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NZ FOREST RESEARCH INSTITUTE LTD
PROJECT RECORD COVER SHEET

PROJECT RECORD NO.: 5482

DIVISION: FOREST TECHNOLOGY

RESOURCE CENTRE: SOILS AND SITE PRODUCTIVITY

CODE:

96 / 97	120	1301-4		CO4505	7-9
Financial Year	Resource Centre No.	Project	Sub-project	FRST Contract	Obj.

WORK PLAN NO.: **EXPERIMENT NO.:**

TITLE: TREE AND SITE RESPONSES TO MECHANICAL SITE PREPARATIONS - AN ANNOTATED BIBLIOGRAPHY

AUTHOR(S): J.A.C. HUNTER-SMITH, C.T. SMITH, J.D. GRAHAM **DATE:** JUNE 1996

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AUTHOR(S): J.A.C. HUNTER-SMITH, C.T. SMITH, J.D. GRAHAM

DATE: JUNE 1996

KEYWORDS: OPERATIONS, EFFECTS, SOILS, REGIONS, SPECIES

ABSTRACT*

A search of the relevant New Zealand and international literature and research reports was conducted using electronic and manual search methods. A bibliographic database was created using the CD-ROM facilities of the New Zealand Forest Research Institute (NZ FRI) National Forestry Library. Five literature searches were conducted using TREE CD (SilverPlatter International N.V.), which contains forestry-specific literature from 1939-1995 from CAB International in CD-ROM format, and CAB Abstracts in CD-ROM from 1987-1995. The CD-ROM searches used the following keyword combinations: site preparation and compaction and forestry; site preparation and compaction; site preparation and forestry; site disturbance; compaction and forestry. The keyword search involves seeking matches in the title, abstract, and keyword list for each citation in the full database. Each search result was downloaded to a bibliographic software database using *Reference Manager* (Institute for Scientific Information 1995), and stored separately after identifying and deleting duplicates.

Electronic and hand searches of the NZ FRI technical records system were conducted to identify relevant unpublished and published technical reports from relevant research programmes. This search was conducted using relevant trial numbers, research programme names, and names of forest and research staff. The NZ FRI database does not include abstracts; therefore the keyword search included such terms as ripping, bedding, mounding, cultivation, compaction, site establishment. Each reference obtained by this search of the NZ FRI technical records and obtained manually was checked for relevance, and manually added to the *Reference Manager* database.

References were retained in the database on the basis of relevance to the site preparation information needs of New Zealand foresters managing plantations of *Pinus radiata*. Reports on other species were retained in the database if they were able to link tree response to quantified changes in soil or site properties. Literature reporting site preparation machinery performance and operating costs, but not measuring the resulting effects on soil, site or tree response, were not retained in the site preparation database[1]. Non-mechanical site preparation techniques, including use of herbicides and burning were also retained in another *Reference Manager* database. The results of the site preparation literature search are contained in this annotated bibliography.

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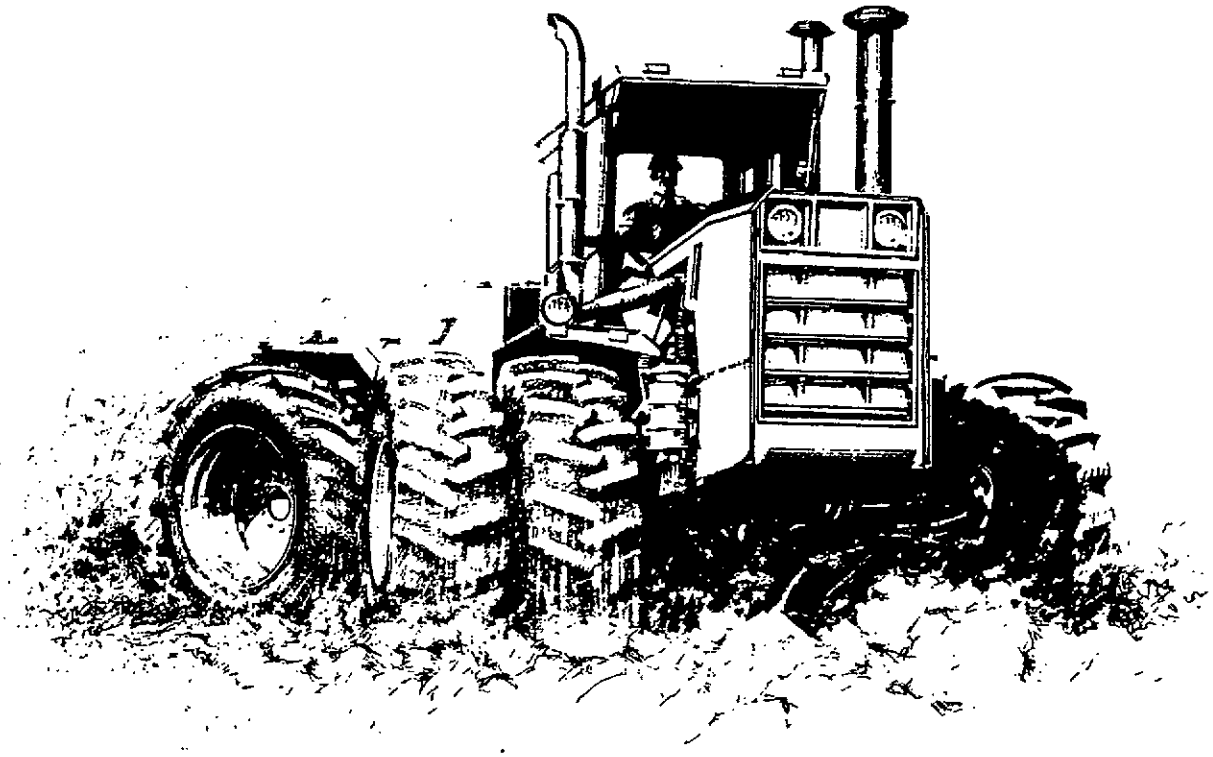
* **Note: This material is unpublished and must not be cited as a literature reference.**

[1] Machinery performance literature was retained in a *Reference Manager* database available for future work from NZ FRI, Soil and Site Productivity Research Group, Rotorua.

Tree and Site Responses to Mechanical Site Preparations

An Annotated Bibliography



Confidential to the NZ Forest Site Management Cooperative

TREE AND SITE RESPONSES

TO MECHANICAL SITE PREPARATIONS

An Annotated Bibliography

Submitted to:

New Zealand Forest Site Management Cooperative
Cooperative Report No. 80

By

J.A.C. Hunter-Smith, C.T. Smith, and J.D. Graham
New Zealand Forest Research Institute
ROTORUA

June 1996

PREFACE

Site preparation operations are often required to ameliorate problems occurring on sites to be planted with tree crops. Problems requiring correction for successful plantation establishment include soil conditions adverse for tree growth and nutrition (e.g. natural hard pans, welded tephra, wet clay subsoils), harvest residues hindering planting access, weeds, and out-of-season frost. Site preparation operations have been considered successful if they cause improved tree survival, growth, wind firmness, form, and harvest volume and value.

Extensive research has been conducted in New Zealand and overseas to identify the type of operation and equipment required to improve site conditions for tree growth. Studies have been conducted intensively by the New Zealand Forest Service and Forest Research Institute from the early 1960s through the late 1980s by Forest Establishment (FE), Propagation and Early Growth (PEG), Soil and Site Productivity (SSP), also known as Soil and Site Amendment, and Tree Physiology research groups. Foresters working in these programmes have periodically written reviews of the literature, syntheses of research results, and summaries of site preparation techniques being used operationally in New Zealand (e.g. Chavasse 1969a, 1969b, 1981; Chavasse and Brunsden 1976; Everts and Follett 1977; Hunter and Skinner 1986; Mason *et al.* 1993). However, because there is no single paper that summarises the current knowledge of the effects of site preparation for the whole country, much of the knowledge is inaccessible to New Zealand foresters.

A search of the relevant New Zealand and international literature and research reports was conducted using electronic and manual search methods. A bibliographic database was created using the CD-ROM facilities of the New Zealand Forest Research Institute (NZ FRI) National Forestry Library. Five literature searches were conducted using TREE CD (SilverPlatter International N.V.), which contains forestry-specific literature from 1939-1995 from CAB International in CD-ROM format, and CAB Abstracts in CD-ROM from 1987-1995. The CD-ROM searches used the following keyword combinations: site preparation and compaction and forestry; site preparation and compaction; site preparation and forestry; site disturbance; compaction and forestry. The keyword search involves seeking matches in the title, abstract, and keyword list for each citation in the full database. Each search result was downloaded to a bibliographic software database using *Reference Manager* (Institute for Scientific Information 1995), and stored separately after identifying and deleting duplicates.

Electronic and hand searches of the NZ FRI technical records system were conducted to identify relevant unpublished and published technical reports from relevant research programmes. This search was conducted using relevant trial numbers, research programme names, and names of forest and research staff. The NZ FRI database does not include abstracts; therefore the keyword search included such terms as ripping, bedding, mounding, cultivation, compaction, site establishment. Each reference obtained by this search of the NZ FRI technical records and obtained manually was checked for relevance, and manually added to the *Reference Manager* database.

References were retained in the database on the basis of relevance to the site preparation information needs of New Zealand foresters managing plantations of *Pinus radiata.*

Reports on other species were retained in the database if they were able to link tree response to quantified changes in soil or site properties. Literature reporting site preparation machinery performance and operating costs, but not measuring the resulting effects on soil, site or tree response, were not retained in the site preparation database[1]. Non-mechanical site preparation techniques, including use of herbicides and burning were also retained in another *Reference Manager* database. The results of the site preparation literature search are contained in this annotated bibliography.

The bibliography contains two sections. The first section is a subject index. This index was developed primarily around topics of interest to forest managers in New Zealand, with key words grouped under the headers Operations, operational Effects, Soils, Regions, and Species. Each key word is followed by a list of the relevant references contained in this volume according to their identification number (e.g. REF ID: 32). These lists were constructed from a computerised keyword search of the references contained in the second section using *Reference Manager*. The second section contains the final selection of references arranged alphabetically by author. Each reference has been assigned a number by *Reference Manager*, and each listing contains, in order; author(s), title, source (book/journal/NZ FRI project record etc.), keywords, and a summary (notes).

References from 1 to 355 are international published literature obtained from CD-ROM and manual searches. References 356 onwards are NZ FRI project records, internal reports and Cooperative reports, obtained from the NZ FRI technical records system. These are generally unpublished reports, many of which were used to develop the published papers written by New Zealand authors listed in references 1 to 355.

ACKNOWLEDGMENTS

The authors are grateful to for the support of the NZ Forest Site Management Cooperative; and for the efforts of the advisory committee in providing helpful guidance in the formulation and review of this project, including Elaine Birk, Peter Hall, Ron Reid, Robyn Simcock, Malcolm Skinner, Paul Stevens, and Graham Will.

[1] Machinery performance literature was retained in a *Reference Manager* database available for future work from NZ FRI, Soil and Site Productivity Research Group, Rotorua.

KEY WORD SEARCHES OF ANNOTATED BIBLIOGRAPHY
("/" denotes "OR")

OPERATIONS

rip / ripped / ripping
1, 2, 22, 23, 25, 29, 73, 85, 98, 100, 109, 110, 111, 117, 126, 131, 138, 146, 163, 176, 188, 189, 190, 191, 199, 203, 204, 246, 251, 260, 261, 268, 269, 276, 290, 291, 345, 350, 351, 352, 354, 355, 362, 368, 374, 358, 385, 388, 390, 395

bed / bedded / bedding
9, 20, 23, 43, 44, 46, 57, 77, 80, 117, 124, 126, 127, 136, 140, 142, 150, 190, 198, 211, 225, 229, 245, 247, 278, 279, 306, 316, 319, 321, 341, 352, 354, 355, 395

mound(s) / mounded / mounding
1, 14, 27, 65, 87, 108, 109, 111, 117, 142, 146, 150, 158, 166, 169, 200, 223, 231, 232, 300, 302, 303, 304, 321, 346, 352, 354, 355, 366

V-blade / V-bladed / V-blading
226, 226

ripping and bedding
23, 117, 126, 190, 352, 354, 355, 395

disc / disced / discing
9, 11, 23, 34, 48, 49, 55, 57, 73, 83, 84, 88, 89, 91, 100, 109, 113, 117, 122, 126, 148, 158, 163, 166, 172, 184, 186, 1912, 204, 211, 225, 226, 238, 245, 247, 250, 260, 261, 291, 318, 319, 331, 333, 341, 350, 351, 352, 354, 355

harrow / harrowing
44, 77, 151, 167, 173, 184, 192, 2465, 306, 3128, 351

windrow / windrowing
7, 11, 24, 67, 99, 129, 138, 142, 143, 146, 148, 151, 152, 181, 198, 211, 213, 220, 237, 250, 283, 284, 305, 306, 311, 321, 327, 331, 339, 357, 367

rake / raking
21, 26, 38, 88, 106, 114, 142, 143, 144, 146, 148, 162, 198, 217, 229, 228, 298, 342

pile / piling
8, 11, 38, 48, 80, 105, 106, 107, 113, 122, 172, 207, 208, 220, 237, 238, 250, 258, 311, 332, 333, 334

spot / patch
No references were found

EFFECTS

frost / frost injury / forest heave
23, 87, 135, 144, 147, 175, 182, 317, 363, 360, 408

wind damage
188, 290, 351, 359

rooting system(s) / rooting depth / root length / rooting pattern
25, 36, 86, 136, 242, 246, 251, 264, 290, 294, 326, 373

survival
1, 5, 13, 15, 17, 20, 22, 23, 29, 39, 44, 46, 56, 57, 77, 85, 86, 88, 89, 91, 98, 100, 111, 130, 132, 133, 135, 136, 138, 139, 144, 148, 150, 151, 152, 155, 163, 167, 172, 176, 189, 191, 199, 202, 203, 205, 206, 208, 217, 224, 226, 227, 232, 234, 236, 247, 251, 254, 261, 275, 276, 278, 281, 284, 291, 296, 302, 303, 308, 318, 321, 323, 325, 336, 342, 345, 346

tree form
185

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peat / peaty / peatlands
168, 186, 249, 319, 320

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385, 390, 414, 415, 418

yellow brown earths
191, 401, 402

podsol
373, 378, 416, 419, 420

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17, 152, 209, 318, 388

silt loam / silt loam soils
24, 302, 150, 346

sand / sandy soil(s) (NOT sand pine)
27, 41, 53, 61, 93, 102, 154, 160, 165, 172, 173, 179, 187, 189, 215, 219, 239, 263, 264, 265, 272, 285, 289, 293, 322, 349

gravel
73, 151, 152, 189, 246

loess
No references found

REGIONS

SPECIES

Ref ID : 1
1. Anonymous Plantation silviculture : inland southern tablelands [: the effect of site preparation on the growth of Pinus radiata]. *Annual Report of the Department of Forestry, Queensland 1971/72* 15-16. 1972.
Keywords : plantations; Silviculture; effects; site; Site preparation; growth; Pinus; ploughing; survival; height; increment; treatment; ripping; hoeing; Pinus radiata; mechanical methods; Conifers
Notes : Complete ploughing resulted in good survival and the best height and height increment at 6 years old; of the other treatments, plough-mounding and/or ripping proved superior to rotary hoeing, which in turn gave better results than no preparation.

Ref ID : 2
2. Anonymous Trends in land preparation methods for tree planting in Otago-Southland. *Farm Forestry* 17:105-106. 1975.
Keywords : land; land preparation; methods; Trees; Planting; trials; New; New Zealand; forestry; establishment; site; Site preparation; weeding; soil; ripping; mechanical methods
Notes : Recent trials by the New Zealand Forestry Service, show that improved tree establishment can be obtained by better site preparation (weeding and soil ripping to a depth of 18 to 24 in).

Ref ID : 3
3. Anonymous Proceedings of the Forest Seed, Nursery and Establishment Research Working Group, 3rd Meeting, Saasveld Forestry Research Station, George, South Africa, 1980. *1981, 85pp* , 1981.
Keywords : establishment; forestry; Forests; Seed; Nurseries; research; South Africa; Africa; Site preparation; Planting; Planting stock; seed treatment; treatment; Conferences; Forest Seed,Nursery and Establishment Research Working Group; site
Notes : Papers were presented on site preparation, conditioning of planting stock, and seed treatment.

Ref ID : 4
4. Anonymous Third technical workshop on forest plantations, Eldorado, Misiones, Argentina, 3-5 October 1984. Volume 1. *1984, iii + 190 pp* iii + 190 pp.; many, 1984.
Keywords : Forests; plantations; Forest plantations; Argentina; volume; establishment; management; pests; diseases; Site preparation; soil; Soil chemistry; chemistry; plant; Agroforestry; forest inventories; Insect pests; vegetative propagation; damage; Silviculture; analysis; Silvopastoral systems; research; education; site
Notes : Twenty-three papers are presented on plantation establishment and management, forest operations, pests and diseases, site preparation, soil chemistry, plant propagation, agroforestry and forest inventories.

Ref ID : 5
5. Anonymous Search for the perfect forest. *Chilean Forestry News* No. 88, 6-7; 2 pl.6-7, 1985.
Keywords : Forests; Reports; methods; Pinus; Pinus radiata; Planting; Planting stock; Nurseries; production; site; Site preparation; Subsoilers; ploughs; soil; fertilizers; Fertilizer application; application; sowing; insecticides; fungicides; New Zealand; mycorrhizal fungi; Fungi; applications; herbicides; Seedlings; cutting; Irrigation; transport; P; survival; growth; Nursery management; mycorrhizas; protection; root pruning; wrenching; Chile; mechanization; increment; height; New
Notes : A report on methods used to produce Pinus radiata planting stock at the 24-ha Biobio nursery of the Forestal Mininco Co., in Chile's Region VIII. Production stages include: site preparation in mid-Aug. using a subsoiler (working to 45 cm depth), followed by a 'chisel' plough to break up soil surface layer; fertilizer application (using a Dutch Vicon spreader), followed by use of a clod-crushing machine to form a 5-cm surface layer, ready for sowing and incorporating fertilizer, insecticides, and fungicides; sowing in early Oct., using a machine designed by the New Zealand Forest Service, followed by introduction of mycorrhizal fungi and the 2nd (and subsequent) applications of fertilizer and herbicides; undercutting in Jan. (seedling ht. 15 cm), followed by a wrenching operation repeated every 21 days; side cutting in March; and irrigation using 2 Perrot Rollamat irrigation machines. Stock is packed in specially designed waxed boxes prior to transport to planting site, where special shovels of New Zealand manufacture or Austrian planting machines are used in the final planting stage. P. radiata stock produced has a ht. of 30-35 cm, with basal diam. 6-8 mm. Survival rate after planting is 98%, with ht. growth in the 1st yr after planting of up to 1.17 m.

Ref ID : 6
6. Anonymous Pre-project study report on plantation establishment methods. *1988, ii + 88 pp* , 1988.
Keywords : Reports; plantations; establishment; methods; guidelines; soil; costs; maintenance; fertilizers; Fertilizer application; application; Trees; improvement; materials; Tests; Silviculture; Site preparation; reviews; Tree breeding
Notes : A report prepared for ITTO giving general guidelines and discussion for intensive soil preparation (methods, appropriate conditions, timing and intensity, cost, and plantation maintenance), fertilizer application (methods, examples, and plantation maintenance), and tree improvement (collection of materials, progeny tests, and clonal propagation).

Ref ID : 7
7. Adams, J.A. Long-term aspects of nutrient loss from forest soils and ecosystems. *New Zealand Journal of Forestry* 23:10-20, 1978.

Keywords : Forests; soil; aspect; nutrients; Losses; forest soils; soils; ecosystems; reviews; effects; Logging; clear felling; felling; skidding; site; Site preparation; burning; windrowing; maintenance; fertilizers; Fertilizer application; application; rotations; productivity; Soil chemistry; nutrient supply; nutrient depletion; Soil fertility; relation to soil; LOSSES FROM SOIL; Forestry practices
Notes : A review of the effects of logging practices (clear felling, roading, skidding) and site preparation (burning, windrowing) on the nutrient resources of a site. Net losses may occur, especially on strongly weathered and leached soils. 'Maintenance' fertilizer application is recommended in each rotation to maintain long-term productivity.

Ref ID : 8
8. Agaponov, N.N. Deep loosening of the soil for forest plantations in the Ukraine. *Lesovodstvo i Agrolesomelioratsiya* No. 77, 77-80.77-80.X, 1988.
Keywords : soil; Forests; Forest plantations; plantations; Ukraine; Pinus; slopes; Cultivation; Conifers; Artificial regeneration; Site preparation; Pinus nigra; Afforestation; stony soils; Tillage; Stones; USSR; Ukrainian SSR; forestry; loosening; Soil types textural; methods
Notes : On the basis of experience in Pinus nigra var. caramanica plantations on eroded stony slopes in the Crimea, recommendations are made on the best methods of soil cultivation. Deep loosening without soil inversion is best, with a distance of 0.7-0.8 m between passes of the implement. After soil loosening, large stones must be collected and removed or piled.

Ref ID : 9
9. Aho, T. The use of cultivation as an aid to forest management. *Proceedings, workshop on nursery and plantation practices in the ASEAN, Jakarta, Indonesia, 3 7 October 1983 [compiled by Aho,* T 315-330. Wellington,New Zealand, 1985.
Keywords : Cultivation; Forests; management; Forest management; Site preparation; discs; disc ploughs; ploughs; Hoes; Rippers; Conferences; Workshop on nursery and plantation practices in the ASEAN; mechanical methods; equipment; Forestry machinery; Cultivators; Bedders; site
Notes : Site preparation using disc ploughs, rotary hoes, rippers, ripper/moulders, bedding ploughs and ripper/bedders is discussed.

Ref ID : 10
10. Allen, H.L., Dougherty, P.M., and Campbell, R.G. Manipulation of water and nutrients - practice and opportunity in southern U.S. pine forests. *Management of water and nutrient relations to increase forest growth* Australia [edited by:E.K.S.-Ecology, 1990.
Keywords : nutrients; Forests; water; pines; responses; treatment; Site preparation; Drainage; weeds; weed control; control; information; research; nutrient availability; Silviculture; development; carbon; growth; application; investment; techniques; Conifers; USA; Southern States of USA; Pinus 'Southern'; Conferences; Management of water and nutrient relations to increase forest growth; fertilizers; Forestry practices; models; forestry; thinning; site; trials; productivity; production; New
Notes : Magnitude and duration of response of southern pine forests to operational silvicultural treatments including site preparation, drainage, weed control, thinning, and fertilization are reviewed. Current information for making silvicultural prescriptions has been developed largely from empirical trials. Silvicultural research has provided only a rudimentary understanding of how water and nutrient availability is altered through silviculture and how they influence stand productivity. Research indicates that many southern pine stands have leaf areas that are below what is theoretically considered to be optimal for maximum productivity. Leaf-area development appears to be limited by both nutrient and water availability. Few data are available to assess the role of changes in resource availability on leaf-area development, photosynthetic efficiency, carbon allocation, and growth attributable to silvicultural treatments. A conceptual model outlining the expected influence of silvicultural treaments on nutrient and water availability and thus on leaf-area development, carbon fixation, carbon allocation and stemwood production is proposed. Blending empirical information with a conceptual understanding of forest productivity should aid in developing silvicultural prescriptions that will help to ameliorate water and/or nutrient limitations, resulting in increased productivity. Major challenges impeding rapid application of existing technology are: lack of awareness of opportunities to increase productivity; inadequate capital for silvicultural investments due to uncertainty of the long-term supply and value of wood; and infrastructure barriers that slow the acceptance and implementation of new silvicultural techniques.

Ref ID : 11
11. Allen, H.L. and Wentworth, T.R. Vegetation control and site preparation affect patterns of shoot elongation for 3-year-old loblolly pine. *Proceedings of the international conference on forest vegetation management held at the School of Forestry, Auburn University, Auburn, Alabama, USA, 27 April 1 May 1992 [edited by Gjerstad, D* G. R.; Mitchell, R.R. J.-Journal, 1993.
Keywords : control; site; Site preparation; pines; vegetation; effects; morphology; Pinus; Pinus taeda; height; growth; seasons; Planting; North Carolina; measurement; Trees; treatment; chopping; stems; Slash; discing; weeds; weed control; Hexazinone; Glyphosate; weeding; Seedlings; herbicides; growth rate; Distribution; availability; chemical control; manual weed control; physical control; slashing; windrowing; increment; plant height; seasonal variation; shoots;

Conferences; Forest plantations; stand establishment; development; USA; Forest vegetation management
Notes : Effects of vegetation control and site preparation on the magnitude, morphology, and phenology of loblolly pine (Pinus taeda) height growth were investigated during the third growing season following planting in the Piedmont of North Carolina. Biweekly measurements were made of shoot elongation (by flush) throughout the 1984 growing season on a subsample of trees within three replicated plots receiving a factorial combination of 2 site preparation treatments (roller drum chopping, or shearing residual stems to ground level, then piling the slash into windrows and then discing) and weed control (none, partial control with hexazinone plus glyphosate, and complete control by hand weeding) treatments. Site preparation treatments were applied in summer 1981 and 1+0 loblolly pine seedlings were planted in March 1982. Herbicide was applied in April 1982 (hexazinone) and August 1982, 1983 and 1984 (glyphosate). Cumulative height growth on the most intensively treated plots was twice that found on the chopped-only plots, with weed control having a more pronounced positive effect than intensive site preparation. Superior height growth resulted principally from greater length per flush but also from an increased number of flushes. Trees on plots where vegetation was controlled averaged between four and five flushes compared with trees on chopped-only plots. which averaged three flushes. As growth rate of one flush slowed, growth rate of the subsequent flush accelerated, resulting in a rather uniform elongation rate for the shoot apex throughout most of the growing season. Treatment did not have much effect on seasonal distribution of growth and growing season length. Thus, intensive culture influence shoot growth rates and morphology, but not phenology. Apparently the effect of intensive culture was to improve the availability of limited environmental resources and, consequently, to increase growth rate throughout the growing season.

Ref ID : 12
12. Andersson, P.O. Plantation forestry in New Zealand. *Ekonomi, Forskningsstiftelsen Skogsarbeten* No. 5, 4 pp.; 4 pl.4 pp. 1979.
Keywords : plantations; forestry; New; New Zealand; site; Site preparation; tending; methods; Pinus radiata; plantations,general; silvicultural aspects
Notes : With particular reference to site preparation and stand tending methods.

Ref ID : 13
13. Armitage, I.P. The establishment of second-rotation radiata pine in Riverhead Forest. *NZ Journal Forestry* 14(2):184-194, 1969.
Keywords : establishment; pines; Forests; radiata pine; Trees; production; quality; Theses; weed; site; fertiliser; crops; soil; responses; regeneration; techniques; methods; Planting; costs; spacing; survival; manual; aspect; trials; vegetation; phosphate fertiliser; weed control; weeds
Notes : It is suggested that there are four principle factors which ensure successful establishment of young trees and form the first stage in the production of sawlogs and pulpwood in greater quantities and of better quality than have been grown in many first-rotation stands in Riverhead Forest. These factors are summarised as: (1) the necessity of having a clean or weed free site; (2) the use of well hardened nursey stock which is well planted; (3) Adequate early hand topdressing with a phosphatic fertiliser; and (4) Where necessary, timely releasing of the crops from competing regrowth vegetation.Planting trees which show a marked tolerance of low soil phosphate concentrations yet remain healthy and vigourous and/or demonstrate superior responses to topdressing is a further factor in achieving these production objectives.Natural regeneration is too sparse and irregularly distributed to be relied upon for successful establishment of second-rotation crops. In the paper, the techniques of achieving clean sites, tree-planting methods, planting costs, spacing and treestock survivals are discussed. Excellent results from manual topdressing young trees are indicated, while some aspects of fertiliser trials in Riverhead are outlined. Techniques for controlling competing regrowth vegetation are discussed.

Ref ID : 14
14. Attiwill, P.M., Turvey, N.D., and Adams, M.A. Effects of mound-cultivation (bedding) on concentration and conservation of nutrients in a sandy podzol. *Forest Ecology and Management* 11:97-110, 1985.
Keywords : effects; nutrients; podzols; Rome plough; ploughs; establishment; plantations; Pinus; Pinus radiata; organic matter; available; P; cations; mounds; Planting; control; pH; soil; Cultivation; ploughing; volume; costs; management; pines; soils; fertility; Site preparation; mechanical methods; Soil chemistry; nutrient contents; Australia,Victoria; Soil fertility; Soil cultivation; Forestry practices; Australia; Victoria
Notes : After mound-cultivation by Rome plough prior to establishment of a second-rotation plantation of Pinus radiata, organic matter, and hence total N, available P, and exchangeable cations, was concentrated in the centre of the mound (the planting line). The C/N ratio throughout the profile of both mounded and control plots was 20, and c.e.c. increased by 1 cmol(NH4+)/kg of organic matter. There were n.s.d. in total N, available P (Bray and Kurtz No. 2), c.e.c. (NH40Ac, pH 7), and exchangeable cations in the surface 40 cm of soil between mounded and control plots measured 9 yr after cultivation and mounding. Rome ploughing also resulted in a significant increase in wood volume and significant decrease in growing cost. Implications are discussed for management of second-rotation pine plantations on Australian soils of marginal fertility.

Ref ID : 15
15. Bacon, G.J. Investigations into radiata pine establishment on the Queensland granite belt. A review of findings and

the literature. *Research Paper, Department of Forestry, Queensland* No. 12, 75 pp.; 23 p:75 pp. 1979.
Keywords : radiata pine; pines; establishment; reviews; Queensland; environment; plantations; techniques; Nurseries; site; Site preparation; beating up; control; Grasses; competition; improvement; performance; intensive; ploughing; Seedlings; survival; growth; roots; wrenching; grading; shoots; pruning; dalapon; Pinus radiata; Australia; plantations,general; mechanical methods; silvicultural aspects; Planting stock; pre conditioning/adaptation to site; Conifers
Notes : The environment, existing plantations and current establishment techniques of the granite belt are briefly described. Local studies of nursery practices, site preparation, refilling (beating up) and control of grass competition are reviewed in detail. The most significant improvement in field performance is gained from intensive site preparation, especially line ploughing. Other practices shown to improve initial seedling survival and growth are stock conditioning by frequent root wrenching, stock grading (notably on the basis of shoot length and root collar diam.) and root dipping in a clay slurry. Shoot topping (top pruning) of transplants and beating up are not recommended. Dalapon (2,2-DPA) is toxic to recently planted seedlings. From author's summary.

Ref ID : 16
16. Bacon, G.J., Hawkins, P.J., and Ward, J.P. Productivity of commercial thinning operations in Queensland plantations: influence of alternative silvicultural options. *New Zealand Journal of Forestry Science* 12:308-323, 1982.
Keywords : productivity; thinning; Queensland; plantations; alternatives; effects; site; Site preparation; spacing; weeds; weed control; control; crown; pruning; types; growth; yields; Araucaria; Araucaria cunninghamii; Pinus; Pinus caribaea; P; stems; size; Harvesting; costs; Theses; Conferences; Economics and harvesting of thinnings; Silviculture; Pinus elliottii; Logging; Economics; Australia; weed
Notes : The effects of species choice, site preparation, initial spacing, weed control, pre-commercial thinning, green crown pruning and thinning types on growth and yield are discussed with particular reference to Araucaria cunninghamii, Pinus caribaea and P. elliottii. The effects of site preparation, weed control, row widths, av. stem vol., stage of thinning, stem uniformity, branch size, green crown depth, yield and row thinning on harvesting productivity and costs are discussed and examples given of changes in local silvicultural practices to allow for these effects.

Ref ID : 17
17. Ball, W.J. Site preparation affects white spruce seedling performance after 20 years. *Forest Management Note Northwest Region, Forestry Canada* No. 47, 7 pp.; 7 ref:7 pp. 1990.
Keywords : site; Site preparation; Seedlings; performance; Picea; Picea glauca; Manitoba; effects; Planting; soil; horizons; measurement; survival; diameter; height; increment; forest soils; blade ploughing; clay soils; Forest plantations; Forest trees; growth; Canada; trials
Notes : Transplants of white spruce (Picea glauca) were planted in 1963-65 in trials in Manitoba to determine the effects of blading and spading before planting on a soil with heavy clay B horizon. Measurements after 21-23 yr showed that summer blading (planting on the B horizon) improved long-term survival but had a profound, lasting negative effect on diameter and height increment.

Ref ID : 18
18. Ballard, T.M. and Hawkes, B.C. Effects of burning and mechanical site preparation on growth and nutrition of planted white spruce. *Information Report Pacific and Yukon Region, Forestry Canada* No. BC-X-309, vii +:vii + 19 pp. 1989.
Keywords : effects; burning; site; Site preparation; growth; nutrition; analysis; measurement; controlled burning; Picea; Picea glauca; height; Planting; British Columbia; pinopsida; nutrient reserves; Plant nutrition; increment; Canada
Notes : Foliar analysis and internode measurement were used to evaluate the effects of controlled burning and associated mechanical site preparation on white spruce (Picea glauca) height growth and nutrition in operational plantings in southern British Columbia.

