught. To achieve a standard error of 30%, 6 traps were required at each site. There was a poor correlation between numbers of moths caught and egg-mass density or defoliation estimates in the following generation, but a threshold density was found that provides a warning of an incipient outbreak. Ground surveys for egg-masses are recommended to confirm suspected infestations after continuous increases in moth catches for 2-3 years or if an average of 25 moths or more per trap has been caught.

OSU Link
Non-OSU Link

122. Shepherd, R.F., I.S. Otvos and R.J. Chorney. 1984a. Pest management of Douglas-fir tussock moth (Lepidoptera: Lymantriidae): a sequential sampling method to determine egg mass density. Canadian-Entomologist 116(7): 1041-1049.

Keywords: tree/stand protection
tree/stand health
stand conditions

Abstract: A sequential egg-mass sample system for Orgyia pseudotsugata (McDunn.) was designed, based on visual scanning of the lower branches of Douglas firs (Pseudotsuga menziesii) in British Columbia. A branch was removed from each quadrant from the upper, middle and lower crown level, and from the lowest whorl of a total of 59 non-defoliated trees in 10 areas. No consistent trend in egg-mass density per branch could be found between crown levels, so the lower whorl of branches was selected for survey purposes. Sample stop lines were determined from egg-mass density and variability data collected on 55 sites, and subsequent defoliation estimates were related to these densities. The system is designed as an early detection tool to be used only in non-defoliated stands at the incipient stage of an impending outbreak.

OSU Link
Non-OSU Link

123. Shepherd, R.F., I.S. Otvos, R.J. Chorney and J.C. Cunningham. 1984b. Pest management of Douglas-fir tussock moth (Lepidoptera: Lymantriidae): prevention of an outbreak through early treatment with a nuclear polyhedrosis virus by ground and aerial applications. Canadian-Entomologist 116(11): 1533-1542.

Keywords: tree/stand protection
tree/stand health

stand conditions

Abstract: Two application methods were tested using a nuclear polyhedrosis virus as a biological control agent at an early stage in an outbreak of Orgyia pseudotsugata on Douglas fir [Pseudotsuga menziesii] in British Columbia in 1981. The virus, which often leads to the development of an epizootic late in the outbreak cycle, was propagated in O. leucostigma. Four plots were treated from a helicopter at a dosage of 2.2 x 1011 polyhedral inclusion bodies (PIB) in an emitted spray volume of 11.3 litres/ha; 5-8 weeks after spraying, 77-100% of live larvae were infected. Two plots were treated from the ground at 2.4 x 1010 PIB in 4.5 litres/tree; 8 weeks after treatment 83-85% of live larvae were infected. No egg-masses could be found in the treated plots in the autumn of 1981, and no larvae were found on sample trees in 1982 or 1983. The treatment was effective over a range of initial mean larval densities of 41-206/msuperscript 2 foliage. Populations in untreated areas nearby increased in 1982. Little foliage protection was obtained the year of application, due to the lengthy virus incubation period, but the trees recovered quickly when larval populations disappeared.

OSU Link
Non-OSU Link

124. Simpson, D.G. 1990. Frost hardiness, root growth capacity, and field performance relationships in interior spruce, lodgepole pine, Douglas-fir, and western hemlock seedlings. Canadian-Journal-of-Forest-Research 20(5): 566-572.

Keywords: nursery operations
tree/stand protection
tree physiology
tree/stand health
growth

Abstract: Interior spruce (Picea glauca-P. engelmannii complex), lodgepole pine (Pinus contorta), interior and coastal Douglas fir (Pseudotsuga menziesii) and western hemlock (Tsuga heterophylla) were grown from seed for 20 wk in containers in a greenhouse, with 18-h photoperiods. Seedlings were then acclimatized under natural daylength and temperature conditions at Vernon, British Columbia, for up to 12 wk (7 September-1 December). To create planting stock batches of varying quality, at 2-wk intervals during the acclimatization period separate samples of seedlings were taken (1) for immediate measurement of foliage frost hardiness or (2) for overwinter storage at 2 degrees C (western hemlock and coastal Douglas fir) or -2 degrees C (interior spruce, lodgepole pine and coastal Douglas fir). After storage, samples were used either for root growth capacity (RGC) measurement or for outplanting at various forest sites in British Columbia. In all species, frost hardiness and RGC increased with increasing weeks of acclimatization. Frost hardiness and RGC were correlated with each other in western hemlock, lodgepole pine and Douglas fir, and with field performance (survival or growth) in interior spruce, lodgepole pine and Douglas fir.