Ref ID : 19
19. Balmer, W., Brooks, G.(., Pennock, C.M.,Jr., Barber, T.,Jr., Stevenson, W.L., Garner, J.W., Jeffries, K.F., Gonzalez, F.E., Pierce, C.F., Fox, W., Alter, N.B.,Jr., Carpenter, R.L., Douglass, J.E., Burns, R.G., and Kunselman, M.B. Proceedings: site preparation workshop - East. *1978, 60 pp* State and Private Fo, 1978.
Keywords : site; Site preparation; North Carolina; information; burning; Pinus; Virginia; fire; Georgia; herbicides; research; chemicals; pines; Florida; impact; equipment; Pinus taeda; alternatives; effects; soil; water; sediment; Forests; Forest management; management; Conferences; chemical methods; mechanical methods; USA
Notes : The workshop was held at Raleigh, North Carolina, on 8-9 Nov. 1977. An appendix gives information on site preparation programmes at 8 non-industrial privately owned locations in North Carolina. The following papers are included: Pennock, C. M., Jr. Prescribed burning for site preparation. - With special reference to Pinus spp. in Virginia. Barber, T., Jr. Site preparation using prescribed fire in Georgia [outline only]. Includes sample forms entitled 'Prescription Burning Agreement' and 'Prescribed Burning Plan'. Stevenson, W. L. Herbicides - what we know, what we need to know, and where do we go from here. [6 ref.] Garner, J. W. Herbicides for site preparation. - Based on research in Virginia. Jeffries, K. F. Use of aerial herbicides in North Carolina. Gonzalez, F. E. Chemical pine site-preparation with 'Velpar' gridball brush killer. Pierce, C. F. Heavy site preparation in Florida. Fox, W. Site preparation - impact of heavy equipment. Alter, N. B., Jr. Site preparation using heavy equipment. Carpenter, R. L. Site preparation with fertilizers/drainage.

-Including research in Pinus taeda. Douglass, J. E. Site preparation alternatives: quantifying their effects on soil and water resources. Burns, R. G. Sediment export in pine forest management. [3 ref.] Kunselman, M. B. Landowner objectives.

Ref ID : 20
20. Balmer, W.E., Hallbick, D.C., Runge, N.W., Campbell, R.G., Clutter, J.L., Fortson, J.C., Shiver, B.D., Kellison, R.C., Heeren, R.D., Jones, S., Pritchett, W.L., Haines, L.W., Haines, S.G., Allen, V.H.,Jr., Wells, C.G., Bengtson, G.W., Belanger, R.P., Hatchell, G.E., Moore, G.E., Maki, T.E., McKee, W.H., Langdon, O.G., Hammond, W.J., Martin, J.P., Maxwell, K.F., and Crutchfield, D.M. Proceedings: Sixth Southern Forest Soils Workshop, Charleston, SC, October 19-21, 1976. *1978, 143 pp* Southeastern Area, S:State & Private Fore, 1978.
Keywords : Forests; forest soils; soils; classification; South Carolina; Drainage; coastal plain soils; Pinus; Pinus taeda; North Carolina; site; Trees; age; plantations; Site preparation; Slash; pines; treatment; survival; soil; phosphorus; P; nutrients; Cycling; fertilizers; technology; Silviculture; Stand characteristics; Reports; Georgia; impact; performance; nutrient deficiencies; Planting; productivity; application; responses; nitrogen; Tests; increment; water relations; Pinus elliottii; Insect pests; Coleoptera; Dendroctonus frontalis; host relations; Pinus serotina; NPK fertilizers; sewage; drainage,land; effects; Southeastern States of USA; Soil types; site class assessment; growth; soil factors; Conferences; Florida; yields; USA
Notes : The workshop was sponsored by the Southern Forest Soils Council; 11 papers and 6 field trip presentations are included: Hallbick, D. C. Classification of the soils in the Atlantic Coastal Plain. [2 ref.] Runge, N. W. Major forest soils in the South Carolina low country. [3 ref.] Campbell, R. G. Drainage of lower coastal plain soils [7 ref.] In 2 natural stands of Pinus taeda in North Carolina with equal 25-yr site index, trees on well-drained soils were approx. 10 ft taller than trees on poorly-drained soils at age 50 yr. In a 13-yr-old plantation, vol. in stands at 330 ft from a drainage was 800ft3/acre, at 1000 ft, 76 ft3/acre. Clutter, J. L.; Fortson, J. C.; Shiver, B. D. Some relationships between soils and site preparation in flatwoods slash pine plantations. -On well-drained soils, site index averaged 5.7 ft higher on bedded than on non-bedded sites. On poorly-drained and hardpan soils, site index for 4 site preparation treatments was n.s.d. Vol., % survival, and number of stems/acre were n.s.d. between both site preparation treatments and soil series group. Kellison, R. C.; Heeren, R. D.; Jones, S. Species selection as related to soils in the Atlantic Coastal Plain. [8 ref.] Pritchett, W. L. Phosphorus fertilization of pine [P. elliottii; P. taeda] in the Atlantic Coastal Plain. [8 ref.] Haines, L. W.; Haines, S. G.; Allen, V. H., Jr. Fertilizing established loblolly pine stands. [6 ref.] Wells, C. G. Nutrient cycling and its relationship to fertilization. [13 ref.] N, P, and K in a 16-yr-old Pinus taeda plantation in North Carolina. Bengtson, G. W. Outlook for improved fertilizers and fertilizer technology in silviculture. [24 ref.] Belanger, R. P.; Hatchell, G. E.; Moore, G. E. Soil and stand characteristics related to southern pine beetle [Dendroctonus frontalis] infestations: a progress report for Georgia and North Carolina. Maki, T. E. Impact of site manipulation on the Atlantic Coastal Plain. McKee, W. H. Soil-site relationships for loblolly pine on selected soils. [5 ref.] In South Carolina. Langdon, O. G.; Hatchell, G. E. Performance of loblolly, slash, and pond [Pinus serotina] pines on a poorly drained site with fertilization at ages 11 and 14. [6 ref.] In a wet savannah in South Carolina, correcting nutrient deficiencies 11 to 14 yr after planting can raise site productivity from very low to av. Hammond, W. J. Application of N&P at planting [1 ref.] In Pinus taeda. Martin, J. P. North Carolina State Forest Fertilization Cooperative Second Regionwide Study: 2-year results. [2 ref.] In Pinus taeda. Haines, L. W.; Maxwell, K. F. Response of 7-year-old loblolly pine to nitrogen and phosphorus fertilization. - In South Carolina. Crutchfield, D. M. Test of municipal waste for forest soil amelioration. [3 ref.] In Pinus taeda.

Ref ID : 21
21. Balneaves, J.B., Skinner, M.F., and Lowe, A.T. Improving the re-establishment of radiata pine on impoverished soils in Nelson, New Zealand. Long-term Field Trials to assess Environmental Impacts of Harvesting. In.Dyck WJ and Mees CA. Rotorua, NZ:Forest Research Institute. Bulletin No. 161(IEA/BE T6/A6 No.5):137-150, 1991.
Keywords : radiata pine; pines; soils; New; New Zealand; Logging; crops; Forests; Slash; slopes; trials; treatment; burning; available; P; Cultivation; effects; weed; weed control; control; site; costs; Planting; Trees; growth; roots; age; volume; improvement; foliage; analysis; application; information; fertiliser; environmental impact; impact; Harvesting
Notes : Following logging of first crop radiata pine in the Nelson forests, the residual slash is root-raked into windrows on the contour of the slopes or into gullies. A trial to compare this treatment with broadcast burning and slash retention demonstrated that root-raking displaces about 3000 kg of N/ha and markedly reduces the amount of available P, K, and Mg. Because of its cultivation effect weed control on root-raked site was twice the cost of weed control on the burnt or slash retention sites. Following planting initial tree growth was faster on the root-raked site but by age 4 year, trees planted into the slash retention site were 50% bigger by volume than those planted on the root-raked site. Those trees planted into the burnt site showed a 20% improvement in volume over the root-raked site. Foliage analysis of the trees showed declining N, P, and B levels such that by age 4 trees in the root-raked site were deficient in P and B, and only just adequate for N. Foliar levels of N, P, and B in the trees on the slash retention site remained adequate for tree growth, while on the burnt site trees were deficient in B by age 4 years. An application of 80 g DAP fertiliser at planting, while improving tree growth, had a short-term benefit on tree foliage levels and this had disappeared by age 4 years, particularly for those trees planted into the root-raked site. On the basis of this trial and other information published elsewhere recommendations are made to cease root-raking as a means of preparing sites for planting after logging of the first crop.

Ref ID : 22
22. Balneaves, J.M. Grass control for radiata pine establishment on droughty sites. *New Zealand Journal of Forestry* 27:259-276, 1982.
Keywords : Grasses; control; radiata pine; pines; establishment; site; trials; New Zealand; methods; survival; growth; Seedlings; Planting; herbicides; application; weeds; weed control; costs; Hexazinone; ripping; diammonium phosphate; nozzles; cones; chemical treatment; mechanical methods; Site preparation; Pinus radiata; testing; Amitrole; simazine; 'DPA'; usage; Economics; chemical vs.cultural weed control; spraying; spot spraying; sprayers; Conifers; New; weed
Notes : Published and unpublished results are given of trials in North and Central Canterbury, New Zealand. Grass control by various methods improved survival, ht. and diam. growth of seedlings for up to 8 yr after planting. In trials using some 12 herbicides, a pre-planting application of a simazine/amitrole [aminotriazole]/'DPA' combination gave effective weed control, but equally good results at half the cost were obtained using hexazinone in the early spring following planting. In another trial, a combination of ripping and weed control increased survival, ht. growth and b.a. more than weed control or ripping alone; weed control gave better survival than ripping. Fertilizing with diammonium phosphate in the absence of weed control gave worse survival than not fertilizing. Broadcast application of herbicides gave the best results for survival and growth, but the cheaper method of spot gun application with a flat fan nozzle was better than with a solid cone nozzle. Estimates are given for the costs of grass control using hexazinone applied by various methods.

Ref ID : 23
23. Balneaves, J.M. Frost damage, survival, and growth of Pinus radiata, P. muricata and P. contorta seedlings on a frost flat. *New Zealand Journal of Forestry Science* 18:161-165, 1988.
Keywords : damage; survival; growth; Pinus; Pinus radiata; P; Seedlings; Cultivation; treatment; ripping; discing; New Zealand; Trees; measurement; height; diameter; yields; soil; Conifers; frost injury; Site preparation; Pinus muricata; Pinus contorta; mechanical methods; site; New; Theses; intensive; Soil cultivation
Notes : Three cultivation treatments (ripping only, discing and ripping, and ripping and bedding) were tested on a frost-prone site in Otago, New Zealand. Incidence of frost damage and tree survival and growth were compared for 1+1 and 1.5+0 P. radiata, and 2+0 P. muricata and P. contorta, planted in 1977. Frost damage, survival, and growth measurements (height and diameter) were made at intervals to 1986. Frost damage to P. radiata and P. muricata was severe on uncultivated plots but was significantly reduced on the intensely cultivated plots; rip/bed sites gave the best results. Survival of these species followed similar trends. P. contorta was relatively unaffected. P. radiata (1.5+0) did not grow well on the uncultivated plots, and growth responded markedly to ripping. More intensive cultivation did not yield additional growth. Growth of P. muricata and P. contorta did not improve significantly with soil cultivation.

Ref ID : 24
24. Balneaves, J.M. and Dyck, W.J. Slash retention a viable option to ensure sustained site productivity? *New Zealand Forestry* 37:13-16, 1992.
Keywords : Slash; site; productivity; effects; Logging; Site preparation; burning; windrowing; nutrients; Planting; New Zealand; stems; Biomass; pines; Pinus; Pinus radiata; mixtures; Eucalyptus; Acacia; height; basal area; Trees; crops; litter; depletion; removal; Harvesting; Conifers; whole tree logging; Losses; Soil fertility; logging effects; Silt loam soils; forest soils; forestry; Soil types ecological; New; radiata pine; P
Notes : The effect of logging and site preparation (burning and windrowing) on nutrients at the planting site and on long-term site productivity in New Zealand is discussed. Studies have shown that relatively small amounts of nutrients are lost in harvested stem biomass on most sites; burning and windrowing can remove substantially more nutrients. On the Canterbury Plains, windrowing displaced up to 2500 kg N from the scalped areas into the windrow heaps. The effect was studied of logging intensity and site preparation in a 7-ha stand of mature radiata pine (Pinus radiata) grown in mixture with Eucalyptus and Acacia on stony Lismore silt-loam, Canterbury. The stand contained 940 stems/ha with a mean height of 18 m and a total basal area of 49 m2. It was estimated that the stand contained 143 t stemwood and bark/ha. The tree crop contained 389 kg N/ha, 43 kg P/ha and 308 kg K/ha. The litter layer contained 653 kg N/ha, 35 kg P/ha and 142 kg K/ha. Eight plots (60X30 m) were whole-tree harvested and 8 plots were log-only harvested (December 1989 to February 1990). Residual logging slash, litter and (in some plots) 10 cm of topsoil were removed on 36 smaller plots (10X10 m) to simulate windrowing. Estimates of N depletion were 3% for log-only removal, 6% for whole-tree harvesting and 40% for windrowed plots; estimates of P depletion were 15%, 26% and 62%, respectively; estimates of K depletion were 18%, 30% and 61%, respectively. Depletion of Ca and Mg was not as severe.

Ref ID : 25
25. Balneaves, J.M. and De-la-Mare, P.J. Root patterns of Pinus radiata on five ripping treatments in a Canterbury forest. *New Zealand Journal of Forestry Science* 19:29-40, 1989.
Keywords : roots; Pinus; Pinus radiata; ripping; treatment; Forests; Planting; Trees; control; development; sweep; Rippers; soil; Conifers; Site preparation; mechanical methods; New Zealand; Distribution; root systems; stem form; site; stems
Notes : Root systems were compared 8 years after planting of 30 Pinus radiata trees excavated from each of five different ripping treatments and an unripped control. Tap roots of trees from deep-ripped (100 cm) treatments penetrated to a far greater depth (153 cm) than those from the shallow-ripped (60 cm) treatment. Tap roots of trees planted on the unripped site penetrated to a maximum depth of 48 cm because of the presence of a hard pan. A single line rip (deep or

shallow) resulted in some orientation of primary lateral roots. This orientation became more pronounced in the secondary lateral roots, which were confined to the line of the rip. Although lateral roots were more evenly distributed in the unripped and cross-ripped treatments, least development was in the north-east quadrant and greatest development in the south-west. The number of butt-swept trees was not significantly affected by treatment but the severity of stem deviation and sinuosity resulting from initial butt sweep was related to treatment. The straighter the tap root and the deeper its penetration, the less stem deviation. It is suggested that all sites with a shallow hard pan be deep ripped, using winged rippers, to maximise soil disturbance, and that forests on the Canterbury Plains have rows orientated south-west to north-east.

Ref ID : 26
26. Banker, R.E., Miller, J.H., and Davis, D.E. First-year effects of rootraking on available nutrients in Piedmont Plateau soils. *General Technical Report, Southeastern Forest Experiment Station, USDA Forest Service* SE-24, 23-25; 7 ref.23-25, 1983.
Keywords : effects; available; nutrients; soils; infiltration; soil; treatment; ridges; slopes; Conferences; Southern Silvicultural Research Conference; forest soils; Site preparation; Soil water movement; Forestry practices; USA; Georgia
Notes : The effects of rootraking on the levels of Ca, Mg, K, PO4 and Na and on infiltration rates in Piedmont Plateau soils were investigated. Soil samples were taken before and after treatments at 10-foot intervals along permanent 100-foot lines located on the ridge, upper slope and lower slopes. Samples were taken at 0-2, 2-4, 4-6, 6-12, 12-18 and 18-24 in. depths and composited. Infiltration rates were measured with a double-ring infiltrometer. There was a general tendency toward nutrient increase at almost all depths with some differences significant at the 5 and 10% levels. A major increase in the PO4 content was found at the 4-6 and 6-12 in depths. Infiltration rates decreased.

Ref ID : 27
27. Bassman, H.J. Influence of two site preparation treatments on ecophysiology of planted Picea engelmannii X glauca seedlings. *Canadian Journal of Forest Research* 19:1359-1370, 1989.
Keywords : site; treatment; Picea; Seedlings; Site preparation; Forests; British Columbia; soil; materials; control; effects; water; growth; Planting; soil temperature; temperature; Soil water; soil water potential; responses; density; water stress; roots; diameter; height; Biomass; Conifers; Canada; Picea engelmannii X P.glauca; mechanical methods; types; Soil physics; Plant water relations; seedling growth; soil water content; forestry; mounds; vegetation; P; water relations; seasons; Theses; stems
Notes : Two treatments were applied at 2 neighbouring sites at 1550 m altitude in the Cariboo Forest Region, British Columbia, viz. (1) mounding, in which mounds were created by heaping 4-litre buckets of B-horizon mineral soil such that the organic mat was sandwiched between the in situ soil profile and the 15 cm deep mound, and (2) scarification, in which 0.5 m2 patches in which all vegetation and organic material were removed down to bare mineral soil. In (1), P. engelmannii X P. glauca seedlings were dibble planted into mounds; in (2), seedlings were planted on the N. side of patches with access to adjacent decomposing organic material; in controls, seedlings were planted through the undisturbed organic mat. The effects were evaluated of site treatment on microclimate, water relations, photosynthesis and growth of planted seedlings over three growing seasons from the time of planting in 1981 and 1982. Mounding increased soil temperatures by up to 40% at depths of 5 and 12 cm (but not at 30 cm) during periods of dry, clear weather. Scarification resulted in small increases in soil temperature only at the 5 cm depth. Soil water potential and soil water content were lower in mounds, but similar in scarified patches and controls from midsummer through autumn. Transpiration, leaf conductance, and xylem pressure potentials were generally reduced by mounding and to a much lesser extent by scarification. These responses were complicated by interactions with leaf to air vapour density differentials and possibly by soil temperatures. Treatments had no significant effects on diurnal or light responses of photosynthesis. Mounding increased stem and needle weights during the first half of the growing season in the first 2 years after planting, but growth was reduced later in the season, probably as a result of increased water stress. Root growth in mounds was significantly greater than in scarified patches and controls in all 3 years. Growth patterns for seedlings planted in scarified patches and control treatments were similar. By the end of the third growing season after planting, seedlings in mound treatments had greater stem diameters, and total seedling weight was more than twice that of controls, but there was little difference in height. Seedlings in scarified patches were similar to controls in diameter and height, but had slightly greater total weights. The results suggest that the positive effects of improved soil temperatures and root growth in mound treatments were negated to a large extent by increased water stress in the first two seasons. By the third growing season, roots were beyond significant drying influence of the mound and their greater length and mass served to increase seedling biomass substantially.

Ref ID : 28
28. Bengtson, G.W. Nutrient conservation in forestry: a perspective. *Southern Journal of Applied Forestry* 5:50-58, 1981.
Keywords : nutrients; forestry; reviews; effects; Harvesting; site; Site preparation; techniques; depletion; pines; Forests; P; Pinus 'Southern'; fertilizers; USA,southern; Soil chemistry; nutrient depletion; USA; Conifers
Notes : A review of the effects of different harvesting and site preparation techniques on nutrient depletion in southern pine forests, and of current fertilization practices with special reference to N and P.

Ref ID : 29

29. Berg, P.J. Developments in the establishment of second rotation Radiata Pine at Riverhead forest. *New Zealand Journal of Forestry* 20:272-282, 1975.
Keywords : development; establishment; rotations; radiata pine; pines; Forests; effects; Site preparation; ripping; fertilizers; herbicides; treatment; survival; growth; Pinus; Pinus radiata; Seedlings; ridges; machinery; superphosphate; application; height; responses; control; vegetation; weeds; weed control; soil; Soil cultivation; Cultivation; Planting; beating up; Trees; tractors; Logging; soil compaction; compaction; standards; mechanical methods; chemical methods; cultivation,soil; or before establishment; Conifers; trials; site; weed
Notes : Describes a series of trials in the Riverhead Forest, N. Auckland, to assess the effects of site preparation by deep ripping, fertilizer and herbicide treatments on the survival and early growth of second-rotation Pinus radiata seedlings planted on natural clay ridges, and on areas compacted by the passage of heavy machinery. Results showed that ripping and superphosphate application increased height growth and survival %, particularly when the treatments were combined. There was also a significant response to the control of competing vegetation. When weed control was applied in combination with soil cultivation and fertilizing, an increase in height growth of >50% was achieved in the first year after planting and the need for beating up or release of trees following planting was eliminated; this indicates a probable reduction in the length of the rotation. It is suggested that, in future, tractor logging should be replaced wherever possible by powered cable logging to reduce soil compaction. Since the ripping trials were so successful, deep ripping has now been adopted as standard practice in the Riverhead Forest.

Ref ID : 30
30. Berry, C. Subsoiling and sewage sludge aid loblolly pine establishment on adverse sites. *Reclamation and Revegetation Research* 3:301-311, 1985.
Keywords : sewage; pines; establishment; site; subsoiling; sewage sludge; spacing; furrows; Reclamation; fertilizers; lime; soil; P; Trees; height; leaching; nutrients; Variation; effects; growth; treatment; production; Biomass; Land types; Mined land; Pinus taeda; Site preparation; liming materials; responses; Forestry practices; Manures; specific; USA,Georgia; NPK; Pinus; Soil cultivation; USA; Georgia
Notes : Eight intensities of subsoiling (in which depth, direction and spacing of furrows were varied) were compared to disking on borrow pit reclamation plots amended with 17 mt ha-1 sewage sludge or inorganic fertilizer (1121 kg ha-1) and lime (2242 kg ha-1). After 1 year, soil N and P levels in sludge plots were significantly higher than in fertilizer plots. K was low in all plots. Foliar N was significantly increased in trees on sludge plots, but foliar K was significantly higher in trees on fertilizer plots. Loblolly pines grown on sludge plots grew an average of 37% more in height and 76% more in DBH than trees grown on fertilizer plots. On fertilizer plots, trees grew faster on plots subsoiled 46 cm deep than on plots subsoiled 92 cm deep from which, apparently, there was more leaching of nutrients. On sludge plots, trees grew faster when subsoiling was 92 cm deep than when it was 46 cm deep. Other variations in subsoiling, i.e. distance between furrows and whether in one direction or two directions, had little effect on growth of trees. On sludge plots, all subsoiling treatments produced better growth than disking. On fertilizer plots, only half of the eight subsoiling treatments produced better growth than disking. Production of herbaceous biomass was significantly greater on sludge plots or on subsoiled fertilizer plots than on fertilizer plots that had been disked.

Ref ID : 31
31. Berry, C.R. Subsoiling improves growth of [shortleaf and loblolly] pine on a Georgia Piedmont site. *Research Note, Southeastern Forest Experiment Station, USDA Forest Service* No. SE-284, 3 pp.; 1:3 pp. 1979.
Keywords : subsoiling; growth; pines; Georgia; site; Pinus echinata; Site preparation; plantations; erodible sites; Pinus taeda; mechanical methods; cultivation,soil; Afforestation; eroded soils; Forestry practices; Conifers; USA

Ref ID : 32
32. Birk, E.M. Biomass and nutrient distribution in radiata pine in relation to previous land use. II. Nutrient accumulation, distribution and removal. *Australian Forestry* 56:148-156, 1993.
Keywords : Biomass; nutrients; Distribution; radiata pine; pines; land; removal; land use; thinning; Slash; burning; Pinus; Pinus radiata; plantations; New South Wales; establishment; Eucalyptus; Forests; pastures; crops; production; Trees; age; clear felling; felling; Residues; available; rotations; Losses; depletion; nutrient content; nitrogen; phosphorus; Site preparation; old fields; Cycling; Australia; New; site; intensive; nutrient depletion
Notes : Above-ground nutrient accumulation and potential nutrient removal through thinning, clearfelling and slash burning were estimated for 3 areas of 21 year-old radiata pine (Pinus radiata) plantation in the central tablelands of New South Wales. The 3 areas differed in previous land use prior to plantation establishment. One area carried native eucalypt (mainly Eucalyptus dives and E, rossii) forest, another had been cleared and grazed (pasture), while the third had been cleared, grazed, and later used for crop (peas and potatoes) production (cultivated pasture). Stands on the previously cultivated pasture accumulated the largest amounts of nutrients (and above-ground biomass); an average of 62 and 19 kg P/ha in the trees and forest floor, respectively, compared with 26 and 6 kg P/ha in the trees and forest floor of the ex-native forest site, and 30 and 8 kg phosphorus/ha in the trees and forest floor of the ex-pasture site. Total tree N contents were 325, 418 and 564 kg N/ha in the native forest, pasture and cultivated pasture sites, respectively. Thinning at 21 years of age removed between 93.7 and 136.0 t/ha of biomass as logs containing 68 to 112 kg N/ha and 6 to 12 kg P/ha, with the largest removals from the cultivated pasture site. At clear felling, 147 (native forest), 173 (pasture) and 200 kg N/ha (cultivated pasture) and 12, 13 and 22 kg P/ha, respectively, could potentially be removed in logs. Total

Ref ID : 37
37. Brace, L.G. and Golec, P.J. Silviculture statistics for Canada, 1975-80. *Information Report, Northern Forest Research Centre, Canada* No. NOR-X-245, v + 4:v + 48 pp. 1982.
Keywords : Silviculture; Canada; statistics; Harvesting; site; Site preparation; Planting; sowing; natural regeneration; regeneration; tending; pests; pest control; control; reforestation; yields; development; forestry; Forest management; planning; Logging
Notes : On the basis of a questionnaire survey, data are presented on harvesting, site preparation, planting, sowing, natural regeneration, stand tending and pest control for each province and territory and for Canada as a whole. It is concluded that present reforestation efforts are insufficient to sustain yield, and recommendations are made for future development.

Ref ID : 38
38. Braches, P. and Schlaghamersky, A.C. Assessing methods of slash removal by performance, costs, and effects on subsequent stand. *Allgemeine Forstzeitschrift* No. 37, 990, 992-993:990, 992-993, 1979.
Keywords : methods; Slash; removal; performance; costs; effects; burning; tractors; forestry; Skidders; soil; soil compaction; compaction; felling; plant; growth; nutrition; disposal; Site preparation; mechanical methods; German Federal Republic; Germany; trials; soil factors
Notes : [See FA 42, 4272] Results are reviewed of several slash-clearing trials (in preparation for replanting of large, clear-felled stands; with or without burning of slash) using (a) an agricultural tractor with a Baas (highly manoeuvrable) slash fork, (b) a forestry skidder with clearing teeth on a dozer blade, (c) a forestry skidder with a Raumfix spring-mounted clearing rake [see FA 42, 4273], and (d) a crawler tractor with a slash rake. Best performance was given by (c) (2.9-3.9 total work hours/ha); soil compaction was least under (d). It is recommended that slash should be cleared in the 1st yr following felling, and should be piled in rows 70-90 m apart, with gaps in rows at 50 m intervals. It is noted that complete removal of slash has several detrimental effects on soil factors, and plant growth and nutrition.

Ref ID : 39
39. Brand, D.G. The establishment of Boreal and Sub-boreal conifer plantations: an integrated analysis of environmental conditions and seedling growth. *Forest Science* 37:68-100, 1991.
Keywords : establishment; Conifers; plantations; analysis; Seedlings; seedling growth; growth; Ontario; British Columbia; yields; pines; Pinus; Picea; Picea glauca; Planting; Picea mariana; Pinus banksiana; soil; mulching; Trees; weeds; weed control; control; responses; soil temperature; temperature; nutrients; nutrient availability; effects; treatment; nitrogen; application; increment; statistical methods; Site preparation; mechanical methods; Canada; herbicides; Glyphosate; Pinus strobus; Picea engelmannii X P.glauca; Pinus contorta; usage; crops; Forests; survival; P; site; seasons; weed; availability; competition; specific; growth rate
Notes : Data from similar field experiments in the Great Lakes-St. Lawrence (GLSL) and Boreal (B) regions of Ontario and the Sub-boreal spruce (SBS) region of British Columbia, were used to study relations among factors such as environmental conditions, seedling growth and survival, and growth analytical yield components. Three pine species (Pinus strobus, P. banksiana and P. contorta) and three spruce species (Picea glauca, P. mariana and P. engelmannii X glauca) were used in this study. Work at the GLSL site started in April 1986 with planting of 3-yr-old Pinus strobus and Picea glauca and continued throughout the 1987 growing season; work at site (B) started in May 1987 with planting of 1-yr-old Picea mariana and Pinus banksiana, and at site (SBS) with 1-yr-old Picea engelmannii X P. glauca and Pinus contorta, and continued throughout the 1988 growing season. The growth analysis included both a conventional growth analysis and an integrated analysis of growth and environmental conditions. Survival was best after soil surface modification (blade scarification, with or without black woven fibre glass/clear plastic mulching around planted trees) or weed control using Vision (n-phosophonomethyl glycine [glyphosate]). Growth responses were positively related to increases in soil temperature and nutrient availability, and a decrease in vegetative competition. Yield component analysis indicated that net assimilation rate (NAR) was positively related to improved growth. However, changes in specific leaf area tended to buffer the effects of changes in NAR on growth, and relative growth rate (RGR) responded less to the treatments than did NAR. RGR was related to the availability of light, nitrogen and soil energy or the efficiency of light, nitrogen and soil energy use by seedlings on the three sites. As availability of a particular resource improved, growth allocation shifted away from tissues used to acquire that resource. Seedlings grew fastest where treatments caused both the availability of a resource and the efficiency of its use (growth/unit resource) to increase. The analytical framework presented has application in studying the responses of trees to environmental changes and in determining silvicultural factors that limit tree growth.

Ref ID : 40
40. Briscoe, C.B. Field Trials Manual for Multipurpose Tree Species. *Multipurpose Tree Species Network Research Series: Manual* No. 3, Ed. 2, 141 pp:Ed. 2, 141 pp. 1990.
Keywords : trials; manual; Trees; Multipurpose trees; forestry; Agroforestry; standards; design; research; projects; extension; Theses; Nurseries; Seeds; seed treatment; treatment; containers; protection; lifting; establishment; size; Site preparation; spacing; sowing; Planting; cleaning; weeding; pruning; thinning; improvement; measurement; height; diameter; stems; volume; Fodder; yields; production; management; information; arid zones; Bibliographies; methodology; Books; Species trials; Experimental design; handbooks; methods; Seed; grading; transport; site; specific

residue plus forest floor was estimated to contain 280 (native forest), 381 (pasture) and 536 kg N/ha (cultivated pasture), which would be available for the second rotation if retained and re-incorporated through chopper rolling. Clear felling followed by a moderate slash burn could remove 4.1 to 6.7% of the total N capital (to 38 cm depth), and 13.5% of the exchangeable K, with greater losses (absolute and proportional) in the previously cultivated pasture. It is concluded that plantations on previously improved pastures, or sites receiving intensive nutrient amendments, appear more vulnerable to nutrient depletion than plantations on ex-native forest sites.

Ref ID : 33
33. Blake, J., Caulfield, J., Fisher, R., and Lea, R. Techniques for assessing the economic contributions of forest soils information in timberland management. *Southern Journal of Applied Forestry* 12:147-152, 1988.
Keywords : techniques; Economics; Forests; forest soils; soils; information; management; soil; Drainage; Site preparation; soil properties; land use; Forest management; planning; productivity; site; methods
Notes : A framework is discussed for relating forest soils information, e.g. productivity, drainage, site preparation, to management goals. The concepts of risk and benefit are introduced in relation to management decision making. Examples show the use of a variety of methods for determining the value of soils information.

Ref ID : 34
34. Boden, D.I. and Herbert, M.A. Site preparation of Eucalyptus grandis at Glendale, Natal Midlands: provisional estimates of profitability. *Annual Report, Institute for Commercial Forestry Research, University of Natal* 119-122; 2 ref. 1986.
Keywords : site; Site preparation; Eucalyptus; Eucalyptus grandis; profitability; growth; Planting; treatment; ploughing; discing; weeding; fertilizers; Fertilizer application; application; yields; returns; NPK fertilizers; South Africa; mechanical methods; NPK
Notes : Growth data at 5 yr after planting are reported for an experiment comparing 5 site preparation treatments in a factorial layout with complete preparation (ploughing, discing, rotavating and complete weeding, with or without fertilizer application). Results were used to estimate yield at 10 yr and internal rate of return. Complete preparation gave the highest vol./ha and was the most profitable treatment. Efficiency of all treatments was increased by NPK fertilizer application.