OSU Link
Non-OSU Link

125. Stein, J.D. and G.P. Markin. 1986. Evaluation of four chemical insecticides registered for control of the Douglas-fir cone gall midge, Contarinia oregonensis (Diptera: Cecidomyiidae), and the Douglas-fir

seed chalcid, Megastigmus spermotrophus (Hymenoptera: Torymidae), in Douglas-fir seed orchards. Canadian-Entomologist 118(11): 1185-1191.

Keywords: seed orchard management
tree/stand protection
stand conditions
tree/stand health

Abstract: The control of Contarinia oregonensis and Megastigmus spermotrophus on Douglas fir (Pseudotsuga menziesii) in Washington and Oregon in 1982 and 1983 depended on the levels of infestation and which of 4 insecticides was used. There was no significant reduction in infestation of either pest when acephate was applied. Oxydemeton-methyl (by spray or injection) and dimethoate (in sprays) significantly reduced damage by C. oregonensis. These three compounds and azinphos-methyl were ineffective against M. spermotrophus for infestations affecting <10% of extractable seed. Oxydemeton-methyl injections, azinphos-methyl and dimethoate significantly reduced the incidence of the chalcid when infestation was high (61%). There was no statistically significant difference for pairwise comparisons between compounds that significantly reduced infestation with either pest.

OSU Link
Non-OSU Link

126. Stein, J.D., R.E. Sandquist, T.W. Koerber and C.L. Frank. 1993. Response of Douglas-fir cone and seed insects to implants of systemic insecticides in a northern California forest and a southern Oregon seed orchard. Journal-of-Economic-Entomology 86(2): 465-469.

Keywords: seed orchard management
tree/stand protection
tree/stand health
reproduction
stand conditions

Abstract: The systemic insecticides acephate, dimethoate and carbofuran were implanted into Pseudotsuga menziesii at Oakridge, Oregon and Willow Creek, California, to evaluate their effectiveness in reducing seed and cone insect damage. The acephate-implant treatment significantly reduced seed damage by Barbara colfaxiana and Contarinia oregonensis, and significantly increased the percentage of filled seed by 300% at the California site. Neither dimethoate nor carbofuran significantly affected any of the seed or cone insects encountered. Acephate was not effective against Megastigmus spermotrophus or Leptoglossus occidentalis. The association observed between C. oregonesis damage and undeveloped seeds suggested that management strategies that include effective control measures should also include methods to monitor and reduce seed abortion.

OSU Link
Non-OSU Link

127. Stein, W.I. 1997. Ten-year survival and growth of planted Douglas-fir and western redcedar after seven site-preparation treatments. Western-Journal-of-Applied-Forestry 12(3): 74-80.

Keywords: site preparation
chemical preparation
prescribed fire
tree/stand protection
growth
tree/stand health
stand conditions

Abstract: Western redcedar (Thuja plicata) and Douglas fir (Pseudotsuga menziesii) were planted together after applying seven site-preparation methods at one cable-logged site in the Oregon Coast Ranges. The treatments, applied during 1980, were: untreated control; spot clear by cutting; aerial spraying with glyphosate; broadcast burning; slash and burn; spray with Tordon 101 (picloram + 2,4-D) and burn; and burn and sow grass. Planting was done in early 1991, and vegetation and trees were measured periodically to 1990. Survival and growth of cedar were markedly less than Douglas fir on this favourable site where both species were components of the original stand. Repeated browsing severely impeded the cedar. Site preparation by broadcast burning generally yielded the best results, but sowing grass after broadcast burning produced Douglas fir responses similar to those for no site preparation. Where grass was sown, herbaceous cover was more abundant and taller, salmonberry (Rubus spectabilis) differed little in density but was slightly taller, and development of red alder (Alnus rubra) was delayed. Red alder is currently overtopping conifers in all treatments, and release is needed to ensure sufficient conifer survival.

OSU Link
Non-OSU Link

128. Stelzer, M.J. and R.C. Beckwith. 1988. Comparison of two isolates of Bacillus thuringiensis in a field test on western spruce budworm (Lepidoptera: Tortricidae). Journal-of-Economic-Entomology 81(3): 880-886.