Ref ID : 35
35. Bonny, L. Growth of a Eucalyptus grandis plantation following intensive silvicultural treatments applied in the first six years. *Research Paper Forestry Commission of New South Wales* No. 12, ii + 19 pp.;ii + 19 pp. 1991.
Keywords : growth; Eucalyptus; Eucalyptus grandis; plantations; intensive; treatment; Forests; New South Wales; effects; Site preparation; ploughing; application; herbicides; fertilizers; propazine; Glyphosate; weeding; insecticides; dimethoate; thinning; Theses; weeds; Trees; weed control; control; increment; responses; growth rate; establishment; Broadleaves; Australia; Forest trees; Pesticides; Forest pests; chemical control; pest control; Malathion; Insect pests; physical control; manual weed control; integrated control; trials; site; New; manual; weed; Fertilizer application
Notes : A Eucalyptus grandis trial was established in 1976 on a forest site in the Coffs Harbour area, New South Wales, to examine the effect of site preparation and silvicultural treatments on growth. Site preparation treatments were ploughing and application of pre-emergent herbicide. Post-planting treatments of fertilizer (N:P:K:S 12:10:18:11), herbicides (propazine, glyphosate), manual weeding and insecticide (malathion, dimethoate) were applied as single treatments and in combination for periods of one or 6 yr. Thinning treatments were added to some plots at 2.75 yr to reduce the stocking from 1087 to 478 stems/ha. A second thinning was applied to some of these plots at 9.3 yr to reduce the stocking to 130 stems/ha. Ploughing reduced the number of weeds and weed dry weight (both by 70%), but did not affect tree growth. Application of insecticide or weed control (manual weeding + herbicide) had no significant effect on growth. Fertilizer application alone increased growth by 50% in the first year alone; this increase was greater in ploughed plots. Treatment for one year with fertilizer in combination with insecticide or weed control had an additive effect on growth that lasted to 6 yr old. In all treatments, treatment for 6 yr caused greater growth increases than treatment for one year. Maximum mean annual increment (m.a.i.) for the fertilizer + weed control + insecticide treatment applied for 6 yr was 34 m3/ha at 8 yr old. M.a.i. values for the fertilizer + weed control + insecticide treatment applied for one yr, and the control, were 24 m3/ha and 18 m3/ha, respectively. Thinning increased the growth response to fertilizer used in combination with weed control and/or insecticide. High growth rates (maximum m.a.i. at 8 yr old of 25 m3/ha) were possible by applying fertilizer and weed control in the first year of establishment, followed by an early thinning.

Ref ID : 36
36. Booth, T.C., Mayhead, G.J., and Pyatt, D.G. Crop stability. *Report on Forest Research, Forestry Commission, UK* 72-75; 1 ref. 1973.
Keywords : crops; Trees; roots; soil; Picea sitchensis; wind; resistance; Site preparation; root system; mechanical methods; systems,distribution; Conifers
Notes : Tree pulling was used to compare the stability of 25-year-old Sitka Spruce on (1) hand-prepared turves and (2) ploughed ground in Northumberland. The greater stability of the trees on (1) is attributed to the greater lateral spread of their roots; the greater rooting depth, root weight and drier soil on (2) did not compensate for the reduced root spread.

Notes : This manual is designed to guide multipurpose tree (MPT) field researchers, from the viewpoint of both forestry and agroforestry objectives, and is based on standard field methods and simple designs, without aiming to be comprehensive. It was originally produced for the research cooperators of the MPTS network (sponsored by the F/FRED Project), and is an extension of the 'Manual for Multipurpose Tree Species Research Cooperators for the F/FRED 1987 Humid and Sub-humid Network Trials' (Manual No. 2 in the series). This second edition incorporates substantial additions and modifications. After the introductory section (part 1), there are 8 other parts. These are: (2) Design of experiments - the range of conditions to be tested, simplicity, randomization, replication, and records; (3) Nursery procedures - introduction, seed treatment, containers and beds, culture, protection, grading stock, and lifting and transport; (4) Establishment - plot size, site preparation, spacing, sowing and planting; (5) Post-planting care - cleaning and weeding, pruning and lopping; pollarding and coppicing, thinning and stand improvement, and harvest; (6) Measurements - traditional forestry measurements (height, diameter at breast height, measurements of single and double stems, and wood specific gravity), non-traditional measurements (total height, stem length, other diameter measurements, wood volume, extractives, fodder, intercrop yield and animal production), re-measurements, other measurements and modelling; (7) Record establishment and management - this section is directly applicable only to the Information and Decision Support System (IADSS) of the F/FRED Global Research Unit, and contains suggestions for minimum data sets; and (8) the IADSS codes. There are 4 appendices (3 summarize recommended F/FRED procedures for the humid/subhumid zone, the arid zone and the semiarid zone, and the fourth is a bibliography of 24 ref.), and a general index which includes authors and species.

Ref ID : 41
41. Broadfoot, W.M. and Bonner, F.T. Soil compaction slows early growth of planted Cottonwood. *1966, Tree Plant* 1966 (13-4). [4 refs, 1966.
Keywords : soil; soil compaction; compaction; growth; soils; bulk density; density; roots; shoots; Populus; Populus deltoides; cuttings; deep ploughing; ploughing; Planting; Planting stock cuttings,unrooted; Populus deltoides incl.var.monilifera planting,site preparation; Propagation,vegetative cuttings direct planting; regeneration; Regeneration,artificial; Silviculture; Site preparation; Soils compaction; cutting
Notes : A recent study at the Southern Hardwood Laboratory, Stoneville, Miss., showed that when sandy-loam soils are compacted to a bulk density of 1.60, the root and shoot growth of planted Populus deltoides cuttings is considerably retarded. Deep ploughing about a year before planting is recommended.

Ref ID : 42
42. Bullard, S.H. and Watson, W.F. Timber harvesting technology: environmental and site preparation costs. *International Journal of Environmental Studies* 27:261-266, 1986.
Keywords : Harvesting; technology; site; Site preparation; costs; Economics; effects; reforestation; forestry; environment; Artificial regeneration; intensive
Notes : The environmental and economic effects of timber harvesting and reforestation practices are discussed briefly. It is suggested that, where intensive forestry is practised, timber harvesting and site preparation costs (monetary and environmental) should be considered together. This may result in less disturbance to the site and more reforestation.

Ref ID : 43
43. Burger, J.A. and Pritchett, W.L. Effects of clearfelling and site preparation on nitrogen mineralization in a southern pine stand. *Soil Science Society of America Journal* 48:1432-1437, 1984.
Keywords : effects; site; nitrogen; pines; Site preparation; mineralization; Forests; Pinus; Pinus elliottii; Pinus palustris; management; impact; availability; soil; techniques; soils; control; simulation; temperature; Theses; carbon; treatment; organic matter; decomposition; quality; Harvesting; determination; environment; transformations; forest soils; Forestry practices; clear felling; nutrient cycles; nitrogen cycle; mechanical methods; USA,Florida; Soil chemistry; methodology; USA; Florida
Notes : A clearcut forest site (45-year-old natural stand of Pinus elliottii and Pinus palustris) was subjected to different intensities of site preparation to determine management impacts on N availability. Using a laboratory aerobic soil incubation technique, N mineralization potentials (N mineralizable over time) (No) were 25.0, 23.3, and 17.7 mug/g for soils from an uncut control area; a burned and chopped area; and a bladed, disced, and bedded area, respectively. The No of soil from the intensively treated area was significantly lower than the others when measured in the laboratory; however, simulations of field conditions indicated that more N may be mineralizied in soils from intensively treated sites due to more favorable soil moisture and temperature conditions. Mineralization rates for these three areas, however, were not significantly different, and C/N ratios (28 and 26 for the chopped and bladed sites, respectively) for the clearcut and prepared areas did not suggest a difference in N availability. Ratios of organic matter/soluble carbon increased from 79 to 136 with treatment intensity and suggest that the N associated with the organic matter remaining on the most intensively treated site may be more resistant to decomposition. Nitrogen availability is a function of substrate quality and microenvironmental conditions. Harvesting and site treatment affected both of these. Laboratory determinations of No appear to be a better index of nitrogen availability than C/N, soluble carbon or total N, but do not adequately account for differences in mineralization due to treatment-induced changes in the soil environment.

Ref ID : 44

44. Burger, J.A. and Pritchett, W.L. Site preparation effects on soil moisture and available nutrients in a pine plantation in the Florida flatwoods. *Forest Science* 34:77-87, 1988.
Keywords : site; Site preparation; effects; soil; available; nutrients; pines; plantations; Florida; Slash; Harrowing; Seedlings; control; water; soil solution; soil organic matter; organic matter; Harvesting; P; Biomass; vegetation; survival; treatment; stems; volume; growth; competition; mechanical methods; USA; Pinus elliottii; groundwater; BIOLOGICAL COMPETITION; Soil chemistry; nitrogen; Pinus; potassium; available nutrients; forestry; Soil water regimes; groundwater level; intensive
Notes : In Aug. 1977, twenty ha of naturally regenerated, 45-yr-old slash pine and longleaf pine were clear felled; the site was broadcast burned in Oct. Half the area was chopped (a) and the remaining area was intensively prepared by blading, harrowing and bedding (b). Unimproved 1+0 slash pine seedlings were planted in spring 1978. Five ha of the original stand were left uncut as control areas. Differences in water table depth, soil solution nutrient concentrations, and soil organic matter and total N were determined for 2 yr. Harvesting caused a rise in the water table and, during drier times of year, area (b) had a water table 10-20 cm higher than that on (a). Despite lower total N reserves after 2 yr on (b) (770 kg/ha vs. 1020 kg/ha), concentrations of NH4 and NO3 in the soil solution were twice those of (a); as a result, foliar N of 2-yr-old seedlings was 0.93% on (b) and 0.85% on (a). Soil solution P was 10X higher and K 5X higher on (b) than on (a). Total biomass of competing vegetation 2 yr after harvesting was 1489 kg/ha on (b) and 3548 kg/ha on (a). There was no difference in survival between the 2 treatments, but the stem volume of seedlings after 2 yr was 2.8X greater on (b). The superior growth elicited by intensive site preparation was attributed to improved soil moisture, more available nutrients and less competition.

Ref ID : 45
45. Burgess, D., Baldock, J.A., Wetzell, S., and Brand, D.G. Scarification, fertilization and herbicide treatment effects on planted conifers and soil fertility. *Nutrient uptake and cycling in forest ecosystems* Halmstad, Sweden, 7-:Sweden, 7-10 June, 1993 [edite, 1995.
Keywords : herbicides; treatment; effects; Conifers; soil; Soil fertility; fertility; scarification; modification; mulching; fertilizers; application; nutrients; carbon; Trees; growth; Forests; Canada; pines; Pinus; Pinus strobus; Picea; Picea glauca; Seedlings; light; temperature; seasons; storage; mortality; productivity; proteins; starch; lipids; management; shelterwood; Harvesting; crops; rotations; Silvicultural systems; succession; Conferences; Nutrient uptake and cycling in forest ecosystems; pinopsida; nutrient availability; Forest trees; Site preparation; P
Notes : Influences of soil surface modification (blade scarification and plastic mulching), fertilizer and herbicide application on soil nutrient and organic carbon content and tree growth and foliar nutrient status were examined after 7 yr in a study located within the Great Lakes-St. Lawrence forest region of Canada. Plots had been planted with white pine (Pinus strobus) and white spruce (Picea glauca) seedlings. Light (PAR), soil moisture and temperature were monitored and recorded throughout the growing season. Forest floor and soil mineral (0-20 cm layer) samples were collected from all experimental plots, except those which had plastic mulching. Foliar samples were collected in autumn and analysed for N, P and K and storage compounds. Seedling mortality was 20% higher in unscarified plots. Combined silvicultural treatments increased productivity as much as 14 times, but scarification reduced soil carbon and nutrient capital 2-3 fold. Herbicide application reduced soil carbon by at least 20%. Foliar nutrient, protein, starch and lipid contents in autumn were little affected by treatment. The future management of such stands in Canada probably will include more shelterwood harvesting and crop rotations, silvicultural systems that are more closely aligned with natural forest succession.

Ref ID : 46
46. Burkhart, H.E., Cloeren, D.C., and Amateis, R.L. Yield relationships in unthinned loblolly pine plantations on cutover, site-prepared lands. *Southern Journal of Applied Forestry* 9:84-91, 1985.
Keywords : yields; pines; plantations; land; seasons; USA; Planting; crown; stems; quality; assessment; vegetation; regression analysis; analysis; age; Trees; measurement; site; Site preparation; survival; increment; volume; Pinus; Pinus taeda; equations; forecasting; mechanical methods; site class assessment
Notes : Permanent plots were established in the 1980-81 and 1981-82 dormant seasons in 12 states in the southern USA, 8-25 yr after planting. D.b.h., total ht., ht. to base of live crown, crown class and a stem quality assessment were recorded for planted pines. Competing vegetation was also noted. Regression analysis showed that yield of planted pines could be predicted adequately from age, av. ht. of dominant and co-dominant trees and the number of surviving trees per unit area. Measurements of competing vegetation did not significantly improve yield predictions. Analysis of covariance showed that av. yields were n.s.d. for physiographic regions (Coastal Plain, Piedmont) or site preparation classes (bedded or not bedded, with or without debris removed). Survival relations were also similar for the regions and preparation classes. Ht./age relations for anamorphic construction of site index curves were significantly different for Coastal Plain and Piedmont sites but there were n.s.d. between preparation classes within the regions.

Ref ID : 47
47. Butler-Fasteland, M.C. and Alm, A.A. Mechanical site preparation and regeneration practices in northern Minnesota. *Northern Journal of Applied Forestry* 1:26-29, 1984.
Keywords : site; Site preparation; regeneration; Minnesota; Forests; Forest management; management; methods; Logging; types; spacing; USA,Minnesota; Artificial regeneration; mechanical methods; USA

Notes : A questionnaire was sent to county, state, federal and industrial forest management agencies in 1982. Results provided data on site preparation method, time of completion, logging system, species planted, type of stock used and spacing used on 12 500 acres on 330 sites in 1981.

Ref ID : 48
48. Byrne, S.V., Wentworth, T.R., and Nusser, S.M. A moisture strain index for loblolly pine. *Canadian Journal of Forest Research* 17:23-26, 1987.
Keywords : pines; Seedlings; chopping; discing; North Carolina; Planting; vegetation; control; herbicides; growth; growth rate; seasons; soil; Site preparation; weeds; weed control; Theses; Soil water; soil water potential; water; effects; treatment; leaves; leaf water potential; Variation; competition; ground vegetation; Pinus taeda; Plant water relations; water stress; Pinus; mechanical methods; USA; Forestry practices; site; weed
Notes : Loblolly pine seedlings were planted in Mar. 1982 on a site that had been clear felled in 1981 and prepared by chopping or shearing, piling and discing, in the NE Piedmont of North Carolina. After planting, competing vegetation was hand weeded (complete control), sprayed with herbicide in spring and autumn 1982 (partial control) or untreated. Relative growth rate was calculated after 1982 and 1983 growing seasons. Soil moisture and predawn xylem pressure potential were measured on 5 dates during summer 1983. Pine relative growth rate increased significantly with increasing intensity of site preparation and weed control, but these two factors did not interact. Soil water potential showed no significant effect of treatment. An index of moisture strain was developed by regressing leaf water potentials of individual seedlings against mean leaf water potentials of all seedlings. This index accounted for 55% of the variation in relative growth rate.

Ref ID : 49
49. Cain, M.D. Planted loblolly and slash pine response to bedding and flat disking on a poorly drained site - an update. *USDA Forest Service Research Note, Southern Forest Experiment Station* No. SO-237, 6 pp.; 4:6 pp. 1978.
Keywords : Slash; pines; responses; site; growth; Site preparation; production; yields; control; discing; effects; Cronartium; Cronartium fusiforme; Pinus taeda; Pinus elliottii; assessment; mechanical methods; Louisiana; yield studies; Forestry practices; Conifers; USA
Notes : [See FA 40, 445] A continuation of the same study presenting data up to 15 yr old. Early increases in ht. growth in response to site preparation had ceased by 8 yr old although the resultant ht. gain was maintained until 15 yr old. For loblolly pine total vol. production at 15 yr old (13-yr-old felled vol. plus 15-yr-old standing vol.) yields on both treated plots were about 6 cords/acre greater than controls; for slash pine there was n.s.d. Discing did not significantly effect the incidence of fusiform rust (Cronartium fusiforme) infection in either species.

Ref ID : 50
50. Cameron, D.A., Stiell, W.M., Heeney, C.J., Moore, L.J., Aird, P.L., Silversides, C.R., Miller, J.S., Wagner, C.E., Methven, I.R., Coons, C.F., Fayle, D.C.F., Pierpoint, G., Struik, H., Brace, L.G., Beckwith, A.F., McNeice, W.S., and DeBoo, R.F. White and red pine symposium. *Symposium Proceedings, Great Lakes Forest Research Centre, Canada* No. O-P-6, 3 + 178 p:3 + 178 pp. 1978.
Keywords : pines; Pinus; Pinus strobus; P; Ontario; Quebec; natural resources; forestry; Forests; Chalk; requirements; management; Logging; ecosystems; equipment; development; site; Site preparation; methods; Silvicultural systems; fire; Planting; performance; Seedlings; tending; cutting; improvement; felling; yields; damage; Losses; growth; plantations; Insects; Insect pests; pests; Pinus resinosa; Conferences; Canada; Conifers
Notes : The symposium, dealing with Pinus strobus and P. resinosa (with special reference to Ontario and Quebec), and sponsored by the Ontario Ministry of Natural Resources and the Canadian Forestry Service, was held at the Petawawa Forest Experiment Station, Chalk River, Ontario, 20-22 Sept., 1977. The following papers are included: Stiell, W.M. Characteristics of eastern white pine and red pine. [13 pp. of ref.] Heeney, C.J. Silvicultural requirements of white and red pine management. Moore, L.J. White and red pine management practices: logging. Aird, P.L. Splendor undiminished: a management objective for red pine and eastern white pine ecosystems. [6 ref.] Silversides, C.R. Trends in logging equipment development. [5 ref., 2 pl.] Miller, J.S. Mechanical site preparation methods as part of a silvicultural system to regenerate white and red pine. Wagner, C.E. van; Methven, I.R. Prescribed fire for site preparation in white and red pine. Coons, C.F. Red and white pine planting. [5 ref.] Fayle, D.C.F.; Pierpoint, G. Interpreting performance of recently outplanted pine seedlings. [8 ref.] Struik, H. Tending of white pine and red pine. Brace, L.G. An intermediate cutting in pine mixedwoods. [5 ref.] Improvement felling was applied to 121.4 ha of two-storeyed stands in Ontario. An av. net sawlog yield gain of approx. 8000 bd ft/ha was indicated after 20 yr; logging damage resulted in a gross vol. loss of 0.25% after 5 yr. Beckwith, A.F.; McNeice, W.S. Guides to growth in red pine plantations. [5 ref.] DeBoo, R.F. Management of pine insect pests. [3 ref.].

Ref ID : 51
51. Campbell, R.G. and Hughes, J.H. Forest management systems in North Carolina pocosins: Weyerhaeuser. *Pocosin wetlands* C.J.]. 1981., 199-21:199-213, 1981.
Keywords : Forests; Forest management; management; North Carolina; Drainage; site; Site preparation; establishment; pines; plantations; Conferences; Pocosin Wetlands; Forestry practices; Afforestation; Land types; wetlands; USA; Pinus taeda; amelioration of forest sites; Conifers
Notes : Drainage, site preparation and fertilization are discussed in relation to the establishment of loblolly pine

plantations.

Ref ID : 52
52. Campbell, T.E. Growth and development of loblolly and slash pines direct-seeded or planted on a cutover site. *Southern Journal of Applied Forestry* 5:115-119, 1981.
Keywords : growth; development; Slash; pines; site; USA; methods; regeneration; Planting; Seedlings; Grasses; sowing; furrows; Trees; volume; crown; Cronartium; Distribution; treatment; Site preparation; comparisons; age; size; Pinus taeda; Artificial regeneration; Direct sowing; Pinus elliottii; mechanical methods; Forestry practices; responses; Conifers
Notes : [See FA 42, 2309] A grassy site in the lower coastal plain of the W. Gulf region of the USA was burned in Feb., 1961 and plots set up in Feb., 1962 using 7 methods of regeneration: (a) planting 1-yr-old seedlings on rough grass; (b) broadcast sowing on rough grass; (c) broadcast sowing on alternating flat-disked strips and undisked balks, each 7 ft wide; (d) broadcast sowing on alternating mound-disked strips and undisked balks; (e) sowing on flat-disked strips only (undisked balks not sown); (f) sowing on mound-disked strips only (undisked balks not sown); and (g) sowing at the bottom of a prepared furrow. D.b.h. of all trees was measured after 15 yr and further data collected from volume sample trees (including d.b.h., ht., crown position, length of live crown, and number of trees with fusiform rust cankers (Cronartium quercuum ssp. fusiforme [C. fusiforme]). Data are tabulated giving diam. class distribution, and mean stand and stocking data (for d.b.h. over 3.6 inches) by treatment. Plots with planted loblolly pine seedlings (a) yielded a greater b.a. and merchantable vol. than (b) (c) (e) or (f); av. d.b.h. for (a) was greater than all other treatments (10% level of significance). The poorest ht. growth on sown plots occurred when there was no site preparation (b). However, comparisons at this early age are difficult, since many trees on sown plots had not reached merchantable size, making differences in total stands greater than those in merchantable stands. There was no clear advantage to any one method of regeneration for slash pine.

Ref ID : 53
53. Carlyle, J.C. Organic carbon in forested sandy soils: properties, processes, and the impact of forest management. *Impacts of harvesting and site preparation on carbon cycling processes in forests* Scotland, 24-30 May:24-30 May 1992 [edited, 1993.
Keywords : carbon; soils; impact; Forests; Forest management; management; sandy soils; Pinus; Pinus radiata; plantations; Australia; productivity; soil; nitrogen; phosphorus; availability; cations; cation exchange capacity; decomposition; weeds; clear felling; felling; Logging; Residues; Harvesting; Site preparation; Losses; litter; crops; Theses; effects; materials; fires; Forest trees; weed control; thinning; Soil chemistry; Conferences; Impacts of harvesting and site preparation on carbon cycling processes in forests; soil organic matter; podzolic soils; carbon cycle; Silviculture; site; New; fire
Notes : Data from a series of experiments in Pinus radiata plantations in Australia were used to illustrate the importance of organic carbon in influencing a range of key determinants of plantation productivity on podzolized sands, which lack a significant inorganic colloidal phase. Organic carbon levels affected soil nitrogen reserves, nitrogen dynamics, phosphorus availability, and cation exchange capacity. Evidence from two experiments indicated that the organic carbon in podzolized sands is highly dynamic and sensitive to management operations which influence organic carbon inputs, decomposition rates, or both. Weeds helped to maintain organic carbon reserves after clear felling, particularly where logging residues had been burnt. Retention of above-ground logging residues also helped to maintain organic carbon reserves. Most harvesting and site preparation operations resulted in loss of a labile carbon pool (representing approximately 30% of total carbon). This pool can be buffered by residue retention and weeds in the period before significant litter inputs from the new crop, but in any case will be replenished once these inputs are resumed. As such, the effect of management on this pool is likely to be transient. Long-term reductions in soil carbon and associated properties are likely only where management operations result in loss from the recalcitrant carbon pool (representing approximately 70% of total carbon). Since such material decomposes extremely slowly, only site preparation operations such as surface soil scalping or the use of high-intensity fire are likely to result in significant short-term losses of this fraction.

Ref ID : 54
54. Carpio-Camarotti, C., Acosta-Romero, R., Kalutskii, K.K., and Yershov, E.V. Preparation of soil for forest plantations under the various conditions found in Cuba. *Baracoa* 7:39-48. 1977.
Keywords : soil; Forests; Forest plantations; plantations; Cuba; ploughing; horizons; growth; Pinus; Seedlings; soil compaction; compaction; Soil water; water; Site preparation; site types; types; forestry; Pinus caribaea; site; methods
Notes : In Pinar del Rio province, Cuba, strip ploughing (to 40-50 cm depth) of soil, in order to break up a compacted horizon, led to improved growth of Pinus caribaea seedlings, decreased soil compaction, and increased soil water retention. Recommended site preparation methods are presented for 7 site types of forestry interest in Cuba.

Ref ID : 55
55. Champs, J. Penetrability of forest soils after soil preparation. *Annales de Recherches Sylvicoles 1980, AFOCEL, France* 123-151; 20 ref., 8:8 pl. Paris, France-Cellulose.X, 1981.
Keywords : Forests; forest soils; soils; soil; soil preparation; resistance; Tests; methods; discs; ploughing; site; Site preparation; Soil physics; compaction; mechanical methods; Liot penetrometer

Notes : The Liot penetrometer is described, which can plot curves of soil resistance to a depth of 30 cm. Tests with the meter on soils which had been prepared by various methods showed that untreated soil was very compact, and that disc ploughing was the best method of site preparation.

Ref ID : 56
56. Chamshama, S.A.O. Establishment techniques for Eucalyptus species: effects of nursery treatments, site preparation and fertilization on survival and growth. *Forestry Abstracts* 46:662-663. 1985.
Keywords : establishment; techniques; Eucalyptus; effects; Nurseries; treatment; site; Site preparation; survival; growth; Theses; Tanzania; Silviculture; Eucalyptus camaldulensis; Eucalyptus tereticornis; root pruning; Planting; types; drought resistance; fertilizers; nitrogen; potassium

Ref ID : 57
57. Chamshama, S.A.O. and Hall, J.B. Effects of site preparation and fertilizer application at planting on Eucalyptus tereticornis at Morogoro, Tanzania. *Forest Ecology and Management* 18:103-112, 1987.
Keywords : effects; site; Site preparation; fertilizers; Fertilizer application; application; Planting; Eucalyptus; Eucalyptus tereticornis; Tanzania; Nurseries; discs; applications; plant; P; triple superphosphate; superphosphate; Trees; roots; survival; soil; increment; discing; drought; growth; treatment; mechanical methods; nitrogen; responses; forestry
Notes : Uniform nursery stock was used to establish an experiment factorially combining site preparation (bedding; disc; or neither), initial N applications (75 g ammonium sulphate per plant; or none) and initial P applications (150 g triple superphosphate per plant; or none). Monitoring was carried out for 2 yr, by which time trees were up to 3.2 m tall and 5.0 cm in diam. at the root collar. Survival at 2 yr was significantly higher among plants that had received N (65%) than those which had not (53%) and among plants on disced or bedded sites (62%) than those on unworked soil (53%). Monthly ht. increment was briefly, but significantly, increased in plants supplied with additional N and further enhanced if there was also additional P. Monthly diam. increment was, over most of the 1st yr, significantly greater on sites prepared by bedding; significant increases also resulted, though for more restricted periods, from site preparation by discing and from provision of additional N. At the end of 1 yr, significantly higher concn. of foliar K, suggesting enhanced drought hardiness, were detected for plants on bedded or disced ground (1% vs. 0.8% on unworked ground). Combining bedding or discing with an initial application of N offset this effect. The short period over which growth benefits from the site preparation and N application treatments is noted but it is stressed that initial growth encouragement is desirable with Eucalyptus and that overall benefits, as in improved survival, may be long term.

Ref ID : 58
58. Chang, M., Ting, J.C., Wong, K.L., and Hunt, E.V.,Jr. Soil moisture regimes as affected by silvicultural treatments in humid East Texas. *IAHS Publication* No. 140, 175-186; 18:175-186, 1983.
Keywords : soil; treatment; Texas; Forests; Site preparation; seasons; depletion; models; standards; Runoff; Losses; storms; Theses; Conferences; Hydrology of Humid Tropical Regions; soil water content; Forestry practices; USA; site
Notes : Based on 268 observations, average soil moisture content generally increases with depth, and with treatments in this order: undisturbed forest, thinned, clear-cutting without site preparation, clearcut and KG bladed, clearcut and chopped, and cultivated. Differences in the mean soil moisture content between cultivated and undisturbed forest plots were as great as 0.20 g cm-3. Fluctuations are greater near the ground surface, in the growing season, and on plots with greater forest cover and less site disturbance. Eight of ten depletion models gave estimates of soil moisture content at 30 cm and 0-120 cm depths for the six treatments with fair accuracy and reasonable results. The most desirable model estimates moisture contents with R2 greater than 0.95 and standard error of estimates less than 5% of the observed mean. The depletion rate is generally greater when soil moisture content is high, near the ground surface, on forest plots, and during the growing season. Surface runoff and soil losses of the six silvicultural treatments are associated with soil moisture content. About 8, 10, 10, 21, 31, and 40% of net storm rainfall, in the above order, occurred as surface runoff; and storms with gross rainfall more than 16.9, 10.0, 4.6, 3.8, 3.4 and 6.5 mm were required to generate surface runoff on these East Texas sites under the six treatments listed above.

Ref ID : 59
59. Chaperon-H Cultivation of maritime pine in Aquitaine, France. *1986, 231pp* 231pp.; 58 ref. 1986.
Keywords : Cultivation; pines; France; Site preparation; Drainage; requirements; Nurseries; Silviculture; pests; diseases; Insect pests; Conifers; site
Notes : Site preparation (including the importance of drainage in the Landes), site requirements, nursery practice, silviculture and pests and diseases are discussed.

Ref ID : 60
60. Chapman, G.W. and Allan, T.G. Establishment techniques for forest plantations. *FAO Forestry Paper* No. 8, vii + 183 pp.vii + 183 pp. 1978.
Keywords : establishment; techniques; Forests; Forest plantations; plantations; Books; regions; site; Site preparation; Direct sowing; sowing; Planting; tending; protection; planning; plantations,general; silvicultural aspects; ecological aspects; Silviculture
Notes : A world-wide reference book, with some emphasis on techniques suitable for tropical and subtropical regions.

There are six chapters on: Site preparation; Direct sowing; Planting and tending; Special techniques for difficult sites; Protection; and Plantation planning.

Ref ID : 61
61. Chapman, J. A manual on establishment techniques in man-made forests. *FAO Report* No.FO/MISC/73/3, 108:108 pp.X, 1973.
Keywords : manual; establishment; techniques; Forests; information; planning; site; Site preparation; Planting; protection; forestry; Forestry development; development; aspect; surveys; plantations; soil; water; water conservation; Direct sowing; sowing; plantations,general; methodology; protection of forests,general; Afforestation
Notes : A working paper based mainly on the information submitted to the FAO World Symposium on Man-Made Forests, convened in Canberra in 1967. The manual is in three parts: (I) Planning procedures; (II) Site preparation techniques; and (III) Seeding, planting, and protection. It is intended to form the basis of an FAO Forestry Development Paper to be published later. The aspects covered in (I) are preliminary reconnaissance and surveys, and the technical aspects, logistics, manpower forecasts, administration and financial forecast of the plantation plan. Part (II) deals with site-preparation techniques on vegetated sites, sites where soil and water conservation measures are critical factors for forest establishment, wet or waterlogged sites, irrigated or irrigable sites, sand-dune sites, and mine tips and spoil-dump sites. Part (III) deals with direct sowing, planting, and protection.

Ref ID : 62
62. Chavasse, C.G.R. Land preparation for forestry in New Zealand. *NZFS Forest Research Institute Symposium No.* 11. pp. 205. 1969.
Keywords : land; land preparation; forestry; New; New Zealand; costs; methods; mechanical; mechanical methods; chemical; chemical methods; fire; establishment; site; Site preparation; Pinus; Pinus radiata; plantations; Conferences,symposia,etc.site preparation in New Zealand; Pinus radiata regeneration,artificial; Site preparation methods compared; New Zealand land clearing; chemicals
Notes : Includes summarized replies to a questionnaire, papers read, and summaries of discussions at Rotorua, March 1969, on: objects and costs of land clearing, hand methods, mechanical methods, chemical methods, use of fire, special problems of re-establishment (compared with initial establishment) and the relation of site preparation to subsequent silvicultural operations and costs, all with reference to conditions in New Zealand, and particularly to Pinus radiata plantations.

Ref ID : 63
63. Chavasse, C.G.R. Site preparation in New Zealand. *NZ Journal of Forestry Science* 14(2): 136-49(2 refs), 1969.
Keywords : site; Site preparation; New; New Zealand; reviews; methods; costs; Afforestation; Conifers; Forests; research; tractors; manual; mechanical; chemical; fire; Costs & costing of operations afforestation,silviculture,protection management; Economics,forestry of silvicultural operations & treatment of stands; Site preparation methods compared; New Zealand land clearing
Notes : Reviews methods and costs of site preparation (mainly for afforestation with exotic conifers or the re-establishment of logged exotic forests) which were discussed at the Forest Research Institute symposium No. 11 [cf. F.A. 31 No. 6245] in relation to the national programme for the next 30 years. Only ca. 52% of the area to be afforested is on terrain suitable for clearing by crawler tractor; manual, mechanical, and chemical clearing and the use of fire are compared with Australian practices.

Ref ID : 64
64. Chavasse, C.G.R. Planting stock quality: a review of factors affecting performance. *New Zealand Journal of Forestry* 25:144-171, 1980.
Keywords : Planting; Planting stock; quality; reviews; performance; New Zealand; Forests; research; pines; effects; Seed; Nurseries; treatment; handling; lifting; site; Site preparation; roots; development; Trees; Genetics; Pinus radiata; Conifers; New; radiata pine
Notes : A review with special reference to the work of the New Zealand Forest Research Institute on radiata pine over the last 10 yr, covering the effects of: seed and nursery treatments; handling from lifting to planting; site and site preparation; planting; release; and root development of planted trees. Genetic effects are only briefly noticed.