Keywords: tree/stand protection
stand conditions
tree/stand health

Abstract: Two isolates of Bacillus thuringiensis (Thuricide 32LV [B. thuringiensis subsp. thuringiensis] and SAN-415 32LV) were compared for efficacy against Choristoneura occidentalis on Douglas fir (Pseudotsuga menziesii) and grand fir (Abies grandis) in Oregon. The insecticides were applied aerially at 20 and 30 billion International Units in a spray volume of 7.1 litres/ha. The 30 BIU/ha dosage provided better population control than 20 BIU/ha dosage with both formulations; however, only the difference between dosages for the SAN-415 32LV formulation was significant. Differences in efficacy between the isolates were not significant. The application of B. thuringiensis improved foliage protection by 15-25% compared with untreated plots.

OSU Link
Non-OSU Link

129. Stevenson, J.F., B.J. Hawkins and J.H. Woods. 1999. Spring and fall cold hardiness in wild and selected seed sources of coastal Douglas-fir. Silvae-Genetica 48(1): 29-34.

Keywords: genetic tree improvement
tree/stand protection
tree/stand health
tree phenology
growth

Abstract: Breeding for increased growth in coastal Douglas fir (Pseudotsuga menziesii) could affect the level of cold hardiness of seedlings used for reforestation. If increased growth is achieved by initiating growth earlier in the spring or prolonging growth later into autumn, cold hardiness could be reduced during these seasons. Cold hardiness was measured in top-cross and first generation seed orchard trees selected for increased growth rates, and wild stand trees on Vancouver Island and near Mission, BC, throughout one growing season by visual assessment of artificial freeze tests. Significant differences in freezing damage between genetically selected and wild stand trees were found during both spring and autumn. In April, LT50 of top-cross trees was 0.7-2.4 degrees C below that of wild stand trees, while in October, LT50 of wild stand trees was 1.9-3.4 degrees C below that of top-cross trees. Mitotic index was investigated as an indicator of dormancy, and a negative correlation between mitotic index and cold hardiness was found. A significant difference in mitotic index between the genetic groups was found once in March when mitotic index in wild stand and seed orchard trees was 1.4% and mitotic index in top-cross trees was 0.9%. There were no significant differences in mitotic index at any other times during the year. Date of bud burst and rates of shoot extension were related to levels of cold hardiness in the three groups of seedlings. The stage of bud burst in May was significantly correlated with levels of hardiness found earlier in March and April. Trees that completed shoot extension earlier in the season were significantly more hardy in autumn. Top-cross trees may extend their growing season later into the fall, thereby gaining a height advantage over wild stand seedlings. These top-cross families do not have an increased mid to late autumn frost damage risk, and in fact may have reduced risk of critical spring frost damage due to delayed deacclimation.

OSU Link
Non-OSU Link

130. 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

131. 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 (Pseudotsuga menziesii) 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

132. Summers, D. and G.E. Miller. 1986. Experience with systemic insecticides for control of cone and seed insects in Douglas-fir seed orchards in coastal British Columbia, Canada. *In* Proceedings of the 2nd Conference of the Cone and Seed Insects Working Party, Station de Zoologie Forestiere, Olivet, France, September 3-5, 1986. *Ed.* A. Roques. pp. 267-283.

Keywords: seed orchard management
tree/stand protection
tree/stand health
reproduction
stand conditions

Abstract: Three systemic insecticides were screened experimentally, and 2 of them used operationally, against cone and seed insects (especially Contarinia oregonensis, Megastigmus spermotrophus and Barbara colfaxiana), in seed orchards of Douglas fir [Pseudotsuga menziesii] on Vancouver I., British Columbia. Dimethoate, as a foliar spray, controlled the pests and increased the number of filled seeds per cone, making it the recommended choice. Oxydemeton-methyl, as a foliar spray, was as effective as dimethoate in controlling the insects but appeared less effective in increasing the number of filled seeds. Injections of oxydemeton-methyl were less effective than foliar sprays in controlling insect damage. Acephate as a foliar spray was inconsistent in the level of pest control achieved and as an injection gave poor results; its use was also associated with the development of serious outbreaks of Adelges cooleyi [Gilletteella cooleyi].

Non-OSU Link

133. Summers, D. and D.S. Ruth. 1987. Effect of diatomaceous earth, malathion, dimethoate and permethrin on Leptoglossus occidentalis (Hemiptera: Coreidae): a pest of conifer seed. Journal-of-the-Entomological-Society-of-British-Columbia 84: 33-38.

Keywords: tree/stand protection
stand conditions

Abstract: Field and laboratory studies were carried out in British Columbia in 1986 to test the efficacy of some insecticides against Leptoglossus occidentalis attacking Douglas fir (Pseudotsuga menziesii). The coreids were exposed to diatomaceous earth [diatomite], and sprays of 0.1 and 1.0% Lagon 2E (dimethoate) and 0.1 and 0.01% Ambush 50 EC (permethrin) in both laboratory and field tests and to 0.1% malathion in the laboratory. In field tests, permethrin and dimethoate caused significant mortality for 2 weeks after sprays were applied and permethrin continued to be effective for a 3rd week. Diatomite was not effective in the field tests or in 1 of 2 laboratory tests. Malathion, dimethoate and permethrin caused significant mortality in both laboratory tests.

OSU Link
Non-OSU Link

134. Tesch, S.D., G.M. Filip, S.A. Fitzgerald and D.D. Marshall. 1994. Silvicultural treatments for enhancing tree value, vigor, and growth in 70- to 120-year-old stands dominated by noble fir on the Warm Springs Indian Reservation: a synthesis of the literature. ForestResearch Laboratory, College of Forestry, Oregon State University. iii + 21 p.

Keywords: fertilization
thinning
pruning
tree/stand protection
growth
yield
tree/stand health

Abstract: The Warm Springs Indian Reservation, Oregon, apparently contains some 30 000 acres of naturally regenerated, largely unmanaged stands of 70- to 120-year-old mixed conifer forest dominated by noble fir (Abies procera), with Douglas-fir [Pseudotsuga menziesii], and some Pacific silver fir [Abies amabilis] and western hemlock [Tsuga heterophylla]. The synthesis focuses on growth and yield, thinning, pruning, fertilizer treatment, disease, minimizing stand damage during thinning, and insect pests.

Non-OSU Link

135. Thies, W.G. and C.Y. Li. 1988. Movement of Lauricidin in Douglas-fir stumps infested by Phellinus weirii. Northwest-Science 62(1): 16-20.

Keywords: tree/stand protection
tree/stand health

Abstract: Two concentrations of Lauricidin (monolaurin) in a carrier solution of dimethyl sulfoxide and EDTA, and the carrier solution alone were applied to holes drilled in the tops of Douglas fir (Pseudotsuga menziesii) stumps infested by Phellinus weirii. Half of the stumps were evaluated after 4 months and the rest after 32 months. Lauricidin did not appear to move significantly in the stumps or roots. Any effect of the treatments on survival of P. weirii occurred near the treatment application holes and appeared to be caused by the carrier solution. It was concluded that the formulation of Lauricidin tested in this study was relatively immobile in wood and for that reason a poor choice as a chemical for treating stumps to control P. weirii.

OSU Link
Non-OSU Link

136. Thies, W.G. and E.E. Nelson. 1987a. Reduction of Phellinus weirii inoculum in Douglas-fir stumps by the fumigants chloropicrin, Vorlex or methylisothiocyanate. Forest-Science 33(2): 316-329.

Keywords: tree/stand protection
tree/stand health

Abstract: Chloropicrin, Vorlex (both liquids) and methyl isothiocyanate (a waxy solid and an active ingredient in Vorlex) were placed in holes in stumps of Douglas fir, 47 yr old, on a site clear felled near Apiary, Oregon. Stumps with liquids were unsealed or sealed with a layer of asphalt roofing compound. Stumps of trees dead when felled were sealed with a plastic covering to reduce loss of fumigant through decayed or weathered wood. All fumigants at the lowest tested dosage reduced or eradicated P. [Inonotus] weirii from infested stumps and roots. There were small, if any, increases in effectiveness as a result of increased dosage, sealing with asphalt or covering with plastic. Chloropicrin and Vorlex were more effective than methyl isothiocyanate. Absence of significant effects may have resulted from large variations within treatments. Assessments of inoculum survival in untreated stumps were similar with aseptic isolation techniques and observations of fungal regrowth on cut surfaces of incubated root discs. Isolations from fumigated stumps indicated greater survival of I. weirii in roots than shown by fungal regrowth. Viable I. weirii was not found in most root discs where fumigant was detected by bioassay.