Ref ID : 65
65. Chevidaev, V.A., Maksimov, V.E., and Kartsev, A.D. Improvement of plantation forestry for rapid growth. *Lesnoe Khozyaistvo* No. 6, 27-30; 3 ref.27-30, 1990.
Keywords : improvement; plantations; forestry; growth; reviews; Russia; Norway; age; establishment; management; soils; stumps; grubbing; height; Site preparation; ploughing; Planting; Planting stock; plant; thinning; mounds; Pinus sylvestris; Forest plantations; stand establishment; size; spacing; regions; intensive; site; methods
Notes : A review is given of experience in the Pskov region of W. Russia, with intensive plantations of Norway spruce [Picea abies]. The first plantations were established in 1976, and data are presented on growth up to age 8-12 years. On this basis, recommendations are made for the establishment and management of fast-growing plantations on freshly felled areas with well-drained soils of site classes I-Ia. This involves various methods of dealing with the stumps

(grubbing them up or reducing their height), site preparation (usually ploughing, but not always necessary), and use of large planting stock (0.3-0.5 or even 0.8 m high). When plants 0.3-0.5 m are spaced 0.7-1 m apart in the rows, the first thinning should take place at 10-12 years; with plants 0.4-0.8 m spaced 1.5 m apart, thinning should be at 25-30 years. On seasonally wet soils, planting should be done on raised strips and mounds (micro-elevations).

Ref ID : 66
66. Cleve, K. and Dymess, C.T. Effects of forest-floor disturbance on soil-solution nutrient composition in a black spruce ecosystem. *Canadian Journal of Forest Research* 13:894-902, 1983.
Keywords : effects; soil solution; nutrients; ecosystems; composition; treatment; Forests; removal; burning; pH; water; control; surface water; P; activity; responses; Vegetation types; boreal forest; USA,Alaska; Picea mariana; Water composition and quality; Logging; Forest litter; Soil chemistry; leaching; Site preparation; mechanical methods; Forestry practices; mechanical
Notes : Data are presented from an experimental study in the interior Alaskan taiga. Four treatments were superimposed on the forest floor following removal of the black spruce overstorey: scorching or burning of the forest floor, and mechanical removal of one-half or all of the forest floor. Conductivity, pH, and the concentrations of NH4, NO3, phosphates, K, Ca, and Mg were determined in water samples from each treatment, and from a control undisturbed spruce area, surface water, throughfall and precipitation. Only in the case of the most severe treatments (one-half and all of the forest floor removed) were there substantial changes in conductivity, pH, and concn. of Ca and Mg; K and P showed no consistent treatment effects. Lack of significant change in N concn. may reflect increased microbial activity and N immobilization in the forest floor in response to disturbance.

Ref ID : 67
67. Clinnick, P.F. and Willatt, S.T. Soil physical and chemical properties measured in an 'ashbed' following windrow burning. *Australian Forestry* 44:185-189, 1981.
Keywords : soil; chemical; burning; chemicals; chemical properties; measurement; soils; conversion; Forests; Victoria; pines; plantations; bulk density; density; infiltration; pH; Trees; growth; Eucalyptus; conversion of stands; Pinus radiata; Australia; Site preparation; Soil chemistry; fire effects; Soil physics; silvicultural conversion; Forestry practices; slash burning; soil physical properties; soil pH; Conifers; radiata pine
Notes : Measurements were made in soils collected from within and outside a burned windrow formed during the conversion of eucalypt forest in Victoria to radiata pine plantation. In windrow soils bulk density was lower while initial infiltration rate, electrical conductivity and pH were higher than in the adjacent bay soils. The implications of the results are discussed and it is suggested that increased tree growth in windrows may be partly attributed to changes in both physical and chemical properties of the soil following heaping and burning. From author's summary.

Ref ID : 68
68. Coates, D., Haeussler, S., MacKinnon, A., Bedford, L., and Maxwell, J. A guide to the use of mechanical site preparation equipment in north central British Columbia. *FRDA Handbook Victoria, B* No. 002, v + 63 pp.v + 63 pp. Canada-British Columbia For, 1987.
Keywords : mechanical; site; Site preparation; equipment; British Columbia; Silviculture; types; treatment; costs; information; mechanical methods; Canada; machinery; productivity; availability
Notes : The guide, which was originally published by the Northern Silviculture Committee in 1984, was revised by MacKinnon, A., Bedford, L., and Maxwell, J. There are 4 major sections giving (i) descriptions of 25 types of mechanical site-preparation equipment, (ii) prices, productivity rates, treatment costs and availability, (iii) descriptions of various objectives and the machines suited to each and (iv) further information sources.

Ref ID : 69
69. Comerford, N.B. and Dyck, W.J. Interaction of forest floor material and mineral soil on orthophosphate sorption. *New Zealand Journal of Forestry Science* 18:191-198, 1988.
Keywords : Forests; materials; soil; effects; phosphorus; Pinus; Pinus radiata; New Zealand; organic matter; potassium; Cultivation; Site preparation; Cycling; mineralization; Soil chemistry; soil organic matter; mechanical methods; Forest litter; nutrients; Humus; Sorption; Soil types; Soil morphology; forest soils; soils; New; site
Notes : The effect of forest floor materials on phosphorus sorption by high and low phosphorus-fixing soils was investigated using L and F+H materials collected from Pinus radiata stands in New Zealand. Organic matter and soil were either incubated for 1 month and equilibrated in 2N potassium chloride or simply mixed and equilibrated. Orthophosphate levels were then measured. Admixing organic matter decreased the phosphorus sorption on both high and low phosphorus-fixing soil - presumably by the action of organic anions present in the leachate. It is concluded that when soil and organic material are mixed during cultivation (site preparation), changes in phosphorus sorption characteristics of soils should be considered in evaluating cycling and mineralization.

Ref ID : 70
70. Corns, I.G.W. Compaction by forestry equipment and effects on coniferous seedling growth on four soils in the Alberta foothills. *Canadian Journal of Forest Research* 18:75-84, 1988.
Keywords : compaction; forestry; equipment; effects; Seedlings; seedling growth; growth; soils; soil; Alberta; materials;

bulk density; density; Logging; Site preparation; Forests; pines; Soil types; Canada; Soil physics; Pinus contorta; Picea glauca; Conifers; soil compaction; responses; mechanical; site
Notes : Soils developed on 4 parent materials (glaciolacustrine clay, clay loam till, coarse fluvial and loamy eolian) were examined to determine residual effects on soil bulk density of summer logging and mechanical site preparation during the previous 24 yr. Compaction was evident on all soils except those of the Summit association which were predominantly Brunisolic Gray Luvisols developed on Tertiary cobbly fluvial deposits. Compaction was greatest on soils of the Marlboro association which were Brunisolic Gray Luvisols developed on clay loam till. Bulk density took up to 21 yr to recover to values in undisturbed forest. In laboratory studies, lodgepole pine and white spruce seedlings were grown on the four soils compacted to bulk densities representing field conditions immediately after logging and site preparation, 5-10 yr after disturbance and in the undisturbed forest. In most cases, seedling growth decreased with increases in bulk density.

Ref ID : 71
71. Corns, I.G.W. and Annas, R.M. Field guide to forest ecosystems of west-central Alberta. *1986, xiv + 251pp* Alberta, Canada; Nor:Canada, 1986.
Keywords : Forests; ecosystems; Alberta; vegetation; soil; productivity; descriptions; management; seasons; Logging; Site preparation; soil compaction; compaction; Erosion; damage; wind; plant; Vegetation types; classification; Canada; Forest management; methods; site; reforestation; competition
Notes : The forests of west-central Alberta were classified into 6 ecoregions and 30 ecosystem associations based on data on vegetation, soil and forest productivity. The loose-leaf guide contains descriptions of each association with management notes on harvest season, logging method, site preparation intensity, dangers of soil compaction, puddling and erosion, reforestation, competition, and damage by wind and snowshoe hares. Colour photos and line drawings are presented for 80 common forest plants.

Ref ID : 72
72. Costantini, A. Definition of a plant zone for weed management during the establishment of Araucaria cunninghamii plantations. *Forest Ecology and Management* 29:15-27, 1989.
Keywords : plant; weed; management; establishment; Araucaria; Araucaria cunninghamii; plantations; weeds; Site preparation; sowing; Grasses; soil; Erosion; control; composition; nutrients; Australia; burning; Glyphosate; Planting; Seedlings; spraying; growth; slopes; Soil conservation; age; Conifers; Queensland; Erosion control; weed control; herbicides; terbumeton; terbuthylazine; Intercropping; Avena sativa; Echinochloa utilis; Pennisetum clandestinum; Cynodon dactylon; chemical control; usage; crops; Forests; cultural control; site; methods; Theses; vegetation
Notes : Existing site preparation methods for A. cunninghamii incorporate the sowing of cereals (Avena sativa and Echinochloa utilis) following clearing and of grasses (Pennisetum clandestinum) in the first year. These measures are applied in order to reduce soil erosion, and to control species composition and structure of inter-row vegetation for weed management. However, since any vegetation in the vicinity of young A. cunninghamii will compete for soil moisture and nutrients, a weed-reduced 'plant zone' (the soil area influence zone of a plant) is also required for successful A. cunninghamii establishment. In a study in SE Queensland, Australia, A. cunninghamii was planted on a site prepared by burning, and treated with glyphosate. The grass Cynodon dactylon was broadcast sown after planting containerized seedlings, and weed-free (<20% weed cover) plant zones of various sizes (radius 0.45-2.12 m) maintained over 3 yr by spraying with glyphosate and terbumeton + terbuthylazine. Both A. cunninghamii growth and accelerated soil erosion increased as the area of the weed-reduced plant zone increased. With a planting espacement of 5X2.4-m, a 3-m plant-zone band orientated across the slope represented a reasonable compromise between growth and soil conservation. In the 1st year, growth was maximized with a minimum plant zone band of 1.8 m. The growth advantages of larger-area plant zones continued to age 5.

Ref ID : 73
73. Craig, F.G., Bren, L.J., and Hopmans, P. A study of establishment techniques for Pinus radiata at Heywood [Victoria]. *Forestry Technical Papers, Forests Commission, Victoria* No. 26, 45-51; 8 ref:45-51, 1977.
Keywords : establishment; techniques; Pinus; Pinus radiata; pines; site; Drainage; ploughing; discing; ripping; treatment; removal; vegetation; lime; superphosphate; Seedlings; mortality; Trees; interactions; fertilizers; soil; Tests; Economics; Site preparation; increment; Australia; chemical methods; mechanical methods; form and methods; relation to soil; Conifers; yields; Victoria
Notes : Ten 0.48-ha pine stands were established in 1970 on gravelly loam sites with different degrees of drainage. Sites were prepared by (a) ploughing followed by discing (except for very wet sites), (b) ripping with penetration to 1 m depth, and (c) no treatment except for the removal of native vegetation. On both fertilized (0.3 kg/tree lime and superphosphate at 1:1) and unfertilized plots seedling mortality at 2 yr old was significantly lower with (b) than with (a) or (c). Mean ht. of the 20 tallest trees was significantly affected by fertilizing. A strong interaction between site and fertilizer treatment indicated that soil tests would be needed for economic fertilizer use.

Ref ID : 74
74. Crow, A.B. Advances in management of Southern Pine. *1961, Proc*, 1961.
Keywords : management; pines; Reports; natural regeneration; regeneration; site; Site preparation; techniques; P; Planting; control; vegetation; thinning; Genetics; Silviculture; Silviculture conferences

Notes : Includes reports on recent advances in natural regeneration (T. Lotti); site preparation techniques (L. P. Wilhite); planting and direct seeding (H. H. Muntz); control of competing vegetation (J. W. Starr); thinning practices in short-rotation stands (J. W. Johnson) and in sawlog-rotation stands (R. F. Kennedy); genetics (R. E. Goddard). Also papers on: Sawlog forestry-dead or alive? (R. I. Bruce); Cellulose forestry-key to the future (G. A. Anderson); etc.

Ref ID : 75
75. Damme, L., Buse, L., Warrington, S., and Van-Damme, L. The effect of microsite compaction on direct seeding success of jack pine and black spruce in northwestern Ontario. *Report Canada Ontario Forest Resource Development Agreement* No. 005, vii + 36 pp:vii + 36 pp. 1988.
Keywords : effects; compaction; pines; Ontario; soil; soil compaction; Seeds; sowing; seasons; Pinus; Pinus banksiana; Direct sowing; Picea; Picea mariana; Tools; Site preparation; Canada; Seed; site
Notes : The purpose of the study was to determine whether soil compaction would reduce seed consumption and extend the spring sowing season of jack pine (Pinus banksiana). Compaction may also allow successful direct sowing of black spruce (Picea mariana) on upland sites with mineral soil substrates. The effect of timing of sowing in relation to the timing of compaction and shape of the compacted surface was also studied for jack pine, in order to determine factors for designing site preparation/sowing tools.

Ref ID : 76
76. Damme, L.W., Buse, L., Warrington, S., and Van-Damme, L.W. Microsite soil compaction enhances establishment of direct-seeded jack pine in northwestern Ontario. *Northern Journal of Applied Forestry* 9:107-112, 1992.
Keywords : soil; soil compaction; compaction; establishment; pines; Ontario; effects; Direct sowing; sowing; Seeds; scarification; Seedlings; seasons; Forest trees; Site preparation; Pinus banksiana; Picea mariana; Canada; pinopsida; site
Notes : Results are presented of field experiments to assess the effects of microsite soil compaction on direct sowing of jack pine [Pinus banksiana] and black spruce [Picea mariana] seeds in conjunction with Bracke scarification. It was anticipated that compaction might reduce the number of seeds needed to establish seedlings, and extend the sowing season in NW Ontario. Soil compaction increased the number of scalps stocked with jack pine by 30% after the first growing season. Tamping the sowing site with a pyramidal surface doubled the percentage of stocked scalps, compared with conventional sowing, for the latest sowing date (mid/late July). Compaction effects were not detected for black spruce.

Ref ID : 77
77. Daniels, K.R.,Jr. and Sarigumba, T.I. Survival and height growth of sycamore following different site-preparation treatments. *Southern Journal of Applied Forestry* 4:185-187, 1980.
Keywords : survival; height; growth; site; Site preparation; treatment; pines; Georgia; Logging; Harrowing; Seedlings; seasons; analysis; Trees; soil; Soil types; types; Spodosols; Platanus occidentalis; mechanical methods; Soil fertility; Plantanus occidentalis; Forestry practices; responses; Broadleaves; USA
Notes : An area previously occupied by natural longleaf pine in the Georgia SE coastal plain was cleared of logging debris using a KG blade, and plots were prepared by (a) harrowing; (b) harrowing and bedding; (c) single bedding, and (d) double bedding. Seedlings (1+0) of Platanus occidentalis were planted in Feb., 1970, and survival and ht. were recorded after 6 growing seasons. Analysis of the data after exclusion of results from a highly variable block showed that survival was significantly higher with treatment (d) than with (a) or (b); survival with treatment (c) was intermediate, with n.s.d. from the others. Treatment (b) produced significantly taller trees. Soil profile analysis showed that the highly variable block contained 2 soil types, one of which, Mascotte soil, a spodosol, was associated with low survival and poor growth.

Ref ID : 78
78. Dargavel, J.B. and Hall, M.J. The contribution of intensive plantation silviculture to industrial development in Australia and New Zealand. *Proceedings of the Eighth World Forestry Congress, Jakarta, 16 28 Oct* No. FID-I/17-16, iii:iii + 36 pp. 1978.
Keywords : intensive; plantations; Silviculture; development; Australia; New; New Zealand; research; management; Pinus; Pinus radiata; wood; available; costs; productivity; rotations; Genetics; improvement; site; Site preparation; weeds; weed control; control; fertilizers; treatment; models; planning; Forest management; systems analysis and simulation; Conifers; land; weed
Notes : Research and development of more intensive silvicultural and management practices for fast-growing exotic species (mainly Pinus radiata) have been stimulated by the demand for wood, shortage of available land, increasing costs and an apparent decline in productivity in second rotations. Attention has been paid to genetic improvement, site preparation, weed control, fertilizer treatment and stocking control; various computer-based models have been developed to aid in planning plantation and industrial development.

Ref ID : 79
79. Day, S.D. and Bassuk, N.L. A review of the effects of soil compaction and amelioration treatments on landscape trees. *Journal of Arboriculture* 20(1), 1994.

Keywords : reviews; effects; soil; soil compaction; compaction; treatment; Trees; landscape; communities; site; methods; Planting; techniques; plant; establishment; growth; research; Theses; Woody plants; roots; water; infiltration; Drainage; bulk density; penetrometer; soil aeration; urban horticulture
Notes : Compacted soil is a frequently encountered problem on urban and community landscape sites. Numerous site amelioration methods and planting techniques have been employed to counteract the harmful effects of soil compaction on plant establishment and growth. Recent research aimed at examining the effectiveness of these techniques has given mixed results. It is evident that compaction restricts woody plant growth, but the nature and causes of the restriction are not completely understood. This is partly a result of the difficulty in separating the effects of interrelated factors such as physical impedance to roots, soil gas exchange, water infiltration and drainage. Consequently, it is difficult to prescribe with confidence techniques to improve compacted soil conditions for landscape trees. A review of our current understanding of soil compaction and its amelioration is presented here from the perspective of woody plant establishment.

Ref ID : 80
80. DeWit, J.N. and Terry, T.A. Site preparation effects on early loblolly pine growth, hardwood competition, and soil physical properties. *General Technical Report, Southeastern Forest Experiment Station, USDA Forest Service* SE-24, 40-47; 32 ref:40-47, 1983.
Keywords : site; Site preparation; effects; pines; growth; competition; soil; soil physical properties; physical properties; height; diameter; volume; methods; soils; basal area; treatment; bulk density; density; Conferences; Southern Silvicultural Research Conference; Pinus taeda; Forestry practices; Physical properties of soil; forest soils; Soil physics; porosity; Woody plants; mechanical methods; USA,Mississippi; USA; Mississippi
Notes : Height, diameter, and volume growth ranking of eight-year-old loblolly pine by site preparation method on Wilcox and Falkner soils in Kemper County, Miss., was as follows: shear-pile-bed > shear-pile > tree-crushed; hardwood basal area followed an exact opposite trend by site preparation method. Total hardwood plus pine basal area remained fairly constant among treatments; as hardwood basal area decreased pine basal area increased. Soil bulk density was greatest on shear-pile plots and soil macropore space was greatest on bedded plots. Hardwood competition and soil physical properties appeared to be limiting pine growth on the study site.

Ref ID : 81
81. Dickens, D.F., Glover, G.R., and Zutter, B.R. Results of 24-year-old Fayette site preparation study. *Proceedings, Southern Weed Science Society, 36th annual meeting* 244-245. 1983.
Keywords : site; Site preparation; control; stems; herbicides; 2,4 D; 2,4,5 T; height; regression analysis; analysis; growth; yields; Pinus taeda; application; frilling; ringing; tree injection; usage; crops; Forests; woody weeds; Conferences; Southern Weed Science Society; USA; Alabama; trials; P
Notes : In long-term trials initiated in 1959 hardwood control by handcutting small stems and girdling stems >3 inches d.b.h., injection, foliar sprays, chain frill or axe frill + herbicide (4 lb of a 1:1 2,4-D + 2,4,5-T mixture/gal) and bulldozing all increased P. taeda d.b.h., mean total height, basal area/acre, cubic foot vol./acre and board vol./acre; axe frill and bulldozing resulted in the highest board vol. Regression analysis showed that the degree of hardwood control at time of site preparation greatly affected the long-term growth and yield of P. taeda.

Ref ID : 82
82. Dissmeyer, G.E. and Singer, J.R. Role of foresters in the Areawide Waste Treatment Management Planning Process. *Southern Journal of Applied Forestry* 1:27-31, 1977.
Keywords : treatment; management; planning; roles; USA; environmental protection; protection; water; water pollution; POLLUTION; control; amendments; effects; development; forestry; soil; Erosion; site; Site preparation; Logging; roads; Buildings; Forest products industries; pollution problems; control measures,general; erosion effects
Notes : An account of the planning process developed in the USA by the Environmental Protection Agency (EPA) under the Federal Water Pollution Control Act Amendments (1972) which come into full effect in 1983. Suggestions are made on the development of Best Management Practices (BMP) in forestry to control soil erosion resulting from site preparation, logging and road building, with examples of the adaptation of BMP to the preparation of different sites in the southern USA.

Ref ID : 83
83. Dominy, S.W.J. A comparison of three site preparation implements in New Brunswick. *Technical Note Forest Engineering Research Institute of Canada* No. TN-207, 8 pp.; 4:8 pp. 1993.
Keywords : comparisons; site; Site preparation; New; New Brunswick; site types; types; Canada; discs; Planting; costs; growth; yields; classification; plantations; performance; trench cutters; implements; Forestry machinery; Tests; performance tests; disc ploughs; equipment
Notes : Side-by-side comparisons of different site preparation implements were carried out on 4 different site types in north-central New Brunswick, Canada. The implements compared were the Donaren 180D disc trencher, the C&H Plow and the Madge Rotoclear. In general, the Donaren produced more acceptable planting microsites, and at a lower cost than the other implements. However, long-term growth and yield data will confirm whether better microsite classifications result in superior plantation performance.

Ref ID : 84
84. Dominy, S.W.J. A comparison of the Silva Wadell powered-cone scarifier and TTS-35 disc trencher in central Newfoundland. *Field Note: Silviculture Forest Engineering Research Institute of Canada* No. 60, 2 pp.; Summa:2 pp.-84. Pointe Claire, C, 1993.
Keywords : comparisons; discs; scarifiers; Newfoundland; performance; Site preparation; treatment; furrows; Silviculture; forestry; Forestry machinery; Tests; performance tests; disc cultivators; Canada; trench cutters; site; cones
Notes : The performance of the Silva Wadell powered-cone scarifier was compared to that of the TTS-35 disc trencher in site preparation. Two settings each of prime mover travel speed, Silva Wadell cone speed, down-pressure and cone angle were used, resulting in 16 different treatments. The TTS-35 disc trencher produced smaller furrows and berms, and over 50% fewer preferred plantable spots than could be obtained with the best Silva Wadell settings.

Ref ID : 85
85. Donald, D.G.M. Nursery and establishment techniques as factors in productivity of man-made forests in southern Africa. *South African Forestry Journal* No. 109, 19-25; 38 r:19-25, 1979.
Keywords : Nurseries; establishment; techniques; productivity; Forests; Africa; development; survival; Planting; inoculation; soil; fertilizers; Fertilizer application; application; control; Fungi; site; Site preparation; Cultivation; ripping; weeds; weed control; Glyphosate; improvement; quality; pines; Pinus; Eucalyptus; Southern Africa; weed
Notes : Recent developments in nursery practice to improve the survival of initial plantings (by mycorrhizal inoculation of the soil, fertilizer application and control of pathogenic fungi) are briefly reviewed. Site preparation by complete cultivation or ripping, weed control by glyphosate application, and fertilizer use are discussed as reasons for the considerable improvement in the quality of establishment and re-establishment that has been achieved in recent years. Particular reference is made to pine and eucalypt cultivation.

Ref ID : 86
86. Dougherty, P.M. and Gresham, C.A. Conceptual analysis of southern pine plantation establishment and early growth. *Southern Journal of Applied Forestry* 12:160-166, 1988.
Keywords : analysis; pines; plantations; establishment; growth; Seedlings; requirements; Planting; soil; USA; Trees; Site preparation; roots; development; Soil types; types; Conifers; Silvicultural characters; Pinus 'Southern'; seedling growth; Southern States of USA; Pinus; survival; chemical; chemical properties; soils; competition; light; vegetation; soil aeration; root system
Notes : Southern pine [Pinus 'Southern'] seedling silvical requirements for survival and growth during the first year after planting were studied in relation to physical and chemical properties of soils in the SE USA. Soil moisture was the factor of greatest concern. Solar radiation was also critical because of intense competition for light between tree seedlings and competing vegetation. Soil aeration was also important, especially in the coastal plain. With an understanding of the silvics of southern pine, seedling genotype and site-preparation prescriptions can be improved to maximize root system development and thus survival and early growth on each soil type.

Ref ID : 87
87. Edlund, L. and Jonsson, F. Swedish experience with ten years of mounding site preparation. *International Union of Forestry Research Organisations* 1986 Workshop(8th Annual), 1986.
Keywords : site; mounds; soil; Humus; Sweden; soils; growth; frost; frost heave; mounding; scarification; Site preparation; plant survival; forestry
Notes : Our ten years of experience with mounding in Jamtland leads us to believe that mounds of mineral soil on inverted humus are desirable on all sites where it is physically possible. Observations made in other locations in Sweden show similiar trends. The suitability of mounding on fine textured soils, should be observed especially from both growth and frost heaving point of view.

Ref ID : 88
88. Edwards, M.B. Five-year responses of Piedmont loblolly pine to six site-preparation treatments. *Southern Journal of Applied Forestry* 14:3-6, 1990.
Keywords : responses; pines; site; Site preparation; treatment; survival; height; diameter; Planting; Pinus; Pinus taeda; Georgia; control; Trees; herbicides; Hexazinone; discs; fertilizers; Fertilizer application; application; nitrate; volume; growth; Conifers; chemical treatment; increment; mechanical methods; USA; Sulfometuron; nitrogen; woody weeds; physical control; cutting; hoeing; discing; integrated control; cultural control; burning; Forest trees; as weeds; growth rate; weed control
Notes : Survival, height and diameter were recorded for 5 yr after planting loblolly pine (Pinus taeda) on a clear felled loblolly pine site in the Georgia Piedmont. Six plots (2 acre) in each of 5 blocks were prepared with 6 treatments in order of increasing intensity: clear felled only (control); chainsaw to fell residual trees >1.0 inch d.b.h.; shear and chop; shear, chop and herbicide (hexazinone); shear, rootrake, burn and disc; and shear, rootrake, burn, disc, fertilizer application (ammonium nitrate) and herbicide (sulfometuron-methyl). In general, survival increased with intensity of site preparation. All site preparation treatments increased volume growth when compared with the control.

Ref ID : 89

89. Edwards-MB Jr. Three-year performance of planted loblolly pine seedlings on a lower Piedmont site after six site-preparation treatments. *Research Note Southeastern Forest Experiment Station, USDA Forest Service* No. SE-337, 3 pp.; 1:3 pp. 1986.
Keywords : performance; pines; Seedlings; site; Site preparation; treatment; Planting; clear felling; control; herbicides; fertilizers; Trees; burning; chemical treatment; mechanical methods; usage; weeds; cultural control; discing; management; felling; Conifers; USA; survival; growth; Pinus; Pinus taeda; discs; intensive
Notes : Survival, ht. and diam. growth of Pinus taeda were measured for 3 yr after planting on sites prepared by 6 treatments of increasing intensity: clear felling alone (control); chain saw after timber harvest; shear and chop; shear, chop and herbicide treatment; shear, windrow, burn and disc; or shear, windrow, burn, disc, fertilizer and herbicide treatments. Trees in the most intensive treatment were 1.5 ft taller and had 8% better survival than control trees.

Ref ID : 90
90. Eitemiller, D.R., Lynch, D.L., Gold, M.A., Sheng, T.C., Avery, M.E., Malmgren, R.C., Fiedler, L., Wilken, G.C., Bentley, W.R., Betters, D.R., Schmehl, W.R., Budowski, G., and Weber, F. Proceedings of the 1986 International Agroforestry Shortcourse. Selected papers and abstracts from the shortcourse conducted August 10-23, 1986, at Colorado State University, Fort Collins, Colorado 80523 USA. *1987, ii + 178 pp* Colorado, USA; Color:USA, 1987.
Keywords : Agroforestry; USA; development; forestry; Trees; watersheds; nitrogen; soil; Soil fertility; fertility; soil properties; pests; control; Economics; appropriate technology; research; design; Taungya; Site preparation; projects; Training; Training courses; International Agroforestry Shortcourse; Colorado; pest control; tenure systems; sociology; rural development; Soil conservation; Leguminosae; nitrogen fixation; farming systems research; beekeeping; extension; communication; descriptions; natural resources; roles; technology; site
Notes : The development of this shortcourse was sponsored and carried out by the International School of Forestry and Natural Resources and the Department of Forestry, College of Forestry and Natural Resources, Colorado State University. The publication resulting from it contains a selection of the major course themes. There are 11 papers: The role of trees in agroforestry, Gold, M.A.; Watershed concerns in agroforestry, Sheng, T.C.; Legumes and nitrogen fixation, Gold, M.A.; Soil fertility and conservation in agroforestry systems, Avery, M.E.; Soil properties for agroforestry, Malmgren, R.C.; Pest control in agroforestry systems, Fiedler, L.; Tenure in agroforestry systems, Wilken, G.C.; Social factors that affect agroforestry: some lessons from rural development, Bentley, W.R.; Economic factors affecting agroforestry, Betters, D.R.; The farming systems approach to developing appropriate technologies for agroforestry systems, Schmehl, W.R.; and Agroforestry research design, Bentley, W.R. Five papers are presented only as abstracts: Agroforestry defined, Budowski, G.; Beekeeping in agroforestry systems, Lynch, D.L.; The taungya system of agroforestry, Budowski, G.; Site preparation within agroforestry projects, Weber, F.; and Extension and communication in agroforestry, Lynch, D.L.

Ref ID : 91
91. Endean, F. and Jones, B.E. Clean cultivation and the establishment of Pinus kesiya in Zambia. *East African Agricultural and Forestry Journal* 38:120-129, 1972.
Keywords : Cultivation; establishment; Pinus; methods; site; Site preparation; techniques; P; seasons; ploughing; discing; plant; effects; survival; height; weed; growth; soil; Planting; intensive; plants; weeding; Grasses; Pinus kesiya; weed control; cultural control; mechanical; Zambia; Brachystegia; Isoberlinia; manual; Gramineae; climat
Notes : Experiments were carried out in the Western Province of Zambia to determine the best method of site preparation and cultivation technique for the establishment of P. kesiya on Brachystegia/Isoberlinia sites with a mean annual rainfall of 48-50 inches and an average dry season of 263 days. Methods of site preparation (either complete ploughing + 2-way discing, line ploughing + 2-way discing, discing only or hand clearance of an area 3 X 3 ft around each plant) had no effect on survival and height of P. kesiya, or on weed growth or soil moisture during the 14 months following planting in November. The most intensive cultivation (4 2-way discings) gave the highest percent survival and the tallest plants (2.5 ft), the least amount of weed growth and the highest level of soil moisture. Reduced weeding allowed a greater quantity of grass to persist during the wet season which depleted soil moisture and so reduced survival and growth at the end of the following dry season.

Ref ID : 92
92. Everts, D. Twin- and single-rope gravity rollers - a site-preparation technique developed in New Zealand. *New Zealand Journal of Forestry* 26:70-80, 1981.
Keywords : Site preparation; techniques; New; New Zealand; development; scrub; machines; slopes; Tracking; leaves; vegetation; burning; mechanical methods; land clearance; land
Notes : The development of gravity rollers used for clearing steep scrub-land in New Zealand is discussed; the machines can operate on slopes of more than 25 deg with a downslope reach of up to 250 m, often avoiding contour tracking. Crusher-rollers of up to 10 t leave vegetation in a compact, shattered mass, ready for burning. From author's summary.

Ref ID : 93
93. Ezell, A.W. and Arbour, S.J. Long-term effects of scalping on organic matter content of sandy forest soils. *Tree Planters' Notes* 36:13-15, 1985.
Keywords : effects; organic matter; Forests; forest soils; soils; soil; sandy soils; Texas; plantations; establishment; Soil

types; Site preparation; mechanical methods; USA; Soil chemistry; carbon
Notes : The organic matter content of sandy soils in the Upper Coastal Plain of E. Texas continued to show the effects of scalping 10 yr after plantation establishment.

Ref ID : 94
94. Fadin, I.A., Leitan, R.I., Smolyanitskaya, L.B., and Stadnitskaya, N.I. The fundamental forestry requirements as regards forest ploughs. *Lesnoe Khozyaistvo* No. 1, 56-58; 11 ref:56-58, 1975.
Keywords : forestry; requirements; Forests; ploughs; reviews; types; USSR; ploughing; plantations; establishment; effects; site; analysis; furrows; available; Drainage; Ditches; mechanical; Planting; design; specific; drainage,land; Site preparation; mechanical methods
Notes : Reviews the various types of forest plough developed in the last 15 years in the USSR for strip ploughing preparatory to plantation establishment. The main requirements as to forest ploughs are discussed, with special reference to the effect of ploughing on excessively wet sites. The analysis indicates that forest ploughs capable of producing furrows 20-25, 30-40, 40-50, and 50-60 cm deep should be available; the plough producing a furrow 50-60 cm deep can also be used for making drainage ditches. The furrow slice produced by the plough should be at least 40 cm wide and 10 cm thick, for mechanical planting. The cross-sections of shallow furrows should be rectangular; furrows 30 cm deep and deeper should be trapezoidal in cross-section, with the furrow bottom 30 cm wide. Various other desirable design features of forest ploughs are discussed, and specific recommendations are made.

Ref ID : 95
95. Fang, Q. Effects of continued planting of Chinese fir on the fertility of soil and the growth of stands. *Scientia Silvae Sinicae* 23:389-397, 1987.
Keywords : effects; Planting; fertility; soil; growth; clear felling; felling; Forests; burning; Site preparation; soil organic matter; organic matter; natural regeneration; Conifers; increment; Variation; Cunninghamia lanceolata; Soil fertility; Soil chemistry; nutrients; Cunninghamia; China; Logging; plantations; forestry; rotations; site; P; available; regeneration
Notes : Growth of Chinese fir (Cunninghamia lanceolata) was 6.3 and 24.3% less respectively in the 2nd and 3rd rotations at 15 yr old than in the 1st rotation after clear felling broadleaved forest, burning and site preparation. From the 1st to the 3rd rotation at 15 yr old, total soil organic matter, total N, P, K and available N, P, and K decreased by 45, 38, 42, 32, 28, 38 and 18% respectively. Natural regeneration of subtropical broadleaved species and understorey species, however, appeared to be relatively unaffected.