OSU Link
Non-OSU Link

137. Thies, W.G. and E.E. Nelson. 1987b. Survival of Douglas-fir injected with the fumigants chloropicrin, methylisothiocyanate or Vorlex. Northwest-Science 61(1): 60-64.

Keywords: tree/stand protection
tree/stand health

Abstract: The fumigants were introduced into holes drilled past the centre of trees uninfected, probably infected or definitely infected with Phellinus [Inonotus] weirii in a 47-yr-old stand near Apiary, Oregon. Test dosages of chloropicrin or methyl isothiocyanate (MIT) were applied in Mar. 1982 and of chloropicrin or Vorlex (containing MIT) in Apr. 1983. Of 120 trees treated with fumigant, 95 trees were still alive in mid-Sep. 1984. After 3 growing seasons, all 45 trees treated with MIT and 21 of 45 trees treated with chloropicrin were still alive. After 2 seasons, crown condition was poorer in trees treated with Vorlex than in untreated trees or those treated with MIT. Attempts were made to isolate I. weirii

from trees that died during the study. The fungus was isolated from all discs of an untreated tree, but from only 22% of root discs from 25 trees treated with chloropicrin or Vorlex. Roots have not been examined in trees still alive.

OSU Link
Non-OSU Link

138. Thies, W.G. and E.E. Nelson. 1996. Reducing Phellinus weirii inoculum by applying fumigants to living Douglas-fir. Canadian-Journal-of-Forest-Research 26(7): 1158-1165.

Keywords: tree/stand protection
tree/stand health

Abstract: In 1982, Douglas fir (Pseudotsuga menziesii) trees in the Oregon Coast Range were placed in three disease classes based on signs and symptoms of laminated root rot caused by Phellinus weirii. Eight fumigation treatments and an untreated check were applied to five replicate trees within each disease class. The dose applied to each tree was based on the estimated biomass in the below-ground portion of the bole, large roots, and first 2.4 m of the above-ground bole. The highest dosages tested were 1.5 g of methylisothiocyanate (MITC), 6.7 ml of chloropicrin (trichloronitromethane), and 6.7 ml of Vorlex (v/v 20% MITC, 80% chlorinated C3 hydrocarbons) per kg biomass. In 1991 the roots of all surviving trees were excavated (roots of other trees were excavated at time of death), dissected, and sampled for viable Phellinus weirii. Twenty-four of the 30 trees treated with the two highest dosages of chloropicrin were killed, presumably by the fumigant. None of 45 trees treated with MITC and only 3 of 15 trees treated with Vorlex died, as did 3 of 15 untreated check trees. Volume of stained and decayed roots occupied by viable Phellinus weirii was reduced 78-90% by MITC or Vorlex compared with reductions of 51-65% by chloropicrin at the two lower, less phytotoxic doses (0.5 or 0.25 times the maximum dose), and 9% for untreated checks.

OSU Link
Non-OSU Link

139. Thies, W.G., E.E. Nelson and D. Zabowski. 1994. Removal of stumps from a Phellinus weirii infested site and fertilization affect mortality and growth of planted Douglas-fir. Canadian-Journal-of-Forest-Research 24(2): 234-239.

Keywords: site preparation
mechanical preparation
fertilization
tree/stand protection
tree/stand health
growth
soil properties

Abstract: A field study was established in a 4.9 ha clearcut on the west slope of the Cascade Range (44 degrees 21'N, 122 degrees 39'W), Oregon, to evaluate the effects of stump removal (of both infested and non-infested stumps) and fertilizing with ammonium nitrate on the incidence of laminated root rot (caused by Phellinus weirii) in Douglas fir (Pseudotsuga menziesii) seedlings. A 2x4 set of factorial

treatments of stump removal in combination with nitrogen fertilizing was applied in August 1980 to 0.04-ha circular plots within the clearcut. Treatments included stump removal (either all stumps removed or the plot left undisturbed) and broadcast application of ammonium nitrate (0, 336, 672, or 1345 kg N/ha). Diameter at breast height and height of Douglas fir, planted as 2+1 bare root seedlings 4 months after treatment (in January 1981), were recorded 5 and 9 seasons after outplanting. Soil bulk density in the upper 20 cm was measured with a single-probe neutron densimeter. Stump removal reduced the number of seedlings killed by laminated root rot but had no significant effect on seedling growth. Stump removal increased soil bulk density only 7% as measured 9.7 years after treatment. Fertilizer increased the growth in diameter at breast height, and height growth of the seedlings but had no effect on mortality. There were no significant interactions between fertilizing and stumping treatments. Increased total soil N could still be detected on fertilized, nonstumped plots 9.7 years after treatment.