Ref ID : 96
96. Ferguson, I.S. and McKimm, R.J. Establishment techniques at Koetong plantation, Victoria: a multivariate analysis and comparison. *Australian Forestry* 38:34-43, 1975.
Keywords : establishment; techniques; plantations; Victoria; analysis; comparisons; Reports; Planting; trials; Pinus; Pinus radiata; site; Site preparation; Slash; slash burning; burning; machines; growth; age; height; planting methods; methodology; Conifers
Notes : Reports results from planting trials with Pinus radiata in which four techniques of site preparation and planting were compared, viz. broadcast slash burning and hand planting (a), and burning slash in windrows followed by hand planting (b) or machine planting (c) between windrows, or hand planting within windrows (d). Growth up to 6 years of age (in terms of height, stocking and b.a.) varied in the order d > c approx equal to b > a.

Ref ID : 97
97. Firth, J. and Murphy, G. Skidtrials and their effect on the growth and management of young Pinus radiata. *NZ Journal of Forestry Science* 19(1):22-28, 1989.
Keywords : effects; growth; management; Pinus; Pinus radiata; Trees; Forests; height; diameter; thinning; pruning; age; crops; trials; Theses; soils; site; soil disturbance; skidtrials
Notes : Growth of Pinus radiata D.Don trees growing on and just off four major skidtrails in Tairua Forest was compared. Those growing on the skidtrials were markedly inferior in height, diameter, and form. This significantly affected the selection of trees for thinning and pruning so that, by age 7.5 years, only 4% of the trees planted on the skidtrials remained to form the final crop compared with 15% of those planted off the trials. Trees left on the trails were 2 cm smaller in diameter and 1 m shorter than those left off the trail. These results suggest that, for soils similar to the clays of Tairua, consideration should be given to either leaving major skidtrails unplanted, or carrying out some sort of site amelioration.

Ref ID : 98
98. Fleming-RL, Black-TA, and Eldridge-NR Effects of site preparation on root zone soil water regimes in high-elevation forest clearcuts. *Forest Ecology and Management* 68:173-188, 1994.
Keywords : effects; site; Site preparation; roots; soil; Soil water; Soil water regimes; water; Forests; Seedlings; growth; survival; British Columbia; seasons; altitude; treatment; ripping; herbicides; application; containers; spacing; Pseudotsuga; Pseudotsuga menziesii; Picea; soil water potential; soil water content; storage; mulches; Drainage; Losses; Forest trees; Planting; rhizosphere; Tillage; weed control; chemical control; Forest plantations; clear felling; Canada; regions; available

Notes : Soil water deficits often reduce seedling growth and survival in the drier forested regions of southern British Columbia. This study investigated growing season soil water regimes on three clearcut, grass-dominated sites (at altitudes of 1220 m, 1450 m and 1670 m) in southern British Columbia to determine whether site preparation treatments could increase seedling root zone water supply. The same treatments were applied at each site and included scalping, scalping followed by ripping and herbicide application. Following site preparation, sites were planted in spring 1986 with 1-yr-old container grown seedlings at 2X2 m spacing - Douglas fir (Pseudotsuga menziesii) at the low altitude site, and Englemann spruce (Picea engelmannii) at the two other sites. In untreated plots, root zone soil water supply was most limited at the low altitude site and least limited at the high altitude site. Over the four growing seasons studied, soil water potentials at 15 cm fell as low as -900 kPa at the low altitude site and as low as -700 kPa at the mid-altitude site, but remained greater than -150 kPa at the high-altitude site. All three site preparation treatments effectively increased root zone soil water content and profile water storage, particularly at lower altitudes. The three treatments were usually equally effective in increasing soil water supply at a given site. Ripping had little effect on root zone available water capacity, and creation of a surface organic mulch with herbicide did not substantially increase soil water supply compared to bare mineral soil surfaces. Treatments reduced evapotranspiration but also increased drainage losses at all sites.

Ref ID : 99
99. Flinn, D.W. Comparison of establishment methods for Pinus radiata on a former P. pinaster site. *Australian Forestry* 41:167-176, 1978.
Keywords : comparisons; establishment; methods; Pinus; Pinus radiata; P; site; Site preparation; Victoria; Slash; ploughs; treatment; growth; soil; responses; chemicals; weed; weed control; control; fertilizers; Pinus pinaster; Australia; mechanical methods; burning; chemical methods; NPZn; herbicides; atrazine; Amitrole; combined with other; chemical
Notes : Three site preparation methods were examined in SW Victoria, (a) slash, macerate and scalp, (b) broadcast burn and plough, and (c) windrow burn and plough, together with 7 fertilizer/weedkiller (Vorox M 2) treatments. Early growth was consistently better on sites prepared by (a), probably largely due to conservation of soil moisture. There was a significant response to P in the presence of weedkiller on (a) sites and to NPZn on (c) sites. A significant growth response to chemical weed control was observed on (b) and (c) but not on (a).

Ref ID : 100
100. Flinn, D.W. and Aeberli, B.C. Establishment techniques for radiata pine on poorly drained soils deficient in phosphorus. *Australian Forestry* 45:164-173, 1982.
Keywords : establishment; techniques; radiata pine; pines; soils; phosphorus; methods; site; Site preparation; discs; ploughing; ripping; vegetation; Victoria; applications; superphosphate; growth; Cultivation; application; survival; P; treatment; Trees; available; costs; responses; woody weeds; weeds; weed control; control; Pinus radiata; Fertilizer application; mechanical methods; fertilizers; Soil chemistry; nutrient deficiencies; foliage; chemistry; Forestry practices; phosphorus fertilizers; Australia; Conifers; weed
Notes : Three methods of site preparation (disc ploughing, deep ripping or a combination of the two) were used for establishment on 4 sites with contrasting native vegetation near Neerim East, Victoria, with or without localized applications of superphosphate at 113-452 g/tree. Characteristics of the dominant vegetation proved to be poor indicators of the potential early growth of radiata pine following cultivation and fertilizing. Localized application of superphosphate was essential for satisfactory survival and early growth, although even the highest rate gave foliar P concn. well below the 'satisfactory' level of 0.14% suggested earlier for radiata pine [see FA 41, 3352]. The combined ripping plus ploughing treatment gave much better growth of fertilized trees than either treatment alone, though insufficient cost/benefit data were available to determine whether the additional cost is justifiable. Growth responses to ploughing alone and ripping alone were more or less proportional to their respective costs: ploughing alone is recommended on the basis of expected subsequent costs for woody weed control.

Ref ID : 101
101. Flinn, D.W., Hopmans, P., Moller, I., and Tregonning, K. Response of radiata pine to fertilisers containing N and P applied at planting. *Australian Forestry* 42:125-131, 1979.
Keywords : responses; radiata pine; pines; fertiliser; P; Planting; Pinus; Pinus radiata; Seedlings; site; soils; plantations; applications; Trees; superphosphate; growth; application; weeds; Site preparation; soil; competition; chemicals; weed control; control; herbicides; fertilizers; NP; form and methods; relation to soil; combined with other treatments; Australia; nitrogen phosphorus fertilizers; Conifers; Victoria; chemical; weed
Notes : Pinus radiata seedlings were planted in July 1975 on 4 ploughed and contour-ripped sites with P-deficient soils in a plantation 100 km E. of Melbourne. Spot applications of (NH4)2SO4 at 0, 34, 68 and 136 g per tree and superphosphate at 0, 113, 226 and 452 g per tree (16 combinations in all) were made in Sept. Growth after 2 yr was increased by P application but there was no evidence of any response to N. The response to P was marked at 2 of the sites but only moderate at the other 2 sites despite symptoms of P-deficiency and very low foliar P contents in unfertilized trees. Weeds, which recolonized soon after site preparation did not appear to compete for soil P, containing only about 2 kg/ha P when harvested in June 1978. It is suggested that differential competition by weeds for soil moisture may have been responsible for the differences in response to P. It is concluded that spot application of about 180 g superphosphate per tree at planting should give a good growth response in this plantation without chemical weed control, but that in the absence of suitable herbicides the use of NP fertilizers is not justified.

Ref ID : 102
102. Flinn, D.W., Squire, R.O., and Farrell, P.W. The role of organic matter in the maintenance of site productivity on sandy soils. *New Zealand Journal of Forestry* 25:229-236, 1980.
Keywords : roles; organic matter; maintenance; site; productivity; sandy soils; soils; research; projects; Victoria; Australia; pines; crops; growth; Theses; design; methods; litter; Logging; Residues; nutrients; soil; Pinus radiata; Site preparation; production,biological; biological production of forests and trees; productivity,forest; Soil fertility; responses; Soil types textural; Conifers; radiata pine
Notes : A further account from a research project in SW Victoria, Australia [see FA 42, 1698], to study the productivity of successive radiata pine crops on infertile sandy soils low in organic matter. Results from studies of the factors affecting growth and the influence of silvicultural practices on these factors have been used to design methods of maintaining site productivity. It has been shown that litter and logging residues should not be burnt but left on-site to conserve organic matter, nutrients (especially N) and soil moisture. From authors' summary.

Ref ID : 103
103. Foster, N.W. and Morrison, I.K. Alternate strip clearcutting in upland black spruce. IV. Projected nutrient removals associated with harvesting. *Forestry Chronicle* 63:451-456, 1987.
Keywords : nutrients; removal; Harvesting; Upland; foliage; stems; bark; stumps; roots; Trees; Ontario; Theses; Biomass; rotations; Logging; Forests; nutrient reserves; growth; Site preparation; Conferences; Alternate strip clearcutting in upland black spruce; Silvicultural systems; clear strip felling; Picea mariana; Canada; whole tree logging; ecology; Cycling; calcium; potassium; magnesium; P; nitrogen; Picea; clear felling; forestry; cones; wood; site; methods
Notes : Samples of foliage, cones, live and dead branches, stem bark and wood, and wood and bark from stumps and roots were collected from 88 trees on sample plots in a stand near Lake Nipigon, Ontario, dominated by black spruce, about 100 yr old. Analyses of these were used to estimate nutrient removal associated with conventional (stem only), full-tree (entire aboveground biomass) and whole tree (including stump and roots) harvesting on 100-yr rotations. Conventional logging would remove 219, 62, 36, 18 and 9 kg/ha of Ca, N, K, Mg and P, respectively. The increased use of phytomass during full-tree harvesting could result in as much as a 400% increase in N removal, a 300% increase in K removal, 200% increases in P and Mg removal and a 60% increase in Ca removal. The forest floor contained 51-72% of the soil's reserves of nutrients (except for P) within the effective rooting zone. Results indicate that there would be sufficient nutrient reserves and replenishment on this site, after full-tree logging, to sustain the next generation of spruce through the early growth period. It is recommended that post-harvesting site preparation methods should be restricted to those that ensure that forest floor nutrient reserves are retained on site.

Ref ID : 104
104. Foster, P.G. and Costantini, A. Pinus plantation establishment in Queensland: I. Field surveys for site preparation planning and site design. *Australian Forestry* 54:75-82, 1991.
Keywords : Pinus; plantations; establishment; Queensland; surveys; site; Site preparation; planning; design; information; soil; Soil types; types; fertilizers; Conifers; Australia
Notes : The surveys used for planning Pinus plantation establishment in Queensland are described. Prior to clearing for plantation establishment, field surveys are used to provide information on soil types, from which site plantability and erodibility status are inferred. Knowledge of site capability is used as an input into selection of site preparation systems, site preparation design, taxon selection and fertilizer prescription.

Ref ID : 105
105. Fowler, W.B. and Helvey, J.D. Soil and air temperature and biomass after residue treatment. *Research Note, Pacific Northwest Forest and Range Experiment Station, USDA Forest Service* No. PNW-383, 8 pp.;8 pp. 1981.
Keywords : soil; temperature; Biomass; Residues; treatment; air temperature; Forests; Oregon; Slash; production; Soil physics; Forest influences; air; soils; Forestry practices; Site preparation; soil temperature; Soil types; forest soils; soil preparation; Soil types ecological; USA
Notes : Residues from forests in Oregon harvested in 1976 were given 5 treatments: (a) slash burned in piles; (b) broadcast burned; (c) slash removed; (d) residues chipped and left in place; and (c) slash left untreated. Starting in May 1977 cumulative soil and air temp. were recorded and biomass samples were collected. Heat accumulation (degree h) in air was increased by (a) and (b) but unaffected by (c) and (d) compared with (e). Heat accumulation in soil was lower in (d)-treated plots than in others. Production of aboveground biomass was (a)<(c)<(d)<(e)<(b).

Ref ID : 106
106. Fox, T.R., Burger, J.A., Kreh, R.E., and Douglass, J.E. An overview of watershed and nutrient cycling research at the Reynolds Homestead Research Center. *General Technical Report, Southeastern Forest Experiment Station, USDA Forest Service* SE-24461-467, 468-47:468-476, 1983.
Keywords : watersheds; nutrients; Cycling; research; projects; Harvesting; Site preparation; Virginia; control; treatment; pines; soil; soil solution; Streams; water; sediment; nitrification; ecosystems; Conferences; Southern Silvicultural Research Conference; Forestry practices; Cycling in ecosystems; clear felling; USA; site
Notes : A project designed to quantify the changes brought about by clearcut harvesting and site preparation has been

established on the Virginia Piedmont. Four forested watersheds were selected for study in 1980. Three of the watersheds were commercially clearcut during the summer of 1981. The fourth watershed remained undisturbed and serves as a control. The clearcut watersheds were site prepared in July 1982. Three separate treatments: chop and burn; shear-disk (1-pass); and shear, rake-pile, disk (3-pass), representing three levels of site preparation intensity were applied. The site prepared watersheds will be planted to loblolly pine in March 1983. H-flumes and ceramic cup lysimeters were installed to monitor changes in streamflow and soil solution. Preliminary results indicate that prior to site preparation, nutrient levels in both soil solution and stream water were higher in the clearcut watersheds. Suspended sediment levels in stormflow from the clearcut watersheds were also higher. Post site preparation nutrient levels in soil solution were higher than levels in the control. Levels of NO3-N in soil solution and stream water from both the clearcut and the site prepared watersheds were higher than NH4-N. This indicates that nitrification may be an important process in disturbed ecosystems on the Piedmont.

Ref ID : 107
107. Fox-TR, Burger-JA, and Kreh-RE Effects of site preparation on nitrogen dynamics in the southern Piedmont. *Forest Ecology and Management* 15:241-256, 1986.
Keywords : effects; site; Site preparation; nitrogen; soil; Logging; Slash; Losses; mechanical methods; Cycling; Forestry practices; USA; Virginia; mechanical; treatment; soil solution; available
Notes : Three mechanical treatments (chop/burn, shear/disc, and shear/pile/disc) were compared on gauged catchments in the Piedmont of Virginia. Samples from soil solution and streamwater and a series of soil incubations, both laboratory and in situ, were used to monitor changes in the treatment areas following site preparation. Available nitrogen reserves were lowest in the shear/pile/disc catchment where the logging slash had been piled into windrows. Larger nitrogen reserves were found in the shear/disc and the chop/burn catchments. Between 58 and 95 kg/ha of nitrogen were mineralized in the site prepared areas during the first year following treatment compared to only 38 kg/ha during the same period in the uncut stand. Streamwater nitrogen export increased following site preparation with the largest losses of nitrogen occurring in the shear/pile/disc catchment.

Ref ID : 108
108. Francis, P.J. Growth of exotic pine on Wongi State Forest. *Unpublished Report, Department of Forestry, Queensland* No. 12, 26 pp.; 2 re:26 pp. 1983.
Keywords : growth; pines; Forests; assessment; trials; Queensland; P; plantations; site; Site preparation; mounds; application; fertilizers; Pinus caribaea; Species trials; Australia,Queensland
Notes : An assessment of several trials at Wongi State Forest, Queensland, suggested that P. caribaea var. hondurensis was the most suitable species to use in any plantation programme in this forest. Site preparation, particularly the use of large mounds, appeared beneficial to early growth of pines. The application of fertilizers other than P did not benefit growth.

Ref ID : 109
109. Francis, P.J. The role of cultivation in plantation establishment in subtropical eastern Australia. *Proceedings IUFRO Symposium on Site and Productivity of Fast Growing Plantations* D.C.; Schonau, A.P.G:A.P.G.-587, 1984.
Keywords : roles; Cultivation; plantations; establishment; Australia; Site preparation; Queensland; Slash; pines; Pinus; Pinus elliottii; Honduras; Pinus caribaea; discing; ploughing; ripping; growth; responses; weeds; weed competition; plant; effects; weed control; control; soil; nutrients; nutrient availability; availability; Drainage; Conferences; Site and Productivity of Fast Growing Plantations; Forestry practices; forestry; forestry plantations; site; methods; mounding; weed; competition
Notes : Cultivation is an integral part of the site preparation phase of a highly mechanized plantation establishment programme on the subtropical coastal lowlands of Queensland in eastern Australia. The principal species in this programme are slash pine (Pinus elliottii Engelm. var. elliottii) and Honduras Caribbean pine (Pinus caribaea Mor. var. hondurensis Barr. et Golf.). The various methods of cultivation (including discing, ploughing, mounding and ripping) are discussed and their associated growth responses examined. Significant increases in early growth have been demonstrated for cultivation. Evidence is presented that the growth responses to cultivation are not solely attributable to a reduction in weed competition, but that cultivation influences plant growth through its effects on weed control, soil physical structure, nutrient availability and drainage.

Ref ID : 110
110. Francis, P.J. and Bacon, G.J. Ripping trials in coastal south Queensland Pinus plantations. *Research Paper, Department of Forestry, Queensland* No. 15, 16 pp.; 16 r:16 pp. 1983.
Keywords : ripping; trials; Queensland; Pinus; plantations; responses; pines; reviews; soil; Soil types; types; effects; stand development; development; methods; Cultivation; Site preparation; mechanical methods; Australia,Queensland; Australia
Notes : Experiments established to investigate ripping responses in exotic pine plantations on the coastal lowlands of Queensland are reviewed. A review is also made of the literature. On the range of soil types examined, no additional beneficial effects on stand development or stand stability could be demonstrated, as compared with cheaper methods of cultivation.

Ref ID : 111
111. Francis, P.J., Bacon, G.J., and Gordon, P. Effect of ripping and nitrogen fertiliser on the growth and windfirmness of slash pine on a shallow soil on the Queensland coastal lowlands. *Australian Forestry* 47:90-94, 1984.
Keywords : effects; ripping; nitrogen; fertiliser; growth; Slash; pines; soil; Queensland; ploughing; survival; fertilizers; P; height; diameter; basal area; Pinus elliottii; Site preparation; Australia,Queensland; mechanical methods; Pinus; wind; resistance; nitrogen fertilizers; responses; Australia; mounding
Notes : Ripping (additional to ploughing and mounding) had no significant effect on survival, growth or windfirmness. N fertilizer (additional to P) gave an early stimulus to height growth, increased root/shoot ratio (with improved windfirmness) but had no effect on survival, diameter or basal area.

Ref ID : 112
112. Frazier, J.R., Burkhart, H.E., and McMinn, J.W. Energy output/input relationships for loblolly pine stands. *Journal of Forestry* 79:670-673, 1981.
Keywords : pines; energy; available; management; yields; Fuels; fuel consumption; site; Site preparation; methods; Pinus taeda; plantations; USA; Direct sowing; plantations,general; silvicultural aspects; Economics; Planting; Conifers
Notes : Energy input and output were calculated from data available in the literature for direct sown and planted stands under a variety of management regimes. Yield, fuel consumption rates, site preparation methods, management options and energy input/output ratios are tabulated for 30-yr-old stands. In most cases direct sown stands were slightly more energy efficient.

Ref ID : 113
113. Fredericksen, T.S., Allen, H.L., and Wentworth, T.R. Competing vegetation and pine growth response to silvicultural treatments in a six-year-old Piedmont loblolly pine plantation. *Southern Journal of Applied Forestry* 15:138-144, 1991.
Keywords : vegetation; pines; growth; responses; treatment; plantations; Site preparation; discs; herbicides; application; applications; Glyphosate; communities; Pinus; Pinus taeda; North Carolina; Trees; Distribution; development; plant; Broadleaves; effects; volume; increment; Forest plantations; mechanical methods; weed control; plant competition; Forest trees; plant communities; USA; site; chopping; plants
Notes : Combinations of 2 intensities of site preparation (chop vs shear, pile and disc) with 2 levels of herbicide application (annual applications of glyphosate vs none) resulted in distinct communities of competing vegetation, as well as differential pine growth after 6 yr in a loblolly pine (Pinus taeda) plantation in North Carolina. Chopping resulted in communities dominated by broadleaved trees, while shear-pile-disc led to a more even distribution of growth forms. Herbicide application reduced overall vegetation but allowed the development of some herbicide-resistant plants. Trees, especially broadleaves, had a negative effect on volume increment of planted pines.

Ref ID : 114
114. Fritzsch, R. System of machines for forest renewal in the [East German] mountains and hills. *Wissenschaftliche Zeitschrift der Technischen Universitat Dresden* 37:215-219. 1988.
Keywords : machines; Forests; equipment; Germany; forestry; tractors; Slash; ploughs; scarifiers; Planting; underplanting; Afforestation; German Democratic Republic; mechanization; Site preparation; mechanical methods; descriptions; reforestation; Upland; sprayers
Notes : A description of the set of equipment developed in E. Germany for reforestation of felled areas in the uplands. It consists of the LKT special forestry tractor, Stralsund und Tharandt rakes for clearing slash and debris, the HS 75 mounted sprayer, the FSP 88 strip plough, the PAB 88 patch scarifier, the WT 2 and BN-2 Marienberg planting machines, and the WT U underplanting machine.

Ref ID : 115
115. Fritzsch, R. New implements for soil cultivation on central German highland sites influenced by air pollution. *Sozialistische Forstwirtschaft* 39:57-59. 1989.
Keywords : New; implements; soil; Soil cultivation; Cultivation; site; air; POLLUTION; Air pollution; Germany; Site preparation; Forests; tractors; ploughs; productivity; Cultivators; mechanical methods; equipment; FSP plough; PAB cultivator; Forestry machinery; German Democratic Republic
Notes : An account of two new implements developed in E. Germany for site preparation for replanting air pollution-damaged areas. Both implements are designed for mounting on the 3-point linkage of forest tractors. One is the FSP 88 forest strip plough, consisting of one chisel-tine and a pair of angled dished disks turning the soil to left and right; the productivity is 0.8-1.0 ha per shift. The other is the PAB 88 patch cultivator, consisting of 4 rigid chisel-tines on a solid frame, which makes screefed loosened patches about 0.9 m wide and up to 3 m long; the productivity is about 0.4 ha per shift.

Ref ID : 116
116. Fritzsch, R. Soil cultivation in conditions of smoke pollution in the central German highlands. *Wissenschaftliche Zeitschrift der Technischen Universitat Dresden* 40:267-271, 1991.
Keywords : soil; Soil cultivation; Cultivation; POLLUTION; smoke; implements; Germany; treatment; Forests; ploughs;

scarifiers; specifications; ploughing; FSP plough; PAB scarifier; Site preparation; mechanical methods; Forestry machinery; air; site; reforestation
Notes : Details are given of two implements developed in eastern Germany for treatment of air pollution-damaged forest sites prior to reforestation. They are the FSP 88 forest strip plough and the PAB 88 patch scarifier. Specifications and field of use are described.

Ref ID : 117
117. Froehlich, H.A. Mechanical amelioration of adverse physical soil conditions in forestry. *Proceedings IUFRO Symposium on Site and Productivity of Fast Growing Plantations* D.C.; Schonau, A.P.G:A.P.G.-521, 1984.
Keywords : mechanical; soil; forestry; research; Conferences; Site and Productivity of Fast Growing Plantations; Forestry practices; Site preparation; discing; subsoiling; ripping; mounding; chopping
Notes : Research work on disking, bedding, mounding, ripping/subsoiling, chopping, and furrowing is reviewed, and advantages and disadvantages of each practice are noted.

Ref ID : 118
118. Fujiwara, N., Shibata, S., and Kamiizaka, M. Site preparation by crawler tractor fot natural regeneration of Ezo spruce (Picea jezoensis) and todo fir (Abies sachalinensis). *Journal of the Japanese Forestry Society* 66:117-122, 1984.
Keywords : site; Site preparation; tractors; natural regeneration; regeneration; Picea; Abies; mechanical methods; Japan; Abies sachalinensis; Picea jezoensis

Ref ID : 119
119. Fyles, J.W., Fyles, I.H., Beese, W.J., and Feller, M.C. Forest floor characteristics and soil nitrogen availability on slash-burned sites in coastal British Columbia. *Canadian Journal of Forest Research* 21:1516-1522, 1991.
Keywords : Forests; soil; nitrogen; availability; site; British Columbia; Slash; burning; Site preparation; effects; fertility; materials; controlled burning; organic matter; types; leaching; measurement; mineralization; models; temperature; plantations; growth; forest fires; fires; Soil chemistry; nutrients; Canada; Soil fertility; forestry; slash burning; regions; soils; fire
Notes : Slash burning is commonly used in site preparation in coastal British Columbia, but little is known about its effects on site fertility. Organic forest floor materials were surveyed on spring and autumn slash-burned sites in the Sproat Lake region of Vancouver Island, British Columbia, in spring 1987 (1.5 or 2 years after controlled burning). Dominant organic matter types, distinguished according to morphological criteria, were sampled and incubated in the laboratory for 26 wk with periodic leaching and measurement of mineral N. Mineralization data closely fit a first-order kinetic model. Field mineralization was estimated using mass of each organic matter type in the field and first-order model parameters corrected for local temperature; it ranged from 2 to 6 g N/m2 p.a., depending on burn severity. This suggests that slash burning did not reduce N availability below levels required to support early plantation growth, except in situations of severe burns on coarse-textured soils. Differential consumption of forest floor organic matter types increased spatial variability in N mineralization and resulted, at the most severely burned site, in 50% of mineralizable N being derived from materials covering only 5% of the site. Significant correlation between N mineralization and codes and indices of the Canadian Forest Fire Weather Index System indicated that predictions of slash-burn effects on site fertility may be made from weather conditions prior to and during burning.

Ref ID : 120
120. Galloway, G. and Borgo, G. Guide for the establishment of forestry plantations in the Sierra Peruana. *1984, 145 pp* Peru; INFOR/FAO. 1984.
Keywords : establishment; forestry; forestry plantations; plantations; treatment; planning; activity; site; site selection; Site preparation; handling; Planting; Planting stock; techniques; protection; Eucalyptus; Eucalyptus globulus; Pinus; Pinus radiata; Peru; Silviculture
Notes : A comprehensive treatment, covering the planning of activities, site selection, species selection, site preparation, handling of planting stock, planting techniques, organization of planting work, and protection of plantations. Emphasis is on the establishment of Eucalyptus globulus and Pinus radiata; notes on several other species are given in an appendix. [See also FA 45, 755].

Ref ID : 121
121. Garrido, M.A. Land preparation for afforestation and restocking. *Instituto Florestal, Sao Paulo, Publicacao* No. 17, 16-27; 9 ref:16-27, 1977.
Keywords : land; land preparation; Afforestation; types; topography; productivity; effects; grading; growth; Eucalyptus; Pinus; Pinus taeda; herbicides; methods; soil; soil properties; Brazil; Site preparation; mechanical methods; chemical methods; arid regions; forestry
Notes : Preparation operations for two types of land (flat or broken topography) are detailed. Representative productivity values (ha treated per man-day) are given for all operations from clearing to fertilizing. There is a short discussion of the results of experiments on the effects of different amounts of grading on the growth of Eucalyptus sp. and Pinus taeda; on pre-emergence herbicides for Eucalyptus spp.; and on the effects of methods of clearing upon soil properties.

Ref ID : 122
122. Gaskin, J.W., Nutter, W.L., and McMullen, T.M. Comparison of nutrient losses by harvesting and site preparation practices in the Georgia Piedmont and Coastal Plain. *Georgia Forest Research Paper* No. 77, 7 pp.; 12 re:7 pp. 1989.
Keywords : comparisons; nutrients; Losses; Harvesting; site; Site preparation; Georgia; removal; stems; whole tree logging; Trees; Logging; burning; discs; Forests; types; USA; pines; Slash; pinopsida; Broadleaves; Pinus taeda; Pinus palustris; Pinus elliottii; mechanical methods; Vegetation types; Cycling; methods; chopping
Notes : Data from several published studies were used to estimate nutrient removals for merchantable stem vs whole tree logging, and for 3 methods of site preparation (burning, roller chopping and burning, or shear/pile and disc) in 5 forest types of Georgia, USA. The forest types were loblolly pine [Pinus taeda], mixed broadleaved and mixed pine/broadleaved in the Piedmont, and slash pine/longleaf pine [P. elliottii/P. palustris] and broadleaved in the Coastal Plain. Representative nutrient masses are tabulated for stand components of each forest type.

Ref ID : 123
123. Gavrusevich-AN Soil cultivation under forest plantations in montane mixed coniferous and broadleaved forests in the Carpathians. *Lesovodstvo i Agrolesomelioratsiya* No. 74, 18-22; BLDSC:18-22, 1987.
Keywords : soil; Soil cultivation; Cultivation; Forests; Forest plantations; plantations; slopes; Site preparation; Terracing; Planting; ploughing; infiltration; effects; Erosion; control; eroded soils; Afforestation; mechanical methods; Contour ridging; upland areas; USSR; Ukraine; site; growth; Norway
Notes : On eroded and sod-covered slopes at 520-570 m alt. in Ivano-Frankovsk Province, Ukraine, site preparation by terracing markedly improved the growth of 6-yr-old plantations of Norway spruce and Quercus rubra, especially on the fill side, compared with pit planting. On sites cleared of well-stocked spruce/fir stands, the growth of pit-planted and slit-planted stands of Norway spruce was n.s.d. at 20-25 yr old. Cultivation by ploughing, etc., greatly increased infiltration on an eroded 9_ slope at 650 m alt. in Lvov Province, but had little effect on a recently felled slope, where rotary cultivation increased erosion compared with an untreated control plot.

Ref ID : 124
124. Gent, J.A., Allen, H.L., Campbell, R.G., and Wells, C.G. Magnitude, duration, and economic analysis of loblolly pine growth response following bedding and phosphorus fertilization. *Southern Journal of Applied Forestry* 10:124-128, 1986.
Keywords : Economics; analysis; pines; growth; responses; phosphorus; economic analysis; age; site; North Carolina; application; P; triple superphosphate; superphosphate; Planting; control; fertilizers; Theses; applications; rotations; Pinus; Pinus taeda; Tillage; Site preparation; mechanical methods; USA,North Carolina; phosphorus fertilizers; USA; Forestry practices
Notes : Data were collected at 3-7 ages during the first 12-13 yr growth of loblolly pine on 9 poorly drained sites in the Lower Coastal Plain, North Carolina, following bedding and/or application of P (50-60 lb/acre as triple superphosphate) at planting. Fertilization significantly increased ht. and diam. at age 12-13 yr on all sites. Ht. and diam. growth were consistently better on fertilized and bedded plots than on flat-planted control plots and plots treated with only bedding or fertilizer. Foliar analyses suggest that growth on these sites may be improved by further applications of P. Projections of response to rotation age showed that fertilizer + bedding would result in the greatest vol. and after-tax net present value.

Ref ID : 125
125. Gent, J.A.,Jr. The impact of intensive forest management practices on the physical properties of Lower Coastal Plain and Piedmont soils. *Forestry Abstracts* 46:654-388. 1985.
Keywords : impact; intensive; Forests; Forest management; management; physical properties; soils; soil; Theses; Soil physics; USA; bearing characteristics; density; porosity; compaction; Logging; Planting; types; Site preparation; mechanical methods; whole stem logging; whole tree logging

Ref ID : 126
126. Gent, J.A.,Jr. and Ballard, R. Impact of intensive forest management practices on the bulk density of lower coastal plain and piedmont soils. *Southern Journal of Applied Forestry* 9:44-48, 1985.
Keywords : impact; intensive; Forests; Forest management; management; bulk density; density; soils; soil; Pinus; Pinus taeda; plantations; North Carolina; Harvesting; Site preparation; machinery; soil compaction; compaction; roots; growth; discing; ripping; Soil physics; Logging; mechanical methods; USA,North Carolina; Mechanical properties of soil; Forestry practices; USA; site; chopping
Notes : Studies were established in a 25-yr-old Pinus taeda plantation on a lower coastal plain site and in a 22-yr-old plantation on a piedmont site, both in North Carolina. Soil samples were collected 0-3, 3-6, 6-9 and 9-12 inches deep before and after harvesting and after site preparation. Use of heavy machinery during harvesting significantly increased soil bulk density to 9-12 inches deep on skid trails and up to 6 inches deep off them. On the coastal plain site bedding was effective in offsetting soil compaction outside skid trails. Bedding appeared to be less effective on skid trails because the original soil surface was so compacted as to inhibit root growth. On the piedmont site, discing was effective in restoring the original bulk density in the upper 3-6 inches of soil, but not in the layer 6-9 inches deep. Chopping did not restore original bulk density. Discing or ripping is recommended on primary skid trails before bedding. Areas such as the piedmont site may need discing over the entire area.

Ref ID : 127
127. Gent, J.A.,Jr., Ballard, R., and Hassan, A.E. The impact of harvesting and site preparation on the physical properties of lower coastal plain forest soils. *Soil Science Society of America Journal* 47:595-598, 1983.
Keywords : impact; Harvesting; site; Site preparation; physical properties; Forests; forest soils; soils; Forest management; management; soil; soil physical properties; diameter; treatment; bulk density; density; porosity; Theses; effects; soil compaction; compaction; height; roots; growth; Forestry practices; Forestry machinery; mechanical methods North Carolina; Pinus taeda; Logging; Soil physics; soils North Carolina; tree length logging; whole tree logging; USA; Conifers; intensive; New
Notes : The impact of intensive forest management practices on soil physical properties was examined by collecting intact, 7.6 cm diameter soil core samples to a depth of 30 cm before harvest, after harvest, and after site preparation in plots established in primary skid trails and areas receiving whole-tree and conventional tree-length harvesting treatments. Site preparation for all plots was shear, burn, chop, and bed. Harvesting increased bulk density and decreased aeration porosity in all sampled areas. Significant changes in these properties were detected to the 30-cm depth in the skid trail plots. However, significant changes in the whole-tree and tree-length plots were limited to the upper 15 cm of soil. Harvesting also significantly decreased saturated hydraulic conductivity to a depth of 8 cm in the skid trail plots and 15 cm in the tree-length plots but had no significant effect in the whole-tree plots. Bedding proved to be effective in offsetting soil compaction in the whole-tree and tree-length plots by forming a new soil surface, 19 cm in height, over the surface which was trafficked during harvest. Bedding may not be as effective in the skid trail plots because the soil found at the original surface under the bed was compacted to the extent that root growth may be inhibited.

Ref ID : 128
128. Gent, J.A.,Jr., Ballard, R., Hassan, A.E., and Cassel, D.K. Impact of harvesting and site preparation on physical properties of piedmont forest soils. *Soil Science Society of America Journal* 48:173-177, 1984.
Keywords : impact; Harvesting; site; Site preparation; physical properties; Forests; soils; forest soils; Forest management; management; soil; bulk density; density; porosity; soil physical properties; Trees; soil compaction; compaction; roots; growth; Physical properties of soil; Forestry practices; Soil physics; mechanical methods; USA,North Carolina; Logging; whole tree logging; USA; North Carolina; intensive; mechanical
Notes : The impact of intensive forest management practices on soil bulk density, aeration porosity, and saturated hydraulic conductivity was examined to a depth of 0.3 m before harvest, after harvest, and after site preparation. Harvesting caused significant changes in soil physical properties to an average depth of 0.17 m in whole tree harvest plots and 0.22 m in skid trail plots. Disking was effective in restoring soil physical properties to preharvest levels in the upper 0.07 to 0.12 m of soil. Soil compaction in chop/burn plots may result in reduced root growth because of mechanical impedance, reduced aeration, or both.

Ref ID : 129
129. Gent, J.A.,Jr. and Morris, L.A. Soil compaction from harvesting and site preparation in the upper gulf coastal plain. *Soil Science Society of America Journal* 50:443-446, 1986.
Keywords : soil; soil compaction; compaction; Harvesting; site; Site preparation; impact; Forests; Forest management; management; physical properties; pines; Pinus; Pinus taeda; plantations; bulk density; density; treatment; porosity; Forestry practices; paleudults; USA; Alabama; Soil types genetic; Acrisols; Soil types physiographic; coastal plain soils; soil density; Soil physics; USA,Alabama; mechanical methods; burning; Logging; Forestry machinery; intensive
Notes : The impact of intensive forest management practices on the physical properties of a Typic Paleudult was examined to a depth of 0.3 m by collecting 7.6-cm core samples before harvest, after harvest, and after site preparation. Whole-tree harvesting of a 22-yr old loblolly pine (Pinus taeda) plantation caused significant changes in bulk density to a depth of 0.23 m outside of skid trails, and 0.30 m in primary skid trails. Subsequent chop/burn and shear/windrow site preparation treatments had little added impact on bulk density. Post site preparation differences in aeration porosity and saturated hydraulic conductivity among treatments were nonsignificant.

Ref ID : 130
130. Germishuizen, P.J. Silvicultural techniques in the establishment of pines in southern Africa. *Mededeling, Fakulteit Bosbou, Universiteit Stellenbosch* No. 98, Vol. I, 305-:Vol. I, 305-324, 1983.
Keywords : techniques; establishment; pines; Southern Africa; Africa; Afforestation; reforestation; aspect; Site preparation; soil; survival; roots; development; growth; treatment; Slash; burning; soils; Planting; Pinus; Conferences; Jubilee Symposia,Faculty of Forestry,Stellenbosch University; site
Notes : Establishment techniques for both afforestation and reforestation are covered. Aspects of site preparation are discussed, and the importance of soil moisture for survival, root development and early growth is emphasized. In reforestation, treatment of slash is discussed together with the benefits that arise from a no burning policy. For both afforestation and reforestation, a knowledge of the soils is considered of prime importance. A few aspects of post-planting techniques are dealt with.

Ref ID : 131
131. Germishuizen, P.J. and Marais, J.P. Site preparation. Establishment and re-establishment of conifer plantations in the summer rainfall region of southern Africa. *Proceedings of the Forest Seed, Nursery and Establishment Research*

Working Group, 3rd Meeting, Saasveld Forestry Research Station, George, South Africa, 1980 26-46; 31 ref. South, 1981.
Keywords : site; Site preparation; establishment; Conifers; plantations; regions; Southern Africa; Africa; Planting; ripping; Cultivation; chemical control; control; Slash; burning; Erosion; roots; diseases; Rhizina undulata; pines; Swaziland; mechanical methods; chemical treatment; Pinus; root and butt rots; Conferences; Forest Seed,Nursery and Establishment Research Working Group; chemical
Notes : Planting pits, ripping, complete cultivation and chemical control for establishment are discussed. In re-establishment, the dangers of indiscriminate slash burning (particularly erosion and root rot disease, Rhizina undulata) are stressed. Re-establishment by planting through slash is described, with particular reference to pines in Usutu, Swaziland.

Ref ID : 132
132. Glover, G.R. and Zutter, B.R. Loblolly pine and mixed hardwood stand dynamics for 27 years following chemical, mechanical, and manual site preparation. *Proceedings of the international conference on forest vegetation management held at the School of Forestry, Auburn University, Auburn, Alabama, USA, 27 April 1 May 1992 [edited by Gjerstad, D* G. R.; Mitchell, R.R. J.-Journal, 1993.
Keywords : pines; chemical; mechanical; manual; site; Site preparation; Alabama; effects; density; Quercus; Liquidambar styraciflua; Acer; Florida; Pinus; Pinus taeda; plantations; growth; yields; treatment; scarification; herbicides; 2,4,5 T; 2,4 D; measurement; size; age; survival; height; diameter; Trees; Broadleaves; stems; Theses; woody weeds; chemical control; physical control; bulldozers; girdling; ringing; increment; plant height; volume; basal area; Carya; Nyssa sylvatica; Acer rubrum; Cornus florida; Diospyros virginiana; Oxydendrum arboreum; Vitus rotundifolia; weed control; Conferences; Forest plantations; cultural weed control; diesel oil; USA; Forest vegetation management; Fuels
Notes : A site-preparation study was established in 1959 in Fayette County, Alabama, to provide data on the long-term effects of varying densities of broadleaved woody species (Quercus spp., Carya spp., Liquidambar styraciflua, Nyssa sylvatica, Acer rubrum, Cornus florida, Diospyros virginiana, Oxydendrum arboreum and Vitus [Vitis] rotundifolia) on loblolly pine (Pinus taeda) plantation growth, yield, and stand structure. Six treatments (girdling, bulldoze scarification, herbicide applied to axe frill, chain frill, or by injection, and an untreated check) were installed as a randomized complete block with 5 replications. All herbicide treatments used a 50:50 mix of 2,4,5-T and 2,4-D esters in diesel fuel. Periodic measurements of pine and broadleaved size and density up to age 27 yr showed that higher densities of broadleaved species occurring early in the pine plantation negatively affected loblolly pine survival and basal area yield. The scarification and herbicide treatments had lower densities of broadleaved species, and higher loblolly pine survival and stand basal area. Pine total height and diameter at breast height were reduced by densities of broadleaved species early in the life of the plantation, but size of surviving trees differed little among treatments at later ages, except on plots where most pine trees were suppressed by broadleaves. Pine basal area per hectare at age 27 yr was correlated with both number of broadleaved stems at age 3 yr and broadleaved basal area at age 6 yr. It is suggested that these relations could be used for predicting long-term growth and yield of loblolly pine plantations from early measures of broadleaved interference.

Ref ID : 133
133. Gorham, J.T. Effect of site preparation on survival and growth of planted loblolly pine. *Forestry Abstracts* 44:707. 1983.
Keywords : effects; site; Site preparation; survival; growth; pines; Theses; Pinus taeda; USA,Texas; burning; mechanical methods; increment; height; Pinus; diameter; competition; Woody plants; USA; Texas

Ref ID : 134
134. Gorman, J.R. Proceedings of the 1984 Mechanized Silviculture Workshop. *Information Report, Northern Forest Research Centre, Canada* No. NOR-X-272, v + 4:v + 47 pp. 1985.
Keywords : Silviculture; Alberta; forestry; Site preparation; machinery; aspect; sowing; thinning; cleaning; Safety; equipment; Conferences; Planting; Direct sowing; mechanization; Canada; Mechanized Silviculture Workshop; site
Notes : Proceedings of a meeting at Edmonton, Alberta, from 29 Feb. to 2 March 1984 at which 11 papers and addresses were presented concentrating on forestry in the prairie provinces. The main emphasis is on site preparation machinery, but aspects of sowing, thinning and cleaning are also included together with questions of evaluation and safety of equipment.

Ref ID : 135
135. Goulet, F. Frost heaving of forest tree seedlings: a review. *New Forests* 9:67-94, 1995.
Keywords : frost; Forests; Forest trees; Trees; Seedlings; reviews; soil; Soil water; water; growth; survival; freezing; resistance; size; Planting; sowing; mulches; shade; plant; natural regeneration; regeneration; Site preparation; frost injury; frost heave; regions; methods
Notes : Soil frost heaving is the result of the formation of ice lenses in the soil caused by a segregation of the soil water. Ice lenses are growing from below and pushed upward. Seedlings heave when they are pushed out of the ground by the ice sheet formed at the surface of the soil. Frost heaving may greatly reduce growth and survival of forest tree seedlings particularly in regions where freezing and thawing are accompanied by high soil moisture. Resistance to frost heaving

increases with size of seedling as the ability of a seedling to anchor itself increases. A few methods, such as fertilizing, choice of planting spots, sowing or planting at the proper time, shading, and use of mulches, appear to be effective in controlling frost heaving. Shade from natural plant cover can greatly reduce frost heaving.

Ref ID : 136
136. Graham, R.T., Harvey, A.E., and Jurgensen, M.F. Effect of site preparation on survival and growth of Douglas-fir (Pseudotsuga menziesii Mirb. Franco.) seedlings. *New Forests* 3:89-98, 1989.
Keywords : effects; site; Site preparation; survival; growth; Pseudotsuga; Pseudotsuga menziesii; Seedlings; performance; soil; control; weeds; Idaho; USA; herbicides; roots; Trees; organic matter; Conifers; Planting; soil treatment; mechanical methods; usage; crops; Forests; soils; vegetation
Notes : The performance (survival and growth) of Douglas fir seedlings planted in minimally disturbed, scalped, and bedded soils, both with and without herbicidal control of weeds, were compared at 2 sites in N. Idaho, USA. Douglas fir growing for 3 yr in bedded soils treated with herbicide were heavier, taller, and had deeper root systems than trees growing in other preparations. Scalping did not improve seedling performance when compared to minimally disturbed soils. Soils rich in organic matter benefited tree growth. Competing vegetation in raised beds was detrimental to seedling performance.

Ref ID : 137
137. Grossnickle, S.C. and Heikurinen, J. Site preparation: water relations and growth of newly planted jack pine and white spruce. *New Forests* 3:99-123, 1989.
Keywords : site; Site preparation; water; water relations; growth; pines; Pinus; Pinus banksiana; Picea; Picea glauca; Ontario; treatment; control; soil; Seedlings; seasons; Planting; Losses; water stress; roots; development; Conifers; mechanical methods; Canada; Plant water relations; forestry; reforestation; horizons; New; testing; shoots
Notes : Bareroot jack pine (Pinus banksiana) and white spruce (Picea glauca) were planted near Elliot Lake, Ontario, on a boreal reforestation site. Site preparation treatments were mixed (rototilled), mineral (LFH horizons removed) and undisturbed (control) soil. Seedling water relations and growth were examined during the first field season. During the first 28 days after planting, jack pine base (predawn) and minimum xylem water potential readings were more negative in the control treatment. White spruce, during the first 10 days, in all treatments had base and minimum xylem water potential readings more negative than -1.7 MPa. By day 28, base xylem water potentials of white spruce had increased to approximately -1.0 MPa in all treatments. As the growing season progressed, white spruce minimum xylem water potential readings ceased exceeding the measured turgor loss point first in the mixed followed by the mineral and then control treatment. Jack pine minimum xylem water potential readings, in all treatments, almost never exceeded the measured turgor loss point. Water stress and stomatal optimization integrals, day 28 and 125, for both species showed least water stress and greater stomatal optimization in the mixed treatment. Both species had less new root growth in the field during the first 28 days after planting compared to seedlings grown for 28 days in a greenhouse for root growth capacity testing. Root growth at 28 days, and both shoot and root development at the end of the growing season, were greatest to least in mixed, mineral, and control treatments, respectively.

Ref ID : 138
138. Guild, D.W. Windrowing and ripping - a comparative study with other site preparation techniques. *NZ Journal Forestry* 16(1):88-97, 1971.
Keywords : windrowing; ripping; site; Site preparation; techniques; drought; soils; establishment; Forests; Planting; New; crops; survival; height; growth; costs; effects; Trees; trials; improvement; windrow; forestry; Pinus radiata
Notes : Frequent droughts and poor stoney soils are severe establishment hazards at Balmoral Forest. Site amelioration by windrowing and ripping prior to planting was introduced in 1966. Preliminary investigations have shown that the new crops are already benefiting from greatly improved survivals, better height growth, and more uniformity than before. The cost of establishment has been reduced and the effect of ripping on tree growth, crop uniformity and stand access is expected to increase the initial cost advantage. It will not be known for some time whether or not the stands are more windfirm on ripped soils. Further trials and consequent improvements are expected to reduce the inefficiencies and increase the versatility of the technique.

Ref ID : 139
139. Guldin, R.W. Container-grown longleaf pine regeneration costs in the sandhills. *Southern Journal of Applied Forestry* 6:33-39, 1982.
Keywords : pines; regeneration; costs; Seedlings; South Carolina; production; site; Site preparation; Planting; methods; effects; survival; Pinus palustris; Planting stock; Artificial regeneration; bare rooted; container grown plants; Economics; North Carolina; Conifers; USA
Notes : The costs of using container-grown seedlings in North and South Carolina are analysed. The 4 components are: seedling production; transportation; site preparation and planting. A method is described and illustrated for comparing the costs of using bare-rooted and container-grown stock, including the effects of poor survival and replanting.

Ref ID : 140
140. Guldin, R.W. Regeneration costs for industrial landowners using hand vs. machine planting. *Southern Journal of*

Applied Forestry 7:104-108, 1983.
Keywords : regeneration; costs; machines; Planting; site; Site preparation; Forests; Upland; Alabama; Louisiana; Mississippi; South Carolina; equations; regression analysis; analysis; Contracts; slopes; plant; Artificial regeneration; mechanization; Economics; Southern States of USA; USA
Notes : An examination was made of the site preparation and planting records for 1980 and 1981 of 6 forest products firms engaged in regenerating coastal plain and upland sites in Alabama, Louisiana, Mississippi and South Carolina. The equation best fitted to the data was calculated by regression analysis using planting cost per acre as the dependent variable. Five of the 13 categories of data collected were found to be important: intensity of site preparation (cost in $/acre); the number of parcels in the planting contract; the slope of the terrain; whether the site was bedded; and whether planted by hand or machine. Results show that planting cost is reduced by only a small amount for every extra dollar spent on site preparation, which cannot always therefore be wholly justified. Hand planting costs have fallen, while costs of planting by machine have risen; bedding will almost always make it cheaper to plant by hand than by machine.

Ref ID : 141
141. Guldin, R.W. Site characteristics and preparation practices influence costs of hand-planting southern pine. *Journal of Forestry* 82:97-100, 1984.
Keywords : site; costs; pines; site characteristics; Contracts; Site preparation; Planting; Pinus; Pinus taeda; P; Forests; Alabama; Louisiana; Mississippi; South Carolina; equations; estimation; burning; plant; mechanical methods; Economics; USA; Pinus elliottii; machines
Notes : Data were collected from 67 contracts for site preparation and planting of Pinus taeda and P. elliottii in 1979-80 and 1980-81, covering 11 344 areas on 8 national forests and areas with corporate industrial owners in Alabama, Louisiana, Mississippi and South Carolina. An equation was calculated using generalized least squares estimation, which explained 79% of hand-planting costs. Contracts for areas of 140-250 acres were the most expensive, being too large for small local contractors, and too small for the large contractors. The intensity of site preparation was measured by the number of machine passes, and the cost of broadcast burning. Planting cost/acre was reduced by $5.21 for every machine pass and by $0.27 per dollar spent on broadcast burning. National forests paid $15.59/acre more to plant sites than industrial owners.

Ref ID : 142
142. Haines, L.W., Maki, T.E., and Sanderford, S.G. The effect of mechanical site preparation treatments on soil productivity and tree (Pinus taeda L. and P. elliottii Engelm. var. elliottii) growth. *Forest soils and forest land management* 379-395; 48 ref. Que:Canada, 1975.
Keywords : effects; mechanical; site; Site preparation; treatment; soil; productivity; Trees; Pinus; Pinus taeda; P; growth; reviews; pines; regions; USA; site quality; quality; compaction; Erosion; windrowing; yields; Losses; plantations; burning; site types; types; Florida; age; Pinus elliottii; mechanical methods; Conifers; mounding
Notes : Reviews the practice of site preparation in the Southern Pine region of the USA, pointing out that some practices may have an unfavourable long-term effect on site quality as a result of compaction, erosion, or displacement of topsoil. Root-raking and windrowing resulted in a yield loss of nearly 50% in a 19-year-old P. taeda plantation in N. Carolina compared with broadcast burning. 'Bedding' (ridging or mounding) has proved advantageous on several site types, but a case is cited of yield loss in P. elliottii in N. Florida after 14 years of age.

Ref ID : 143
143. Hall, M. Establishment of radiata pine on a high altitude second rotation site. 1. Effect of site preparation on nutrient capital. *Australian Forestry* 47:194-198, 1984.
Keywords : establishment; radiata pine; pines; altitude; rotations; site; effects; Site preparation; nutrients; burning; litter; Slash; New South Wales; removal; materials; Logging; organic matter; soil; impact; techniques; tractors; mechanical methods; Soil chemistry; nutrient contents; organic compounds; Soil fertility; Pinus radiata; Australia,New South Wales; nitrogen; Losses; Losses from soil systems; Forestry practices; forest soils; Soil types; Soil types ecological; Australia; New; windrow
Notes : The effects were investigated of broadcast burning or hand raking of litter and slash on a 3 ha site in New South Wales that had been clearfelled with the removal from the site of commercial logs and all woody material greater than 10 cm diam. Broadcast burning of the litter and logging slash removed 139 kg/ha N but had no effect on the organic matter content of the soil. Hand raking removed 212 kg/ha N from the litter and slash and 124 kg/ha N in the 1 cm of topsoil raked off with the litter. Although broadcast burning has less impact on above-ground nutrients, the more commonly used technique of raking into windrows by tractor is likely to continue. It is suggested that a raking operation which removes only the woody debris and not the nutrient-rich topsoil should be developed.

Ref ID : 144
144. Hall, M. Establishment of radiata pine on a high altitude second rotation site. II. Effect of site preparation on early survival and growth. *Australian Forestry* 48:79-83, 1985.
Keywords : establishment; radiata pine; pines; altitude; rotations; site; effects; Site preparation; survival; growth; New South Wales; removal; litter; Logging; Slash; burning; soil; soil temperature; temperature; materials; mulches; Seedlings; Losses; nutrients; techniques; Theses; Cultivation; Pinus radiata; Forestry practices; New; frost

Notes : [See FA 46, 3336] In an experiment carried out on a high altitude second rotation site in the central tablelands of New South Wales, the removal of litter and logging slash by raking or burning resulted in increased soil temperatures and reduced frost intensity compared with sites where this material had been left as a surface mulch. Radiata pine seedlings planted on raked or burnt sites survived better in the first 2 yr than those planted into a mulch of litter and logging slash. Pines on raked sites did not appear to grow as well as those where litter and slash were burnt, possibly because of the greater loss of nutrients in litter and topsoil from raked sites. A suggested site preparation technique for these high altitude sites would be rough stacking of large woody debris to allow access, followed by line cultivation through the remaining litter to expose bare mineral soil, in which the pine seedlings could be planted.

Ref ID : 145
145. Hall, P. Roller crushing of cutover as a logging residue management technique. *Report New Zealand Logging Industry Research Organisation* 17:5 pp. 1992.
Keywords : Logging; Residues; management; techniques; Slash; Forests; New Zealand; Logging machines; Forestry machinery; Site preparation; plant residues; New
Notes : Results are presented of a study of a bulldozer-based gravity and towed roller crushing operation to break down slash in the Omataroa Forest, New Zealand.

Ref ID : 146
146. Hall, P. Mechanical site preparation using excavators. *New Zealand Forestry* 40:31-35, 1995.
Keywords : mechanical; site; Site preparation; excavators; New Zealand; Forests; Logging; research; Slash; costs; Cultivation; ripping; slopes; equipment; impact; machinery; economic evaluation; New; roles; windrowing; machines; mounding
Notes : The use of excavators for site preparation is becoming increasingly popular in New Zealand. Excavators can be fitted with a wide range of attachments and can fulfil multiple tasks within a forest. This paper summarizes recent LIRO (Logging Industry Research Organisation) studies of excavators used in a site preparation role in the forest industry in New Zealand. Windrowing rates up to 0.46 hectares per productive machine hour were achieved with an excavator fitted with a slash rake at a cost of NZ$240/ha. Spot cultivation by ripping and mounding with an excavator cost NZ$434/ha at 0.29 hectares per productive machine hour. The ROTREE spot cultivator-mounder working on sites with slopes of 0-15_ covered 0.23-0.29 hectares per productive machine hour at a cost of NZ$450-540 per hectare. Excavators can typically work on steeper slopes than other commonly used site preparation equipment and operate with less site impact.

Ref ID : 147
147. Hall, P.W. Effects of harvesting residue on re-establishment: results from a nationwide survey. *FRI Bulletin* No. 169, 28 pp.; 3 r:28 pp. 1991.
Keywords : effects; Harvesting; Residues; forestry; New Zealand; Slash; establishment; costs; Logging; slopes; crops; Site preparation; requirements; plantations; Economics; New; site; specific; frost
Notes : A questionnaire survey was sent to all major forestry companies in New Zealand in mid-1989 in order to investigate the effects of harvesting residues (slash) on establishment, the quantity of slash left on sites, and the cost of dealing with it. The results revealed that for most (ca. 90%) of the area surveyed, slash is not considered to be a major problem at re-establishment. Replies covered approximately 85% of New Zealand's exotic logging area. Those that considered slash a problem usually had an area or site-specific problem, such as steep slopes, no pulp market, harvesting of a minor species crop or frosts, or an insect/pathogen problem. Indications of the additional site preparation requirements and costs resulting from harvesting are presented.

Ref ID : 148
148. Hatchell, G.E. Site preparation and fertilizer increase pine growth on soils compacted in logging. *Southern Journal of Applied Forestry* 5:79-83, 1981.
Keywords : site; Site preparation; fertilizers; pines; growth; soils; Logging; South Carolina; Skidders; soil; spraying; vegetation; herbicides; Trees; discing; treatment; Seedlings; seasons; survival; roots; stems; foliage; Biomass; responses; Pinus taeda; NPK fertilizers; sawdust; chemical methods; mechanical methods; Soil physics; density,compaction; Forestry practices; Conifers; USA; windrow; P
Notes : A poorly-drained area of 30 acres in South Carolina was clear felled using rubber-tyred skidders known to compact soil and burned in 1972. Plots were prepared by: (a) spraying woody vegetation with herbicide; (b) shearing trees at ground level, raking into windrows and flat-discing; and (c) as (b) but preparing beds at 10 ft intervals instead of discing. Three fertilizer treatments were applied: (d) no fertilizer; (e) 200 lb/acre N, 50 lb/acre P, 100 lb/acre K; and (f) 400 lb/acre N, 175 lb/acre P, 175 lb/acre K and a layer of sawdust 3/4 inch deep. Loblolly pine seedlings were planted by hand in March, 1973. After 4 growing seasons, survival, ht. and root collar diam. were recorded, 31 trees were felled and the oven dry wt. of stem, branches and foliage determined. Ht. and diam. growth (but not survival) were reduced on compacted soil. Treatment (c) produced significantly higher survival than (a), and significantly taller trees than (a) or (b). Treatments (e) and (f) produced significantly lower survival but taller trees with a greater root collar diam. Biomass per tree and per acre were significantly greater in (c) than (a) or (b); fertilizing increased biomass/tree. The response to fertilizer in ht. and diam. growth was significantly greater on compacted soil.

Ref ID : 149
149. Hay, D. Planting among the stony rises. *Trees and Natural Resources* 37:3-7. 1995.
Keywords : Planting; improvement; Victoria; basalt soils; soils; wetlands; land use; Grazing; oats; Wheat; Grasses; hay; clover hay; landscape; landscape architecture; planning; land management; management; fencing; pastures; Revegetation; Farm forestry; forestry; vegetation; protection; Trees; Seedlings; shade; shelter; wildlife; habitats; salinity; control; Site preparation; techniques; shrubs; Acacia; Eucalyptus; Leptospermum; Banksia marginata; Bursaria spinosa; Callistemon paludosus; Dodonaea viscosa subsp.cuneata; Hymenanthera dentata; Allocasuarina verticillata; Dodonaea viscosa; eel culture; Trifolium; Avena sativa; Triticum; Linum usitatissimum; linseed; flax; Banksia; Bursaria; Callistemon; Dodonaea; Hymenanthera; Allocasuarina; Violaceae; Afforestation; shade trees; sheep farming; cattle farming; environmental protection; agrosilvopastoral systems; Australia; rehabilitation; Soil types; stony soils; Reclamation; Agroforestry; land; technology; site; maintenance
Notes : Improvement works are described which have been carried out over 8 yr to a 2044-acre privately owned property S. of Skipton in central western Victoria, in an area of basalt soils (including stony rises), plains and extensive wetlands. The predominant land uses were grazing (12 000 Merino sheep and 30 Angus & Hereford cattle), cropping (oats, wheat, linola, grass hay and clover hay) and eel farming. The works have been carried out under an agreement with the Landscape Architecture School of the Royal Melbourne Institute of Technology, and Thomson Hay & Associates, a company specializing in landscape architecture, farm planning and land management. The improvements include fencing, paddock subdivision and laneways, pasture improvement, extensive revegetation which includes farm forestry systems, extensive wetland re-establishment (leading to improved eel farming facilities), and remnant vegetation protection. Over 30 000 tree seedlings have been planted for a variety of purposes including stock shade and shelter, wildlife habitat, farm forestry, regional salinity control, landscape amenity and remnant vegetation protection. The necessary steps for successful tree growing are identified as forward planning, site preparation, rabbit control, suitable species selection, suitable planting techniques, and follow-up maintenance. Suitable tree and shrub species are listed, and include Acacia spp., Eucalyptus spp., Leptospermum spp., Banksia marginata, Bursaria spinosa, Callistemon paludosus, Dodonaea viscosa subsp. cuneata, Hymenanthera dentata and Allocasuarina verticillata.

Ref ID : 150
150. Haywood, J.D. Small topographic differences affect slash pine response to site preparation and fertilization. *Southern Journal of Applied Forestry* 7:145-148, 1983.
Keywords : Slash; pines; responses; site; Site preparation; roots; Seedlings; Louisiana; fertilizers; survival; growth; Trees; mounds; ridges; wetters; treatment; superphosphate; Soil water; increment; phosphorus; mechanical methods; Pinus elliottii; USA,Louisiana; Forestry practices; USA
Notes : Bare root seedlings (1+0) were planted in Feb. 1983 on silt loam plots in SW Louisiana treated in 6 ways: (a) burned only; (b) burned and fertilizer applied; (c) harrowed; (d) harrowed and fertilizer applied; (e) bedded; and (f) bedded and fertilizer applied. Survival, d.b.h., total ht. and ht. growth were recorded after 6 yr for trees more than 4.5 ft tall, and vol. was calculated. Trees on drier mound or ridge sites were larger than those on wetter depressions: av. d.b.h. was 100% greater and av. vol. was 286% greater. On sites in poorly drained depressions, trees planted on beds were 37% taller with 49% more vol. on av. than those on harrowed plots. On better drained sites, site preparation treatments produced n.s.d. but pines treated with superphosphate were on av. 24% taller, with 84% more vol. per tree than those not treated with fertilizer.

Ref ID : 151
151. Haywood, J.D. and Burton, J.D. Loblolly pine plantation development is influenced by site preparation and soils in the West Gulf coastal plain. *Southern Journal of Applied Forestry* 13:17-21, 1989.
Keywords : pines; plantations; development; site; Site preparation; soils; effects; treatment; soil; application; triple superphosphate; superphosphate; fertilizers; Fertilizer application; Planting; survival; growth; Pinus; Pinus taeda; Louisiana; Arkansas; Broadleaves; control; herbicides; harrows; Conifers; mechanical methods; USA; burning; Soil types; phosphorus; plant competition; weed control; weeds; chemical control; physical control; cutting; Harrowing; windrowing; cultural control; integrated control; Upland; competition; windrow
Notes : An account is given of the effects of 7 site preparation treatments, 5 soil classes, and application of triple superphosphate or no fertilizer application at the time of planting on the survival and growth after 12 yr of loblolly pine (Pinus taeda) on upland sites throughout central and northern Louisiana and southern Arkansas. All sites had severe broadleaf competition. The soil classes were loamy, gravelly, silty, slowly permeable clays and very slowly permeable clays. The site preparation treatments were (1) control (underplant-inject in which remaining broadleaves were injected with herbicide in the spring after planting), (2) chop and burn, (3) chop, burn and harrow, (4) double chop, (5) shear and burn, (6) shear and windrow, and (7) shear, windrow and harrow.

Ref ID : 152
152. Haywood, J.D. and Burton, J.D. Phosphorus fertilizer, soils, and site preparation influence loblolly pine productivity. *New Forests* 3:275-287, 1990.
Keywords : phosphorus; phosphorus fertilizers; fertilizers; soils; site; Site preparation; pines; productivity; soil; growth; yields; Pinus; Pinus taeda; plantations; Louisiana; Arkansas; USA; burning; Planting; volume; Soil types; types; clay soils; Conifers; soil texture; increment; mechanical methods; Soil physics; Soil types textural; superphosphate; Delta States of

USA; forestry; Fungal diseases; Plant diseases; methods; chopping; windrowing; Theses; triple superphosphate; survival; P
Notes : Growth and yield of 12-yr-old loblolly pine (Pinus taeda) plantations in Louisiana and Arkansas, USA, were compared among 5 subsoil textures (loam, silt and clay), 7 site preparation methods (burning, chopping, shearing, windrowing or combinations of these) with and without phosphorus fertilizer (triple superphosphate, equivalent to 73.4 kg P/ha). Phosphorus broadcast before planting slightly increased mean d.b.h. and vol. of pines. However, soil differences significantly influenced stand survival, and method of site preparation significantly affected total stand yield, so the influence of phosphorus on total stand yield depended on these 2 parameters. The site preparation/fertilizer combinations yielding the most volume per soil type were: on loam soils, shear-windrow preparation with P; on gravelly clay soils, chop-burn-harrow preparation without P; on silt soils, double chopping without P; on silty clay soil, chop-burn-harrow preparation with P; and on clay soils, shear-windrow-harrow site preparation without P. Soil differences and P fertilization influenced the incidence of fusiform rust in the stands: percent rust was significantly greater on silt soils than on silty clay or clays, and where P fertilizer was applied.

Ref ID : 153
153. Henderson-GS, McFee-WW (ed.), and Kelly-JM Soil organic matter: a link between forest management and productivity. *Carbon forms and functions in forest soils* 419-435; 56 ref. 1995.
Keywords : soil; soil organic matter; organic matter; Forests; Forest management; management; productivity; Harvesting; Site preparation; nutrients; bulk density; density; water; effects; Planting; control; thinning; Agroforestry; Soil fertility; carbon; Soil types ecological; forest soils; Logging; aspect; roads; site; nutrient supply; water relations; maintenance; competition; reforestation
Notes : The links between forest management, soil organic matter, and forest productivity are examined. There are two distinct aspects of a harvesting operation than influence future productivity: the road and skid trail system for extracting timber; and the harvesting patterns and intensity. Productivity linkages to changes associated with harvesting and site preparation are discussed with reference to nutrient supply, subsoil nutrient dynamics, bulk density, and water relations. The effects of stand maintenance (planting, competition control, thinning, fertilization) and reforestation and agroforestry on soil organic matter are described. Established, possible, and speculative relationships between forest management, soil organic matter and forest productivity are listed.