OSU Link
Non-OSU Link

140. Thies, W.G. and R.N. Sturrock. 1995. Laminated root rot in Western North America. Pacific Northwest Research Station, USDA Forest Service General Technical Report GTR-PNW-349. iv + 32 pp. p.

Keywords: planting operations
site preparation
mechanical preparation
fertilization
thinning
tree/stand protection
tree/stand health

Abstract: Laminated root rot, caused by Phellinus weirii, is a serious root disease affecting Douglas fir (Pseudotsuga menziesii) and other commercially important species of conifers in northwestern North America. This report gives an overview of the disease as it occurs in the Pacific Northwest in Canada and the USA. Information on recognizing crown symptoms and signs of the disease is presented. The disease cycle of laminated root rot, from initiation to intensification and distribution within infected stands, is described. Finally, disease management strategies during stand development and at stand regeneration are discussed. Features on the nomenclature of the fungus and on its management by silvicultural and mechanical approaches also are included.

OSU Link
Non-OSU Link

141. Wass, E.F. and R.B. Smith. 1997. Impacts of stump uprooting on a gravelly sandy loam soil and planted Douglas-fir seedlings in south-coastal British Columbia. Pacific-Forestry-Centre,-Canadian-Forest-Service Information-Report BC-X-368. vi + 15 p.

Keywords: site preparation
mechanical preparation
tree/stand protection
soil properties

stand conditions
growth

Abstract: Studies to determine levels and impacts of soil disturbance caused during root-disease control by stump removal were initiated on a cutover on southern Vancouver Island immediately prior to the control operation and the establishment of a plantation of Douglas-fir (Pseudotsuga menziesii). Soil surface condition was assessed on the stumped area. Soil disturbance was measured at 699 planting spots. Vegetation development was assessed at 10% of the spots. Of all planting spots, 180 were undisturbed soil, 277 deposits and 242 gouges. The soil, a gravelly sandy loam, increased naturally in soil density with depth from 1.05 t/msuperscript 3 at the surface to over 1.60 t/msuperscript 3 at depths more than 40 cm. Disturbance did not significantly increase soil density. Unlike previous studies of this nature, ease of soil penetrability was increased by the stump uprooting disturbance and vegetation development was not greatly dissimilar between disturbed and undisturbed soil. The relatively low soil impacts were attributed to the ability of the excavator to pile stumps without pushing topsoil, and the low site sensitivity to compaction. These low impacts on soil and reduced vegetative competition on disturbed soil resulted in tree growth rates which were significantly greater after 10 years on deposits (12% in height and 18% in diameter) and gouges (6% in height and 8% in diameter) than on undisturbed soil.

OSU Link
Non-OSU Link

143. White, T.L. 1987. Drought tolerance of southwestern Oregon Douglas-fir. Forest-Science 33(2): 283-293.

Keywords: genetic tree improvement
tree/stand protection
tree phenology
tree/stand health

Abstract: Seedlings of 2 open-pollinated families from each of 36 seed sources were tested for their ability to survive simulated drought in a growth room, greenhouse and cold frame. Generally, seedlings of sources from higher alt. and, to a lesser extent, drier sites were more drought tolerant. Seedlings from drought-tolerant sources tended to have earlier bud set, smaller initial ht. and less winter injury (needle mortality). The main selective force leading to earlier bud set and smaller ht. growth appeared to be the colder temp. regime at higher alt. Seedlings from higher alt. entered dormancy sooner and were better able to survive drought.

OSU Link
Non-OSU Link

144. Wilson, J. 2004. Vulnerability to wind damage in managed landscapes of the coastal Pacific Northwest. Forest-Ecology-and-Management 191(1/3): 341-351.