Ref ID : 154
154. Herbert, M.A. Fertilizer/site interactions on the growth and foliar nutrient levels of Eucalyptus grandis. *Management of water and nutrient relations to increase forest growth* Australia [edited by:E. K. S.-Ecology, 1990.
Keywords : interactions; growth; nutrients; Eucalyptus; Eucalyptus grandis; fertilizers; effects; NPK fertilizers; design; South Africa; Africa; control; Variation; site factors; responses; sandy soils; soil; organic matter; applications; potassium; application; yields; quality; Soil water; water; roots; development; establishment; Nurseries; Site preparation; Broadleaves; requirements; foliage; Conferences; Management of water and nutrient relations to increase forest growth; Soil fertility; plant; Plant composition; NPK; trials; site; P; soils; improvement; site quality; availability; weeding
Notes : A study was made in order to optimize fertilizer recommendations and characterize their effect on growth of E. grandis. Six comprehensive NPK fertilizer trials, employing confounded factorial designs, were laid out over a number of years on six sites in Natal and Zululand, South Africa, covering a wide range of environmental conditions. Experiments were assessed and compared at 4 years old in order to control within-block variation of site factors. The major growth responses were to N and/or P, N being suitable only on sandy soils low in organic matter. Topsoils very high im mineralizable N responded to applications of P only. Sites with moderate amounts of organic matter required both N and P. Potassium generally had a depressive effect. Foliar values agreed well with responses to fertilizers, and were useful in characterizing sites and determining optimum application levels. The improvement in yield as a result of fertilization was relatively greatest on poor sites. However, there was a trend for the response in absolute terms to increase with site quality. For fertilizer recommendations to be optimized, there is a need for sites to be classified in terms of their soil water availability and the organic-matter content and texture of the topsoil. As improvements in growth increase with time, they are probably due to changes in root development and structure, rather than overall nutrient status. Thus, fertilizing must be viewed only as an integrated part of establishment practices, including the conditions of nursery stock, site preparation and weeding.

Ref ID : 155
155. Herr-DG, Duchesne-LC, Tellier-R, McAlpine-RS, and Peterson-RL Effect of prescribed burning on the ectomycorrhizal infectivity of a forest soil. *International Journal of Wildland Fire* 4:95-102, 1994.
Keywords : effects; burning; Forests; forest soils; soil; Ontario; Seedlings; survival; Pinus; Pinus resinosa; Planting; fires; control; roots; Fungi; ectomycorrhizas; Forest trees; controlled burning; mycorrhizas; Site preparation; pines; Canada; P; fire; site
Notes : In studies in eastern Ontario, formation of ectomycorrhizas, seedling health index (visual appearance) and seedling survival were assessed for two-year-old nursery-grown seedlings of Pinus resinosa and P. strobus two months after planting in clear-cuts that had received prescribed burning under different fire intensities. Controls consisted of seedlings planted in unburned clear-cuts. Fire intensity positively correlated with percent ectomycorrhizal roots, seedling health index and seedling survival for P. strobus, but with only seedling survival for P. resinosa. Seedling health index

and survival were higher on burned-over sites than on control sites for both species. Colonization of seedlings by ectomycorrhizal fungi did not correlate with seedling health index or seedling survival. P. resinosa seedlings planted in burned-over sites had a smaller number of lateral roots per unit length primary/secondary roots compared with seedlings planted in control plots.

Ref ID : 156
156. Herring, L.J. and McMinn, R.G. Natural and advance regeneration of Engelmann spruce and subalpine fir compared 21 years after site treatment. *Forestry Chronicle* 56:55-57, 1980.
Keywords : regeneration; site; treatment; advance growth; growth; Harvesting; Trees; felling; natural regeneration; scarification; Picea; Picea engelmannii; Abies; Abies lasiocarpa; performance; soil; removal; Seedlings; seedbed conditions; Site preparation; mechanical methods; British Columbia; Conifers; Canada
Notes : The mean ht. of advance growth 21 yr after release by overstorey harvesting and residual tree felling was 8 and 9 times greater than that of natural regeneration following brush blade scarification for Picea engelmannii and Abies lasiocarpa respectively. Ht. c.a.i. of advance growth was 39 and 34 cm respectively, compared with 7 cm for natural regeneration. The poor performance of natural regeneration on scarified soil is attributed to the removal of organic and top mineral soil beyond the immediate reach of seedlings. From authors' summary.

Ref ID : 157
157. Hizal, A., Sengonul, K., and Zoralioglu, T. Temporal variations in the physical properties of fine textured soil prepared by different tillage methods and their effect on the growth of Pinus pinaster plantations. *Doga, Turk Tarim ve Ormancilik Dergisi* 15:89-94, 1991.
Keywords : Variation; physical properties; soil; Tillage; methods; effects; growth; Pinus; Pinus pinaster; plantations; Turkey; bulk density; density; water; porosity; Site preparation; soil compaction; compaction; soil treatment; treatment; Conifers; mechanical methods; soil texture; Soil physics; forestry; air; site
Notes : Various mechanized methods were used to prepare fine textured soil in Turkey in 1978. Physical properties of the soil, e.g. bulk density, water holding capacity, porosity and air capacity, were improved immediately after site preparation, but had deteriorated significantly after 8 yr because of soil compaction. Growth of Pinus pinaster planted in 1979 was not affected by soil treatment.

Ref ID : 158
158. Hofle, H. Preparing forest planting areas. Methods of total area tillage. *Landtechnik* 39:122-124, 1984.
Keywords : Forests; Planting; methods; Tillage; Cultivation; available; Theses; discs; disc ploughs; ploughs; soil; mounds; requirements; costs; forestry; Site preparation; Labour productivity; ploughing; machines
Notes : The aims of total area cultivation are discussed. The methods currently available are reported; these are heavy disc plough, deep bed plough used to completely turn the soil and disc plough with a double conical roller which forms raised semi-circular mounds. Work time requirements and costs are calculated for a number of commercially available machines.

Ref ID : 159
159. Holley, M.N.H. Amelioration of soil for tree planting. *Canadian Patent Application* CA 2, 014, 951, 14 p:14, 951, 14 pp. 1990.
Keywords : soil; Trees; Planting; Seedlings; cutting; volume; felling; equipment; Site preparation; patents; forestry; methods; cuttings; stumps
Notes : A method of and apparatus for amelioration of soil in preparation for tree planting are described. Separate zones in a predetermined formation for the planting of seedlings, cuttings or slips in such zones are ameliorated by grabbing the soil in the seleced zones, thus disturbing the soil with concomitant decompaction and aeration, and allowing it to re-occupy the volume from which it was grabbed. The zones may be between the rows of stumps after tree felling and are about one metre square and 25-75 cm deep. Apparatus for carrying out the above method is a grapple having articulated tines adapted to move in between a closed and an open position. The tines are adapted to enter the soil at the desired zone in their open position, to contain a volume of soil in the closed position, and to release the soil again in the open position.

Ref ID : 160
160. Hopmans, P., Flinn, D.W., Geary, P.W., and Tomkins, I.B. Sustained growth response of Pinus radiata on podzolised sands to site management practices. *Australian Forestry* 56:27-33, 1993.
Keywords : growth; responses; Pinus; Pinus radiata; site; management; rotations; Victoria; Site preparation; Logging; Residues; burning; Cultivation; Theses; treatment; herbicides; Amitrole; atrazine; fertilizers; nutrition; Trees; age; weeds; weed control; control; Planting; foliage; application; requirements; sandy soils; soil; Forest trees; increment; Plant nutrition; chemical control; Slash; Australia; methods; weed; P
Notes : Pinus radiata was planted at a second rotation site, in SW Victoria, after three methods of site preparation: (i) retention of logging residues, and (ii) clearing or (iii) broadcast burning of residues followed by cultivation. These treatments were superimposed with herbicide (amitrole and atrazine) and fertilizer treatments. Growth and nutrition of trees were monitored over 15 years. Growth at age 5 years was significantly better where logging residues were retained

rather than cleared or burned. A significant growth response was observed to weed control plus P applied at planting. Addition of N, K, Zn and other micronutrients at planting did not increase growth appreciably. Concentrations of N and P in foliage declined from 15 to 11 mg-1 and from 1.5 to 1.1 mg-1, respectively, by age 8 years. Growth response to a second application of P at age 9 years was significantly better where logging residues were retained. However, levels of N in foliage remained low after this second application of P indicating a requirement for N as well as P fertilizer. Retention of logging residues improved tree growth on a sustained basis until age 15 years. It is concluded that growth of P. radiata on a podzolised sandy soil is influenced by residue management, weed control, and N and P nutrition.

Ref ID : 161
161. Horn, R. and Lebert, M. Possibilities and limits of physical recultivation of the soil in forestry. *Forsttechnische Informationen* 44:61-65, 1992.
Keywords : soil; forestry; effects; rotary cultivators; Cultivators; calcium; deep ploughing; ploughing; podzols; physical properties; improvement; soils; lime; loosening; amelioration of forest sites; Tillage; Krohn cultivator; Germany; Site preparation; mechanical methods; Soil types; podozols; pseudogleys; fertilizers; Land improvement; site
Notes : Studies were made on the effect of rotary cultivating with the Krohn rotary cultivator, used alone or in combination with the incorporation of 10 t calcium carbonate per hectare and deep ploughing (1 m). The site was a podzol pseudogley formerly carrying larch [Larix] and beech [Fagus sylvatica]. Data are presented on the physical properties of the soil. Preliminary results indicate that soil improvement by rotavating and/or deep ploughing should only be done on soils that have dried out sufficiently, and that simultaneous incorporation of lime is very important. Deep 'slotting' (subsoil loosening) could also be advantageously combined with the rotary cultivating.

Ref ID : 162
162. Hulugalle, N.R., Lal, R., and Kuile, C.H.G. Soil physical changes and crop root growth following different methods of land clearing in western Nigeria. *Soil Science* 138:172-179, 1984.
Keywords : soil; crops; roots; growth; methods; land; Nigeria; effects; soil physical properties; physical properties; manual; rakes; density; hydraulics; infiltration; porosity; size; Distribution; Soil water; water; mechanical; bulk density; soil water content; comparisons; control; maize; Seedlings; yields; Physical properties of soil; land clearance; tropical soils; Soil types climatic; Soil physics; compaction; Site preparation; mechanical methods
Notes : The effects of four different methods of land clearing in western Nigeria were studied on soil physical properties of an Alfisol and on the root growth of the following crop. The methods used were manual clearing and clearing with a shearblade, a treepusher, and a treepusher/rot rake. Soil physical properties measured were bulk density, saturated hydraulic conductivity, infiltration rate and cumulative infiltration, total porosity, pore size distribution, and soil water retention. Mechanical clearing increased bulk density and proportion of medium-sized pores (2 to 14.3-mum radius) and decreased infiltration rate, cumulative infiltration, saturated hydraulic conductivity, total porosity, and proportion of macropores (> 14.3-mum radius). Soil water content at a potential of 0 kPa was significantly reduced, whereas that at potentials of -10 and -33 kPa was increased. In comparison with the forested control, the magnitude of changes in soil physical properties was in the order of manual clearing < treepusher < shearblade < treepusher/root rake. Although the differential effects of land clearing methods on the soil were reflected only in the initial pattern of maize root growth during the seedling stage, it was sufficient to affect grain yield. Root growth of mucuna and cowpea were not affected by the changes in soil physical properties.

Ref ID : 163
163. Hunter, I.R. and Skinner, M.F. Establishing radiata pine on the North Auckland podzols. *New Zealand Forestry* 31:17-23, 1986.
Keywords : radiata pine; pines; podzols; Afforestation; soils; impeded drainage; Drainage; fertility; Cultivation; fertilizers; trials; improvement; soil; ripping; discing; Trees; growth; survival; Forests; Soil cultivation; P; Pinus radiata; Site preparation; Soil types; New Zealand; mechanical methods; nitrogen; Pinus; phosphorus; nitrogen fertilizers; phosphorus fertilizers; responses; Forestry practices; Soil types genetic
Notes : Early attempts at afforestation with radiata pine on the severely podzolized soils of Northland failed because of the soils' restricted vol., impeded drainage and low fertility. Cultivation and fertilizer trials carried out since 1973 show that with the improvement of soil drainage and vol. through deeper ripping, which penetrated the hardpan, and discing, which formed raised and cultivated beds of soil, tree growth and survival comparable to those in Kaingaroa State Forest can be achieved. With soil cultivation, trees can make better use of fertilizer, initially N and P.

Ref ID : 164
164. Idczak, R.(., Minko, G., Flinn, D.W., Hopmans, P., McKimm, R.T., Stewart, H.T.L., Aeberli, B., and Squire, R.O. Silviculture. *Research activity 75* 5-11. Melbourne, Vic:Victoria, Australia, 1976.
Keywords : Silviculture; research; Nurseries; quality; Tests; Pinus; Pinus radiata; crops; effects; plant; pines; establishment; rotation; P; techniques; site; Site preparation; fertilizers; weed; atrazine; Amitrole; vegetation; Sorption; 2,4,5 T; sampling; herbicides; formulations; control; understorey; regeneration; soil; requirements; growth; Eucalyptus; weed control; Australia; research,forestry; chemical; Victoria; rotations
Notes : Brief summaries are given of research in progress under five headings:1. Nursery practiceMinko, G. A quality test for stored Pinus radiata seedlings.2. Crop establishment.Minko, G. Effect of plant location [close to or away from pine

stumps] on establishment of second rotation Pinus radiata.Flinn, D.W.; Hopmans, P. Establishment techniques for Pinus radiata at Rennick. - Site preparation, fertilizer and weedkillers treatment.3. Weed control.Minko, G. Effects of atrazine and amitrole on vegetation in young pine [P. radiata] plantations.Hopmans, P. Sorption of 2,4,5-T by glass and plastic [stream] sampling containers.McKimm, R.T.; Stewart, H.T.L. Herbicide formulations for control of mesophytic understorey vegetation [in regeneration of ash-type eucalypts].4. Nutrition.Hopmans, P.; Flinn, D.W.; Aeberli, B. Soil tests for predicting the phosphate requirements of Pinus radiata at Heywood.Minko, G. Effect of the foliar fertilizer Maxicrop on Pinus radiata seedlings.5. Site quality.Squire, R.O. Second-rotation growth of Pinus radiata at Rennick.

Ref ID : 165
165. Idczak, R.(., Minko, G., Hopmans, P., Bren, L.J., Craig, F.G., Edgar, J.G., Squire, R.O., McKimm, R.J., Flinn, D.W., and Fagg, P.C. Silviculture. *Research activity 74* 5-15; 1 pl. Melboum:Victoria, Australia, 1975.
Keywords : Silviculture; research; Nurseries; P; Seedlings; quality; Pinus; Pinus radiata; Planting; crops; establishment; effects; site; Site preparation; fertilizers; regeneration; soil; Soil cultivation; Cultivation; roles; reforestation; Eucalyptus; Eucalyptus nitens; Forests; altitude; trials; rotation; pines; wood; production; weed; growth; Losses; Grasses; competition; control; vegetation; plantations; nutrients; nutrient deficiencies; Pseudotsuga; Pseudotsuga menziesii; superphosphate; responses; site quality; Planting stock; increment; nutrition; Eucalyptus delegatensis; Australia; Victoria
Notes : Brief summaries are given of research in progress under five headings:1. Nursery practice.Minko, G.; Hopmans, P. Seedling quality. - Chlorotic seedlings of Pinus radiata raised under waterlogged conditions were not suitable as planting stock.2. Crop establishment.Bren, L.J.; Craig, F.G.; Hopmans, P. Establishment of Pinus radiata at Heywood. - Effects of three site preparation and two fertilizer treatments.Edgar, J.G.; Squire, R.O. Regeneration of low quality stands of mixed eucalypts. - Effects of soil cultivation; and The role of lignotubers in the regeneration of mixed eucalypts.McKimm, R.J.; Flinn, D.W.; Reforestation of the Toorongo Plateau. - Eucalyptus nitens and E. delegatensis appear promising.Fagg, P.C. Regeneration of mixed eucalypt forests at high altitudes. -Trials with E. obliqua and E. fastigata.McKimm, R.J. Short rotation forest in East Gippsland. - Of 16 eucalypt and 2 pine species, max. wood production after 3 yr was shown by E. globulus (33.4 m3/ha), E. st-johnii (21.7) and E. botryoides (20.7).3. Weed control.Squire, R.O. Growth loss on pine associated with grass competition. - Over a 30-yr rotation, loss of growth in P. radiata was estimated as 2-3 yr mean b.a. growth or 1-2 yr mean ht. growth.Minko, G. Control of vegetation in young pine plantations. - Trials with glyphosate.4. Nutrition.Flinn, D.W.; Craig, F.G.; Hopmans, P. Phosphate sources for Pinus radiata at Heywood.Flinn, D.W.; Craig, F.G. Nutrient deficiencies in Pseudotsuga menziesii at Narbethong. - Chlorotic needles and severe needle cast were attributed to deficiency of P, and possibly of N.Bren, L.J. Superphosphate response of Pinus radiata upon deep yellow sands; and Superphosphate response in second rotation Pinus radiata at Creswick.Bren, L.J.; Craig, F.G.; Hopmans, P. Superphosphate response of an established Pinus radiata stand at Scarsdale.5. Site quality.Squire, R.O.; Flinn, D.W. The stability of site quality under Pinus radiata.

Ref ID : 166
166. Johansson-MB The influence of soil scarification on the turn-over rate of slash needles and nutrient release. *Scandinavian Journal of Forest Research* 9:170-179, 1994.
Keywords : soil; scarification; Slash; nutrients; effects; pines; Pinus; Pinus sylvestris; Norway; Picea; Picea abies; Abies; Sweden; treatment; ploughing; discs; Humus; control; mineralization; production; Forest trees; nitrogen; calcium; phosphorus; magnesium; potassium; disc cultivators; foliage; leaves; Forest litter; decomposition; Site preparation; Cycling; site; mounding; P; methods; soils
Notes : The effect of soil scarification on decomposition of green Scots pine (Pinus sylvestris) and Norway spruce (Picea abies) needles and mineral nutrient release was investigated at a wet clear felled site and a dry clear felled site in S. Sweden. The treatments studied were ploughing, disc trenching, mounding on inverted humus and untreated control. The needles decomposed and released their N and Ca contents considerably faster on scarified areas than on untreated plots. For P, Mg and K, only minor differences between scarified and untreated areas were established. At the wet site, needle decomposition and nutrient mineralization were generally affected to the same extent by all 3 scarification methods. At the dry to fresh site, mounding and ploughing enhanced needle decomposition and nutrient mineralization more than disc trenching. The effect of different scarification methods on the long-term production capacity of soils is discussed.

Ref ID : 167
167. Kalaghe, A.G. and Mansy, W. Effect of different site-preparation intensities on growth of Pinus patula at Sao Hill, Tanzania. *Forest Ecology and Managemeni* 29:29-38, 1989.
Keywords : effects; Site preparation; growth; Pinus; Tanzania; plantations; Harrowing; height; diameter; volume; treatment; projects; costs; Planting; soil; Conifers; mechanical methods; Pinus patula; P; subsoiling; survival; basal area; production; site; soils
Notes : Eight site-preparation intensities were studied for P. patula plantations at the Sao Hill pulpwood scheme: complete-ploughing plus 25-cm-deep harrowing and subsoiling (1); complete-ploughing 20 cm deep plus harrowing (2); strip-ploughing 15 cm deep plus harrowing and subsoiling (3); strip-ploughing 15 cm deep plus harrowing (4); strip-ploughing 15 cm deep (5); strip-ploughing 10 cm deep plus harrowing (6); subsoiling 35 cm deep (7); and pitting 30 cm deep (8). At the end of 6 yr, there were significant ($P = 0.01$) differences in survival, mean heights, mean diameters, basal area and volume production between the different site-preparation intensities. There was a trend of increase in

growth with increase in site-preparation intensity. Treatments 1 and 2 gave the best results, followed by treatments 3, 4 and 5. Treatments 6, 7 and 8 significantly (P = 0.05) depressed growth of P. patula. Although treatments 1 and 2 gave the best results, they were about 3 times more expensive than the current practice (15-cm-deep strip-ploughing). It is suggested that the project should be prepared to incur more costs in order to achieve better growth by ensuring that planting sites are complete-ploughed plus harrowed to a minimum depth of 20 cm, and that subsoiling should be restricted to sites with compacted soils. If the project cannot afford to incur extra costs, there is no advantage in subsoiling where strip-ploughing is undertaken to a depth of 15 cm.

Ref ID : 168
168. Kaunisto, S. and Metsanen, R. Effects of soil preparation and fertilizer placement on the root development of Scots pine on deep peat. *Folia Forestalia, Institutum Forestale Fenniae* No. 390, 14 pp.; 13:14 pp. 1979.
Keywords : effects; soil; soil preparation; fertilizers; roots; development; pines; peat; Pinus sylvestris; Site preparation; Fertilizer application; Forestry practices; responses; amendments; placement; Finland; Conifers; application methods

Ref ID : 169
169. Kauppila, A. and Lahde, E. The effects of soil treatments on forest soil properties in North Finland. *Folia Forestalia, Institutum Forestale Fenniae* No. 230, 29 pp.; 51:29 pp. 1975.
Keywords : effects; soil; soil treatment; treatment; Forests; forest soils; soil properties; Finland; scarification; methods; ploughing; height; Humus; Distribution; density; water; air; temperature; activity; soils; Site preparation; mechanical methods; Soil water; Tillage; Soil biology; activity,biological; Soil chemistry; organic; Soil physics; density,compaction; texture; mounding
Notes : A study of the effects of planting-site preparation by scarification, two methods of ploughing (shown in diagrams), rotovating or mounding (to a height of 40 or 50 cm) on the humus content, particle-size distribution, density, water and air contents, temperature and biological-decomposition activity of forest soils.

Ref ID : 170
170. Kellison, R.C. and Gingrich, S. Loblolly pine management and utilization - state of the art. *Southern Journal of Applied Forestry* 8:88-96, 1984.
Keywords : pines; management; utilization; ecosystems; Virginia; South Carolina; Georgia; Florida; North Carolina; stand establishment; establishment; site; Site preparation; Trees; improvement; Seedlings; production; Planting; natural regeneration; regeneration; tending; thinning; burning; fertilizers; Fertilizer application; application; diseases; Insects; growth; yields; equipment; Harvesting; productivity; water; wildlife; Conferences; Loblolly pine ecosystem East region; Pinus taeda; Silviculture; USA; regions
Notes : A summary of 31 papers presented at a symposium on the Loblolly Pine Ecosystem (East Region) - including Virginia, North and South Carolina, Georgia and Florida, held Dec. 8-10, 1982 in Raleigh, North Carolina. Topics covered were: the resource; stand establishment (site preparation, tree improvement, seedling production and planting, natural regeneration); stand tending (thinning, prescribed burning, fertilizer application, diseases and insects); quantification and utilization (including growth and yield); equipment for regeneration and harvesting; integration (maintaining site productivity, water and wildlife management); and challenges.

Ref ID : 171
171. Kiss-G and Yeh-FC Heritability estimates for height for young interior spruce in British Columbia. *Canadian Journal of Forest Research* 18:158-162, 1988.
Keywords : height; British Columbia; Tests; Site preparation; weeds; weed control; control; Planting; performance; Genetics; inheritance; Tree breeding; early selection; Variation; Conifers; Canada; growth; Picea; Picea glauca; P; site; productivity; weed; interactions
Notes : Ht. growth of Picea glauca and P. engelmannii after 3, 6 and 10 yr was assessed in a progeny test of 174 open-pollinated families at 3 sites in N.-central British Columbia. Test sites had a major influence on juvenile growth, reflecting differences in potential site productivity, site preparation and weed control after planting. Mean ht. within and across sites differed among families. Family performances after 3 and 6 yr correlated with performances after 10 yr. Family-site interaction was significant, but accounted for less than a quarter of the family variance. Performance of the best and poorest 25% of families was consistent across sites. Narrow-sense heritability estimates after 3, 6 and 10 yr were, respectively, 0.52, 0.36 and 0.29. Corresponding family heritability estimates were 0.82, 0.73 and 0.67.

Ref ID : 172
172. Knowe, S.A., Shiver, B.D., and Kline, W.N. Fourth-year response of loblolly pine following chemical and mechanical site preparation in the Georgia Piedmont. *Southern Journal of Applied Forestry* 16:99-105, 1992.
Keywords : responses; pines; chemical; mechanical; site; Site preparation; Georgia; height; diameter; volume; survival; Pinus; Pinus taeda; treatment; soils; chemical treatment; Picloram; 2,4 D; Triclopyr; Hexazinone; Glyphosate; discs; vegetation; formulations; performance; models; development; Forest plantations; chemical control; weed control; woody weeds; weed competition; herbicides; mechanical methods; increment; cost benefit analysis; USA; chopping; competition
Notes : Height, diameter, volume and survival responses of 4-yr-old loblolly pine (Pinus taeda) were compared for chemical and mechanical site preparation treatments on sandy clay loam soils in Putnam County, Georgia. Chemical

treatments in early or late summer involved various combinations of Tordon K, Tordon 101, Garlon 3A, Garlon 4, Velpar L and Roundup (respectively, picloram, picloram + 2,4-D, triclopyr amine, triclopyr ester, hexazinone and glyphosate). Mechanical treatments involved shear, pile and disc in early summer or double chopping in late summer. Competing woody and herbaceous vegetation was measured each August. Either Tordon formulation combined with Garlon and the 3-pass mechanical treatment gave the best pine performance in the early summer study, but Tordon 101 + Garlon 4 was the most cost-effective. Tordon K + Garlon 4 was the most cost-effective late-summer treatment. Models were developed to predict pine development as a function of hardwood competition.

Ref ID : 173
173. Kovalev, L.S. The settling of clay-loam and sandy soils in relation to the method of tillage. *Lesnoi Zhurnal* 14:161-165. 1971.
Keywords : sandy soils; soils; methods; Tillage; site; Planting; Conifers; stumps; grubbing; ploughing; litter; removal; Harrowing; measurement; height; soil; growth; Site preparation; mechanical methods; cultivations,soil; Soil physics; density,compaction
Notes : Wet sites were prepared for planting conifers by creating micro-elevations by means of various combinations of operations, viz. stump grubbing, ploughing, scalping and litter removal, harrowing, etc. Measurements were made of the initial height of the micro-elevations produced, and of their height a year later, and the settling of the soil was determined in cm and %. It is concluded that, in order to ensure satisfactory growth of conifers planted on periodically wet soils, account should be taken of the settling of micro-elevations. Recommended initial heights of the micro-elevations are 20 cm on soddy strongly podzolic clay-loams, and 30 cm on soddy strongly podzolic sandy soils.

Ref ID : 174
174. Krause, H.H. and Ramlal, D. In situ nutrient extraction by resin from forested, clear-cut and site-prepared soil. *Canadian Journal of Soil Science* 67:943-952, 1987.
Keywords : nutrients; soil; anions; cations; ions; Forests; forest soils; types; Site preparation; Trees; Planting; podzols; Sorption; nitrate; materials; Logging; horizons; effects; soil temperature; temperature; forestry; clear cutting; seasonal variation; Canada; New Brunswick; Variation; Soil chemistry; methodology; clear felling; ecology; site
Notes : Anion and cation resins were tested as sinks for nutrient ions under variable forest soil conditions. The resins, contained in nylon bags, were placed for periods of 4 wk below the forest floor of a softwood stand, and at approximately 7.5 cm depth on an adjacent clearcut with two different types of site preparation for tree planting. The soil was an Orthic Humo-ferric Podzol. Ion sorption below the forest floor, especially the sorption of ammonium, nitrate and phosphate, was strongly increased after clear-cutting of the forest. Sorption rates were generally lower in the mineral soil than immediately below the forest floor, except for nitrate and sulphate. Mixing of forest floor materials and fine logging debris into the mineral surface horizons generally increased resin sorption if compared to sorption in soil from which the forest floor had been removed. Resin sorption also revealed strong seasonal effects which may have been caused by changes in soil temperature and moisture.

Ref ID : 175
175. Kubin, E. and Kemppainen, L. Effect of soil preparation of boreal forest on air and soil temperature conditions in forest regeneration areas. *Acta Forestalia Fennica* No. 244, 56 pp.; 64:56 pp. 1994.
Keywords : effects; soil; soil preparation; boreal forest; Forests; air; soil temperature; temperature; regeneration; boreal forests; Finland; treatment; scarification; ploughing; pines; Pinus; Pinus sylvestris; height; Forest trees; Site preparation; frost
Notes : A clear felled area in Finland was subjected to one of 3 soil preparation treatments (Scarification, ploughing or cross-directional ploughing) to determine the effects on temperature conditions in the soil and adjacent air layer. The maximum and minimum temperatures were measured daily in the summer months from 1975 to 1985, and other temperature observations were made at 4 h intervals. Scots pine (Pinus sylvestris) was planted in some areas and broadcast sown in others in 1976 to determine the effect of shading on soil surface temperatures. Soil preparation decreased the daily temperature amplitude of the air at a height of 10 cm. It also considerably reduced the risk of night frost. At a depth of 5 cm, soil preparation increased daytime temperatures and reduced night temperatures compared with the unprepared area. Soil preparation increased the cumulative temperature sum. The mean summer temperature in the unprepared area was lower than in prepared area and the difference did not diminish during the period studied. The increase in temperature brought about by soil preparation thus lasted more than 10 years.

Ref ID : 176
176. Laar, A. The effect of ripping in combination with fertiliser to ameliorate forest sites on the Harkerville Plateau, southern Cape. *South African Forestry Journal* No. 145, 28-32; 6 re:28-32, 1988.
Keywords : effects; ripping; fertiliser; Forests; site; mortality; growth; Pinus; Pinus radiata; Planting; applications; superphosphate; Site preparation; Conifers; fertilizers; phosphorus; Pinus pinaster; mechanical methods; South Africa; phosphorus fertilizers; responses; P; survival
Notes : In 1977 experiments were established to assess the effects on mortality and early ht. growth of Pinus radiata and P. pinaster of ripping and pit planting and/or 1 or 2 applications of rock phosphate or superphosphate. Site preparation appeared to interact with species: ripping improved survival of P. pinaster but reduced that of P. radiata. Site preparation

did not have a lasting effect on the ht. growth of either species. Superphosphate had a significantly greater effect on ht. growth than rock phosphate.

Ref ID : 177
177. Lea, A.D. Use of natural regeneration to establish second-rotation crops of radiata pine in the Australian Capital Territory. *Commonwealth Forestry Review* 63:263-269, 1984.
Keywords : natural regeneration; regeneration; crops; radiata pine; pines; rotations; Planting; site; Slash; tending; Site preparation; treatment; fertilizers; herbicides; herbicide application; application; returns; Theses; slopes; Artificial regeneration; Pinus radiata; Economics; vs.natural regeneration; Australia,Australian Capital Territory; Australia; New South Wales
Notes : Procedures are described and the advantages and disadvantages discussed. Four options for establishing 2nd rotations are considered and compared economically: (a) traditional practice -hand planting on clear-felled, prepared sites, with slash heaped and burned; (b) natural regeneration with min. tending; (c) natural regeneration with some site preparation; and (d) planting with slash retention. All treatments included fertilizer and herbicide application. Present net worth per ha and internal rate of return (%) are given for all treatments. These show that (d) maximises financial returns followed by (b), (c) and then (a). Natural regeneration was thought to be the most appropriate for establishing stands on steep slopes.

Ref ID : 178
178. Lewis, R. and Abee, A. Site preparation strategies for skeletal soils. *Reforestation of skeletal soils [edited by Hobbs, S* 40-49; 40 ref., 5 fi:5 fig. Oregon, USA, 1981.
Keywords : site; Site preparation; soils; Oregon; establishment; plantations; Seedlings; mortality; vegetation; treatment; nutrients; soil; Losses; Conferences; Reforestation of Skeletal Soils; Forestry practices; stony soils; USA; available; New; maintenance
Notes : For most Southwest Oregon skeletal soils, available moisture is the most limiting factor governing the successful establishment of new plantations. Foresters can overcome this limitation and some other causes of seedling mortality associated with competing vegetation by employing agressive site preparation and maintenance strategies. Site differences preclude prescribing a particular combination of treatments for all skeletal soils. Caution must be used before prescribing maximum disturbance treatments because of potential nutrient and soil losses on some sites. Dry ravel on highly disturbed sites requires special mitigation.