Keywords: planting operations
thinning
tree/stand protection

computer modeling
tree/stand health

Abstract: Managed forested landscapes in the coastal Pacific Northwest follow a pattern of transition from dominance by naturally regenerated second growth to dominance by planted stands. This transition should have dramatic influence on many characteristics of these landscapes and the larger region, including susceptibility to wind damage. In this paper, inventory and spatial information from an example landscape are integrated using the Landscape Management System to produce alternative management scenarios and evaluate the projections using a wind damage vulnerability rating system. Planted Douglas-fir stands tend to develop higher height to diameter ratios in the dominant trees, are thinned more often, and tend to have more exposed windward edges; characteristics which increase susceptibility to wind damage. In this analysis, the increasing vulnerability factors are mostly compensated for by the reduced rotation lengths expected in the plantations. The pattern of transition in managed landscapes generates an associated pattern of vulnerability to wind damage. Homogeneously and heterogeneously aged landscapes have distinct patterns of vulnerability. These differences could be harnessed to enhance the particular goals associated with managing individual ownerships.

OSU Link
Non-OSU Link

145. Wilson, J.S. and C.D. Oliver. 2000. Stability and density management in Douglas-fir plantations. Canadian-Journal-of-Forest-Research 30(6): 910-920.

Keywords: planting operations
thinning
tree/stand protection
tree morphology
tree/stand health

Abstract: Limited tree size variation in Douglas fir (Pseudotsuga menziesii) plantations in coastal Oregon, Washington, and British Columbia makes them susceptible to developing high height to diameter ratios (H/D) in the dominant trees. The H/D of a tree is a relative measure of stability under wind and snow loads. Experimental plot data from three large studies were used to evaluate the impact of initial planting densities and thinning on plantation H/D values. The H/D predictions from the experimental plot data match spacing trial results closely but are substantially different from distance-independent growth model predictions. The results suggest that plantation H/D values can be lowered and stability promoted through reduced planting densities or early thinning; however, later thinnings may not be effective in promoting stability, since they do not appear to lower H/D values. Higher initial planting densities shorten the time period during which thinning can be expected to effectively lower future H/D values. Time-sensitive thinning requirements in dense plantations make their management inflexible. The flexibility with which a stand can be managed describes the rigidity of intervention requirements and/or potential range of stand development pathways.

OSU Link
Non-OSU Link

146. Witmer, G.W., M.J. Pipas and J.C. Bucher. 1998. Field tests of denatonium benzoate to reduce seedling damage by pocket gophers (Thomomys talpoides Rich.). Crop-Protection 17(1): 35-39.

Keywords: tree/stand protection
tree/stand health

Abstract: The repellency of a bitter compound, denatonium benzoate, to reduce pocket gopher damage to conifer seedlings was tested in two independent field trials in Oregon and Idaho. In the Oregon trial (1992 to 1993), treatments included a denatonium benzoate tablet placed in-ground with the seedling roots; a tablet plus denatonium benzoate foliar spray applied to both roots and foliage; and no chemical application (i.e. control). No significant difference between treatments was noted for ponderosa pine (Pinus ponderosa) or Douglas fir (Pseudotsuga menziesii) seedlings suffering gopher-related mortality. Non-animal mortality (58.2% of all seedlings) accounted for a greater loss of seedlings than gophers (38.2%). Composite foliage and composite soil samples collected from the treatment plots were all negative for the presence of denatonium benzoate. In the Idaho trial (1993 to 1994), similar treatments (but with an additional spray-only treatment) were used on ponderosa pine seedlings. There was no significant difference in gopher-related mortality levels between treatments. A large portion (72.5%) of all seedlings was destroyed by gophers. It appears that the bitter compound, denatonium benzoate, as evaluated in these trials, is not an effective gopher repellent.

OSU Link
Non-OSU Link

147. Yarris, L. 1983. Cranberry girdlers eat trees, too. Agricultural-Research-USA 31(12): 14-15.

Keywords: nursery operations
tree/stand protection
tree/stand health

Abstract: Field observations and pheromone-trap monitoring carried out in Oregon, USA, by J.A. Kamm & L.M. McDonough showed that adults of the cranberry girdler [Chrysoteuchia topiaria (Zell.)], which is a serious pest of cranberries and grasses, migrated into nurseries of Douglas fir [Pseudotsuga menziesii], where eggs were laid and the hatching larvae fed on tap-roots, reducing seedling quality and vigour and in some cases killing the seedlings. This problem could be practically eliminated by applying diazinon to nurseries during the flight period of the pest, usually from mid-June to mid-July, followed by 1 or 2 applications of chlorpyrifos to control any larvae. In addition, wherever possible, grasslands bordering a nursery should be re-seeded to a crop on which C. topiaria does not feed, to reduce migration into the nursery, and weeds should be removed from vacant beds and a non-host cover crop planted.

OSU Link
Non-OSU Link