Ref ID : 179
179. Lhotsky, J. Raising the humus content as a fundamental condition for making dry sands fertile, and their preparation for forestry use. *1956, Sborn, csl* (915-34). 24 refs. 1956.
Keywords : Humus; forestry; trials; felling; site; ploughing; weeding; loosening; soil; growth; Cultivation; maize; millets; Seedlings; Pinus; Pinus sylvestris; Quercus; Quercus robur; Carpinus betulus; Tilia; Theses; crops; Arid; oats; Planting; P; cover crops; Panicum; methods; organic matter; Agri silviculture; Carpinus betulus regeneration combined with field crops; Carpinus betulus site amelioration; cultivation,soil; Fertilizing; Green manuring; Humus measures to increase; Pinus sylvestris combined with field crops; Quercus robur s.s.regeneration combined with field crops; Quercus robur s.s.site amelioration; Regeneration,artificial; Regeneration site preparation; Regeneration site preparation ploughing; Sands including dunes afforestation; Silviculture; Tilia spp.regeneration combined with field crops; Tilia spp.site amelioration
Notes : Trials in Slovakia showed that the following measures can be recommended: (1) In a weed-infested felling area on a semi-arid site: autumn ploughing; clean fallow; weeding and slight loosening of soil surface during growth; cultivation of potatoes, maize and millet in E.-W. strips or rows between the seedlings of Pinus sylvestris, Quercus robur, Carpinus betulus and Tilia sp., and ploughing in of these field crops; use of BHC against cockchafer grubs. (2) On blown sand on an arid site: green manuring (vetch and oats); planting 1-year seedlings of P. sylvestris, and Q. robur (C. betulus and Tilia sp. did not give very good results); cover crops (E.-W.) between the rows (Panicum germanicum, Sorghum vulgare, S. halepense, spring rye); very shallow and careful soil loosening during growth. Both methods resulted in an increase of organic-matter % and improved moisture conditions.

Ref ID : 180
180. Little, S.N. and Waddell, D.R. Highly stocked coniferous stands on the Olympic Peninsula: chemical composition and implications for harvesting strategy. *Research Paper Pacific Northwest Research Station, USDA Forest Service* No. PNW-RP-384, 29 p:29 pp. 1987.
Keywords : chemical; composition; Harvesting; assessment; Distribution; Conifers; Forests; Washington; USA; Pseudotsuga menziesii; nutrients; materials; Site preparation; Biomass; growth; Seedlings; treatment; Cycling; Thuja; Pseudotsuga; Tsuga; phosphorus; potassium; calcium; magnesium; Logging; Thuja plicata; Tsuga heterophylla; tree length logging; soil; nitrogen; Theses; crown; site; production
Notes : An assessment is presented of macronutrients and their distribution within highly stocked, stagnant stands of mixed conifers on the Quilcene Ranger District, Olympic National Forest, northwest Washington, USA. These stands consisted of predominantly three species: western hemlock (Tsuga heterophylla), coast Douglas fir (Pseudotsuga menziesii var. menziesii), and western redcedar (Thuja plicata). Preliminary investigation suggested that the living crown

contained a small portion of the nutrient capital on the site. Extracting this material from the site during harvest or site preparation should not pose a threat to future production of biomass. Bioassays suggested that no macronutrients were deficient for growth of Douglas fir seedlings. However, care should be taken during harvest and site treatment to protect the nutrient capital in dead material and in the forest floor.

Ref ID : 181
181. Lockaby, B.G., Slay, J.M., Adams, J.C., and Vidrine, C.G. Site preparation influences on below ground competing vegetation and loblolly pine seedling growth. *New Forests* 2:131-138, 1988.
Keywords : site; Site preparation; vegetation; pines; Seedlings; seedling growth; growth; Pinus; Pinus taeda; regeneration; coastal plain soils; soil; Louisiana; techniques; fuelwood; application; herbicides; treatment; roots; height; diameter; mechanical methods; USA; chemical treatment; burning; competition; weed control; management; weeds; control; cultural control; cutting; chemical control; ecology; forestry; windrow; intensive
Notes : The relationship between competing vegetation characteristics (above and below ground dry weights, length and surface area) and Pinus taeda seedling characteristics during regeneration were examined on a southern coastal plain soil of NW Louisiana. Four site preparation techniques were used: chop and burn, windrow, fuelwood harvest, and fuelwood harvest followed by an application of herbicide. The more intensive treatments (chop and burn, windrow, and fuelwood harvest followed by a herbicide) had less root and above ground competition than the fuelwood treatment. The fuelwood treatment ranked lowest in pine seedling height, ground line diameter, pine root length, and pine root surface area and highest in terms of competing vegetation characteristics. Regression relationships between pine roots and competing vegetation root characteristics indicated that seedling ground line diameter is inversely related to quantities of competing vegetation roots.

Ref ID : 182
182. Low, J.D. and Greig, B.J.W. Spring frosts affecting the establishment of second rotation crops in Thetford Chase. *Forestry* 46:139-155 + 6 pl. 1973.
Keywords : frost; establishment; rotation; crops; temperature; height; site; Nurseries; soils; Forests; Trees; growth; effects; ground cover; slopes; weed; weed competition; competition; Seedlings; Pinus; Pinus nigra; Planting; damage; plants; air; Cultivation; deep ploughing; ploughing; underplanting; felling; P; soil; costs; methods; Site preparation; Pinus nigra maritima; Artificial regeneration; injuries; frost injury; frost,general; microclimatology,micrometeorology; Conifers
Notes : Presents results of a study in which temperature was recorded at heights of 6 in and 4 ft above ground level on a range of sites (including bare nursery soils, various forest clearings, and under tree cover) from April to June during 1964-1967. Growth studies were made (in which the effects of ground cover, tree cover, slope, weed competition and initial seedling height were noted) in 33 plots of Pinus nigra var. maritima after planting in 1964 and 1965. It was found that : spring frosts occur every year at Thetford [cf. FA 31, 1811], but the severe frosts that kill trees outright may occur only once every few years; frost damage to plants occurs mainly when the trees are <18 in tall; forest clearings of >2 ha do not act as artificial frost hollows; and cold air flows down slopes of > 1 deg and accumulates at the bottom, forming a frosty zone. Frost damage must be minimized by complete cultivation, deep ploughing, underplanting, or strip felling, if P. nigra var. maritima is to be successfully established in areas liable to spring frosts. With bare soil, in particular, establishment costs may be lower than with traditional methods of site preparation.

Ref ID : 183
183. MacBrayne, C.G. Forest-grazing: what can Britain learn from New Zealand? *Scottish Forestry* 35:22-31, 1981.
Keywords : New; reviews; Grazing; Forests; New Zealand; site; Site preparation; weeding; fire; climate; Upland; shelter; soils; Agroforestry; returns; Planting; rotations; thinning; tractors; grazing and pasture; Farm forestry; Great Britain; farm woodlands; agriculture/forestry relations,general; UK; rotation
Notes : A review of the grazing of livestock in forests in New Zealand, and its possible benefits for site preparation, weeding, improving access and reducing fire hazard. In spite of a poorer climate in Britain, the prospects are good, especially in the uplands where shelter for stock is crucial. The bad name of forest grazing has largely arisen from mismanagement, especially overstocking on wet soils. An agroforestry scheme for farmers is suggested that gives a reasonable return with the min. of silvicultural expertise. Planting would be at 3.5X1.5 m [species unspecified] with under-grazing throughout the 20-yr rotation, no thinning and easy tractor access.

Ref ID : 184
184. Madeira, M.V.A., Melo, M.G., Alexandre, C.A., and Steen, E. Effects of deep ploughing and superficial disc harrowing on physical and chemical soil properties and biomass in a new plantation of Eucalyptus globulus. *Soil and Tillage Research* 14:163-175, 1989.
Keywords : effects; deep ploughing; ploughing; discs; Harrowing; chemical; soil; soil properties; Biomass; New; plantations; Eucalyptus; Eucalyptus globulus; intensive; site; Site preparation; techniques; biomass production; production; Planting; bulk density; density; soil compaction; compaction; porosity; infiltration; treatment; chemical properties; carbon; pH; cations; cation exchange capacity; roots; Portugal; disc harrows; Soil physics; Soil chemistry; Soil biology; Tillage; Broadleaves; mechanical methods; soil density; soil pH; calcium; ion exchange capacity; organic
Notes : The effects of minimal (surface disc harrowing) and intensive (deep ploughing) site preparation techniques in a Eucalyptus globulus plantation on various soil properties as well as on biomass production were compared. The results

presented cover the first 30 months after planting. Disc harrowing caused a significant decrease in bulk density to 30-cm depth, a decrease in soil compaction to 10-cm depth and an increase in porosity in the 0 to 10-cm layer. Deep ploughing induced a decrease in the bulk density between 10- and 80-cm depth, but had no effect on porosity or the levels of soil compaction. Infiltration was greater with disc harrowing. In both treatments the chemical properties of the soil were only affected within the top 20 cm. Significant decreases in organic carbon, pH, exchangeable Ca, sum of bases and cation exchange capacity occurred in both treatments. Decreases in all variables except pH were significantly higher in deep ploughed than in disc-harrowed plots. Biomass production and partitioning, measured 18 and 30 months after planting, were not affected by the treatments. However, roots were concentrated in the 0 to 20-cm layer in the disc-harrowed plots and in the 20 to 75-cm layer in the deep-ploughed plots. The results are discussed with reference to current techniques for managing E. globulus plantations in Portugal.

Ref ID : 185
185. Madgwick, H.A.I. Pinus radiata - biomass, form and growth. *1994, ix + 428 pp* New Zealand; H. A. I, 1994.
Keywords : Pinus; Pinus radiata; Biomass; growth; reviews; New Zealand; Australia; estimation; Trees; stems; foliage; roots; soil; climate; nutrients; Planting; Planting stock; Genetics; Variation; defoliation; mortality; mycorrhizas; forestry; Harvesting; Site preparation; mycorrhizal fungi; Fungi; Books; stem form; increment; Stand characteristics; mensuration; plant morphology; Plant nutrition; New; cones; site; competition; methods
Notes : A comprehensive review of literature concerning the biomass, growth and form of Pinus radiata (mainly with respect to New Zealand and Australia) is presented in 14 chapters: (1) estimation of individual tree weight; (2) estimation of stand weight; (3) biomass of stands; (4) tree form - stems; (5) tree form - foliage; (6) tree form - branches and cones; (7) tree form - roots; (8) stand form; (9) growth; (10) site studies; (11) physical factors affecting growth (site, soil depth and climate); (12) soil nutrients affecting growth; (13) biological factors affecting growth (planting stock, genetic variation, defoliation, mortality, competition, and mycorrhizas); and (14) forestry operations affecting growth (harvesting and site preparation). Details of field and laboratory methods, and a list of mycorrhizal fungi are included in appendices.

Ref ID : 186
186. Malyshev, E.S. Effect of different soil cultivation methods on changes in soil hydro-physical properties and annual height increment of Scots pine plantations. *Lesovedenie i Lesnoe Khozyaistvo* No. 25, 27-30; 5 ref:27-30, 1990.
Keywords : effects; soil; Soil cultivation; Cultivation; methods; height; increment; pines; plantations; Site preparation; trials; peat; stumps; stump removal; removal; loosening; ploughing; discs; superphosphate; application; Planting; treatment; growth; Conifers; mechanical methods; Poland; Pinus sylvestris; Soil water; Soil water regimes; Tillage; bog soils; Belarus; forestry; site; P
Notes : Site preparation trials were made on a 5-yr-old cutover area on a drained transitional bog site with a peat layer 30-60 m deep. Cultivation followed stump removal and was by : soil loosening to depths of 25 or 50 cm; ploughing to 50 cm depth; ploughing to 25 cm plus loosening to 50 cm depth; and disc ploughing to 25 cm depth. Plots with and without double superphosphate application at 2 g per planting spot were included in all treatments. Nearly all treatments improved height of planted Scots pine [Pinus sylvestris] and soil moisture regime, with combined ploughing and soil loosening giving the best results over the first 3 yr of growth. P application produced no significant increase in height increment in most treatments.

Ref ID : 187
187. Martell-DL and Fullerton-JM Decision analysis for jack pine management. *Canadian Journal of Forest Research* 18:444-452, 1988.
Keywords : analysis; pines; management; Forests; Site preparation; Artificial regeneration; STATISTICAL ANALYSIS; site types; Forest management; planning; Conifers; Canada; Ontario; Pinus; Pinus banksiana; boreal forest; regions; regeneration; methodology; treatment; site; tending
Notes : Clear felled jack pine (Pinus banksiana) areas in the Boreal Forest region of Ontario pose complex management challenges for stand regeneration. A decision analysis procedure was used to develop a methodology that can be used to evaluate silvicultural treatments (including site preparation, stocking and subsequent tending) for clear felled areas on sand flats. The use of the procedure is illustrated by applying it to a hypothetical, representative site.

Ref ID : 188
188. Mason, E.G. Causes of juvenile instability of Pinus radiata in New Zealand. *New Zealand Journal of Forestry Science* 15:263-280, 1985.
Keywords : Pinus; Pinus radiata; New; New Zealand; effects; roots; soil; Soil cultivation; Cultivation; P; plantations; Trees; stems; wind; age; ripping; soils; development; sweep; stem form; leaning stems; deformation; mechanics; Wind damage; Site preparation; mechanical methods; site
Notes : The effects of root configuration and soil cultivation on stability of juvenile P. radiata were studied in New Zealand plantations. Results showed that trees which have 'socketed' (formed a funnel-shaped depression in the ground around the stem, caused by the tree swaying in the wind) are more prone to juvenile instability (toppling) than trees which have not. Trees with straight-grained taproots and plenty of sinkers are less likely to topple at ages 2 and 3 than trees with twisted or no vertical roots. Cultivation can increase the likelihood of toppling on some sites. However, ripping on sites with compact soils can improve vertical root development, reducing the likelihood of toppling. The rare form of toppling in

which trees snap below ground level results from constriction of the stem where lateral roots are wrapped around the bole. Toppled trees acquire a lean from which they gradually recover, resulting in trees with butt sweep and sinuous stems.

Ref ID : 189
189. Mason, E.G. and Cullen, A.W.J. Growth of Pinus radiata on ripped and unripped Taupo pumice soil. *New Zealand Journal of Forestry Science* 16:3-18, 1986.
Keywords : growth; Pinus; Pinus radiata; soil; pumice soils; P; Seedlings; Forests; age; ripping; survival; Trees; roots; analysis; volume; treatment; development; horizons; Site preparation; mechanical methods; New Zealand; Soil types; volcanic soils; Forestry practices; Soil types lithological
Notes : P. radiata seedlings were planted on ripped and unripped Kaingaroa gravelly sand and Kaingaroa loamy sand in S. Kaingaroa State Forest. Results at age 5-7 yr showed that ripping significantly increased survival and growth on gravelly sand and trees were more uniform. Fine root analysis showed that roots were exploiting the increased volume of soil provided. Growth of trees planted next to the ripline was slightly better than those planted in the ripline. On loamy sand, there were n.s.d. in survival and growth between treatments. Ripping accelerated the development of a B horizon in the soil profile and improved the vertical rooting habit of some of the trees.

Ref ID : 190
190. Mason, E.G., Cullen, A.W.J., and Rijkse, W.C. Growth of two Pinus radiata stock types on ripped and ripped/bedded plots at Karioi forest. *New Zealand Journal of Forestry Science* 18:287-296, 1988.
Keywords : growth; Pinus; Pinus radiata; types; Forests; Site preparation; techniques; ripping; control; treatment; soil; tephra; New Zealand; Seedlings; diameter; costs; Cultivation; roots; Planting; resistance; Conifers; mechanical methods; Soil physics; soil compaction; Planting stock; size; age; site; soils; New; improvement; height; extension; plant
Notes : Two site preparation techniques - ripping and ripping plus bedding - were compared with an uncultivated control treatment on compacted, podzolised soils from weathered andesitic tephras at Karioi Forest, New Zealand. Two seedling stock types (1+0 and 1.5+0) were used. Ripping/bedding caused a significant improvement in height and diameter growth between 2 and 7 yr old, but this improvement alone was not large enough to justify the cost of cultivation. Root form and vertical extension were better in the cultivated lots than in the control, but no significant differences in stability between cultivation treatments were recorded. The 1.5+0 stock was larger at planting time than 1+0 stock, but was more difficult to plant properly, and exhibited much poorer root form; it toppled almost twice as often, despite slightly deeper planting and a larger mean root/shoot ratio. Growth was not significantly different between stock types by 7 yr old. Root extension was related to penetration resistance, and was severely restricted when the resistance exceeded 3 MPa.

Ref ID : 191
191. Mason, E.G., Milne, P.G., and Cullen, A.W.J. Establishment regimes for radiata pine on yellow-brown earths in Southland. *New Zealand Forestry* 37:24-28, 1993.
Keywords : establishment; radiata pine; pines; effects; Cultivation; fertilizers; Fertilizer application; application; weeds; weed control; control; growth; survival; Pinus; Pinus radiata; Seedlings; New Zealand; Site preparation; ripping; discing; treatment; Planting; age; Hexazinone; design; height; diameter; crops; Drainage; improvement; stems; plantations; Rippers; discs; ploughing; blade ploughing; Tillage; seedling growth; yellow brown earths; herbicides; Soil types; weed; site; New; P
Notes : The results are presented of 2 experiments investigating the effects of cultivation, fertilizer application and weed control on growth and survival of radiata pine (Pinus radiata) seedlings on yellow brown earths at 2 sites in New Zealand. In the first experiment 1+0 seedlings were planted in 1977. Plots had been subjected to various site preparation (ripping, discing and blading) treatments. Velpar [hexazinone] was applied to subplots 10 d after planting at a rate equivalent to 3 kg/ha. Growth and survival were measured at age 5 yr. In the second experiment 1+0 seedlings were planted in 1983. Plots had been subjected to various ripping treatments. Hexazinone (2 kg/ha) and fertilizer (N, P, K, Mg, B and Cu) were applied to subplots in a factorial design. Growth and survival were measured up to 5 yr. Site preparation significantly improved height and diameter growth; seedling survival was better for treatments involving discing than for treatments involving ripping. Site preparation also improved crop uniformity. Results suggested that drainage of the topsoil was the most important improvement brought about by site preparation. Weed control improved height growth. Fertilizer application without weed control decreased survival by 10%. Weed control increased the incidence of multiple stems from 18% to 30%. It is suggested that plantation managers should consider site preparation with ripper tines and discs followed by spot weed control on yellow brown earths in Southland and Otago.

Ref ID : 192
192. May, J.T., Rahman, S., and Worst, R.H. Effects of site preparation and spacing on planted Slash Pine. *Journal of Forestry* 71:333-335, 1973.
Keywords : effects; site; Site preparation; spacing; Slash; pines; Pinus; Pinus elliottii; Georgia; USA; measurement; Planting; site quality; quality; interactions; height; diameter; volume; growth; growth rate; treatment; Harrowing; Trees; productivity; increment; diseases and disorders; stem rusts; mechanical methods; rust diseases; Conifers; yields
Notes : Presents further results of a study previously noticed [see FA 26, 2053] on Pinus elliottii in Georgia, USA. Measurements made 10 years after planting showed that, in general, site quality, site preparation, spacing and the

interactions between them significantly affected height, diameter, total cubic volume and incidence of infection by fusiform rust. The best growth rates, greatest volumes and highest incidence of rust infection were on the better drained sites. Site-preparation treatments that included harrowing increased height and diameter growth and cubic volume on all sites. Incidence of fusiform-rust infection on dominant and codominant trees increased with an increase in spacing, site productivity and intensity of site preparation.

Ref ID : 193
193. Mayfield, J.E., Edwards, M.B., and Dashek, W.V. Relationship of macrofungal population to silvicultural treatments in a recently harvested pine forest. *Forest Ecology and Management* 31:109-119, 1990.
Keywords : treatment; pines; Forests; Site preparation; herbicides; clear felling; Biomass; Pinus; Pinus taeda; plantations; Georgia; USA; seasonal variation; Variation; soil; Soil water; water; nutrients; Conifers; Logging; ecology; soil fungi; mechanical methods; Soil biology; Fungi; soil water content; forest soils; forestry; Soil types ecological; alternatives; site; roles; wood
Notes : The relationship between site-preparation - sheared roller-chopped (SC), chopped and herbicide treated (CH) as well as no treatment (C) following clear-felling - and fungal biomass and diversity was assessed. A 35-ha loblolly pine (Pinus taeda) plantation within the Hitchiti Experimental Forest, Juliette, Georgia, USA, was harvested in the winter of 1980, and subjected to alternative treatments during 1981; between Feb. and June 1983, visible fungal fruiting bodies were counted and identified. Of 55 genera over the whole area, 29, 41 and 32 species were collected in C, SC and CH plots, respectively. Fruiting biomass percentages were 17%, 30% and 50%, respectively. The degree of correlation between fungal species and site preparation varied according to species. Factors such as seasonal variations in soil water, the role of macrofungi as nutrient reservoirs, and presence of residual wood on harvested sites are discussed as possible influences.

Ref ID : 194
194. McColl, J.G. and Powers, R.F. Consequences of forest management on soil-tree relationships. *Nutrition of plantation forests [edited by Bowen, G* 379-412; approx. 140:4 fig., 5 tab. Londo, 1984.
Keywords : Forests; Forest management; management; Site preparation; stand development; development; treatment; Harvesting; quality; Soil fertility; Forestry practices; site; site quality
Notes : The following are discussed: (a) site preparation, (b) stand development, (c) stand treatment, (d) harvesting, and (e) site quality decline.

Ref ID : 195
195. McDonald, M.A., Malcolm, D.C., and Harrison, A.F. The use of 32P root bioassay to indicate the phosphorus status of forest trees. 2. Spatial variation. *Canadian Journal of Forest Research* 21:1185-1193, 1991.
Keywords : roots; phosphorus; Forests; Forest trees; Trees; Variation; uptake; Picea; Picea sitchensis; pines; Pinus; Pinus contorta; Scotland; sampling; seasons; ridges; Site preparation; furrows; effects; Seedlings; Conifers; Plant nutrition; nutrient uptake; UK; methodology; ploughing; site
Notes : The influence on bioassay results of spatial variability on the forest floor on the uptake of 32P was investigated in 3 microtopographical positions in 17-yr-old Sitka spruce (Picea sitchensis) and lodgepole pine (Pinus contorta) stands in Scotland in 1984-85. Within-plant variation of the uptake of phosphorus was examined under controlled conditions. Sampling stands growing on spaced-furrow ploughed sites indicated that positional or microsite differences interact with season of sampling. The ridges created by this kind of site preparation appeared to be nutritionally impoverished compared with the flats and furrows, and this effect was most marked in summer. A greenhouse split-root experiment with Picea sitchensis seedlings indicated that within-plant variability is of less consequence than the spatial variability of the forest floor. Sampling positions are suggested for standardizing sampling procedure.

Ref ID : 196
196. McElwee, R.L. and Hall, O.F. Cultural, management and economic research needed to assist the non-industrial private forest landowner in the southeastern U.S. -a problem analysis. *Publication, School of Forestry and Wildlife Resources, Virginia Polytechnic Institute and State University* No. FWS-5-82, i + 34:i + 34 pp. 1982.
Keywords : management; Economics; research; Forests; analysis; cultural; reviews; pines; projects; productivity; Theses; chemical control; control; vegetation; site; Site preparation; alternatives; investment; Forest management; information; methods; effects; Harvesting; costs; equipment; techniques; thinning; pests; Pest management; Private forestry; USA; extension; chemical
Notes : A review of the economic concerns and research needs of non-industrial private owners who together own 65% of pine and pine/oak forests and hold the key to meeting the projected need to double by 2030 the vol. of southern pine timber harvested in 1976. A list of 12 research projects considered vital to increasing productivity in these forests was put to an invited technical review committee of 16 foresters for ranking in order of importance. These were (in order of decreasing overall ranking): chemical control of vegetation; site preparation alternatives for small tracts; factors affecting investment in forest management; improved technical and information delivery methods; effects of harvesting systems on site preparation costs for small tracts; harvesting equipment and techniques; evaluation of alternative public incentive methods; analysis of long-term timber supply from these forests; economics of thinning and other intermediate stand management practices for firewood etc.; alternative methods for leasing timber growing rights; effect of changes in timber

output on local economies; and pest management. Emphasis throughout was on low-intensity, low-cost practices. A comprehensive list of relevant research projects is appended with details of institutions currently or recently involved.

Ref ID : 197
197. McKee, W.H.,Jr., Hatchell, G.E., and Tiarks, A.E. Managing site damage from logging. A loblolly pine management guide. *General Technical Report, Southeastern Forest Experiment Station, USDA Forest Service* No. SE-32, 21pp.21pp.X, 1985.
Keywords : site; damage; Logging; pines; management; guidelines; Site preparation; planning; soil; soil compaction; compaction; Pinus taeda; Soil physics; Forestry practices; USA
Notes : Guidelines are given for site preparation and planning before logging operations, to minimize site damage, and for repair to damaged areas after logging, especially amelioration of soil compaction.

Ref ID : 198
198. McKee, W.H.,Jr. and Wilhite, L.P. Loblolly pine response to bedding and fertilization varies by drainage class on lower Atlantic Coastal Plain sites. *Southern Journal of Applied Forestry* 10:16-21, 1986.
Keywords : pines; responses; Drainage; site; felling; stems; ridges; ploughs; shrubs; Trees; control; effects; competition; Seedlings; fertilizers; P; seasons; growth; increment; treatment; interactions; age; Site preparation; mechanical methods; USA,South Carolina; Pinus taeda; phosphorus; Pinus; chemical treatment; phosphorus fertilizers; USA; South Carolina; windrow; mechanical
Notes : Studies were made for 10 yr on sites classified as (1) moderately well-drained, (2) somewhat poorly drained and (3) poorly drained in S. Carolina. Sites were broadcast burned before and after felling stems >5 inch d.b.h. Ridges were constructed on (3) with a fireline plough. Sites (1) and (2) supported more shrubs and trees that were sheared and raked into windrows for bedded plots. Control plots were not sheared or raked. All plots were sprayed with 2, 4, 5-T to reduce the effects of woody competition. Seedlings (1+0) were planted in Feb. 1971 on (2) and 2 yr later on the other sites. Fertilizers (P, K or P + K) were applied at the beginning of the second season and N at the start of the sixth season. Growth was not improved by K on any site. Ht. and diam. increment for 10 yr showed a pronounced response to treatment on site (3) but only a small response on other sites. Fertilization with P produced a larger response than mechanical bedding. An interaction between bedding and P occurred only on site (3) where the main effect of bedding was considered to be improved drainage. Growth curves suggest that response to P alone may compare favourably with bedding + P after pines are age 20 yr on (3). Foliar concn. P could be improved as an indicator of response to P fertilizer if a measure of drainage was included in the prediction.

Ref ID : 199
199. McKimm, R.J. and Flinn, D.W. Eucalypt species, site preparation and fertiliser requirements for reforestation of the Toorongo Plateau in central Victoria. *Australian Forestry* 42:117-124, 1979.
Keywords : site; Site preparation; fertiliser; requirements; reforestation; Victoria; climate; exposure; Seedlings; Eucalyptus; Eucalyptus nitens; ploughing; ripping; control; survival; growth; methods; fertilizers; trials; P; Planting; Trees; age; urea; Eucalyptus delegatensis; Eucalyptus globulus bicostata; Eucalyptus regnans; Australia; Species trials; mechanical methods; NPK fertilizers; N,urea and; frost
Notes : The Tooronga Plateau, (alt. 950-1250 m) near Noojee, central Victoria, is an area of harsh climate, subject to severe frosts and heavy snowfall. At each of 3 sites, differing in exposure 1+0 seedlings of Eucalyptus nitens, E. deleegatensis, E. regnans and E. globulus ssp. bicostata were planted in Sept. 1972 following site preparation in May, by ploughing, ripping, or furrowing. Control plots had no site preparation. Survival and growth were assessed for 5 yr. Survival was poor for E. regnans and E. globulus ssp. bicostata on all the sites with all the preparation methods. E. nitens was more suitable, in terms of survival and growth, for the range of sites than E. delegatensis, which survived poorly on the harshest site. All the site preparation methods improved the growth of E. nitens and E. delegatensis, ploughing and furrowing being better than ripping. A fertilizer trial was established with E. nitens and E. delegatensis in Oct. 1973 on a ploughed area of the least exposed site, with a range of N, P and K fertilizers applied at planting. N-based fertilizers (20 g N per tree) increased the growth of both species (measured at age 4), urea giving the best results.

Ref ID : 200
200. McMinn, J.W. Site preparation for natural regeneration of slash pine. *Southern Journal of Applied Forestry* 5:10-12, 1981.
Keywords : site; Site preparation; natural regeneration; regeneration; Slash; pines; Florida; Seeds; Seedlings; establishment; size; treatment; density; types; effects; mounds; soil; exposure; Seed; Pinus elliottii; mechanical methods; preparatory measures; relation to site factors; Conifers; USA
Notes : Plots in 30-yr-old natural stands in N. Florida were thinned to b.a. of 10, 30 and 50 ft2/acre in July and furrowed and disced (to give alternate scarified and unscarified 8-ft strips) in early Aug. Single seeds were dropped at 1 ft intervals in Oct. along ten 100-ft long line transects perpendicular to the strips. The number and ht. of seedlings were recorded the following July. Overall, seedling establishment and size was not affected by site treatment or overstorey density (17% of seeds produced seedlings, with an av. ht. of 15 cm). Type of microsite had a significant effect. All exposed scarified sites produced more surviving seedlings than expected, mounds being best. Unexposed scarified sites produced less seedlings than expected, indicating the importance of soil exposure at the time of seed fall.

Ref ID : 201
201. McNab, W.H., Miller, T., and Brender, E.V. Growth and fusiform rust responses of Piedmont loblolly pine after several site preparation and regeneration methods. *Southern Journal of Applied Forestry* 14:18-24, 1990.
Keywords : growth; responses; pines; site; Site preparation; regeneration; methods; Georgia; burning; chopping; Pinus; Pinus taeda; Planting; Seedlings; Direct sowing; sowing; effects; soil; soil physical properties; physical properties; Trees; diameter; height; Distribution; mortality; Conifers; Fungal diseases; Cronartium; Cronartium fusiforme; rust diseases; ecology; mechanical methods; USA; vs.planting; cultural methods; activity; intensive
Notes : Clear felled pine/broadleaved sites in the Piedmont of central Georgia were prepared by burning or drum chopping and were regenerated to loblolly pine (Pinus taeda) by planting (1+0 seedlings) or direct sowing (broadcast or row sowing). Site preparation had little effect on soil physical properties. After 12 yr, trees were larger in diameter at breast height and total height, the merchantable stand was greater and distribution was more uniform on planted than on sown areas. Intensive site preparation (drum chopping) enhanced regeneration from direct sowing more than that from planting. Neither fusiform rust (Cronartium quercuum f. sp. fusiforme [C. fusiforme]) incidence nor rust-associated mortality was affected consistently by the intensity of site preparation, but both factors were generally greater on sown than on planted plots.

Ref ID : 202
202. McNabb, D.H., Baker-Katz, K., and Tesch, S.D. Machine site preparation improves seedling performance on a high-elevation site in southwest Oregon. *Western Journal of Applied Forestry* 8:95-98, 1993.
Keywords : machines; site; Site preparation; Seedlings; performance; Oregon; Pseudotsuga; Pseudotsuga menziesii; treatment; soil; removal; control; altitude; mountains; survival; vegetation; Planting; effects; seedling growth; growth; Soil fertility; fertility; Forest trees; beating up; mechanical methods; Tillage; Forest plantations; USA; plant competition; mortality; drought
Notes : Douglas fir (Pseudotsuga menziesii) seedlings planted on areas receiving one of four site preparation treatments (scarify, scarify/till, soil removal, and soil removal/till) and on unprepared control areas were compared for 5 yr at a high-altitude, nutrient-poor site in the western Siskiyou Mountains. Fifth-year survival of seedlings was at least 85% among machine-prepared plots, compared to 42% on control plots. Cover of competing vegetation remained less than 25% during the period for all machine treatments. In contrast, vegetation cover on control plots was 30% at the time of planting and increased to nearly 75% after 5 yr. Competing vegetation clearly impeded seedling performance. The effects of unusually droughty conditions at the time of planting in 1982 were examined further by interplanting additional seedlings in the soil-removal treatment in 1985. The interplanting was followed by more normal spring precipitation, and seedlings grew better over 5 yr than those planted in 1982. The slow recovery of competing vegetation and generally poor seedling growth on all treatments during both planting years are attributed to low soil fertility.

Ref ID : 203
203. McNabb, D.H. and Hobbs, S.D. Shallow tillage fails to increase 5-year growth of ponderosa pine seedlings. *Northwest Science* 63:241-245, 1989.
Keywords : Tillage; growth; pines; Seedlings; Forests; forest soils; soils; Skidders; tractors; Harvesting; Site preparation; Rippers; effects; performance; soil; ripping; Pinus; Pinus ponderosa; Oregon; spacing; furrows; bulk density; density; survival; Planting; Conifers; USA; site; machines; bare rooted
Notes : Forest soils can be compacted by rubber-tyred skidders and tracked tractors during timber harvesting and site preparation. Compacted soils are often tilled with machines pulling rock rippers to reduce the detrimental effects on seedling performance. The effects of soil ripping on the performance of ponderosa pine (Pinus ponderosa) was investigated in southwest Oregon. The rip-furrow spacing was 1.68 m. Seedlings were planted in the centre of the rip furrows and mid-way between the furrows in 1981. Bulk densities in the middle of the rip-furrows to depths of 20 cm were significantly less than those mid-way between furrows. A significant reduction in bulk density was limited to approximately 6% of the surface 30 cm of soil. Tillage did not increase growth of 2+0 bare-rooted seedlings of ponderosa pine planted in the rip-furrow compared with those planted midway between furrows. Survival was at least 96% on both planting locations. The results indicated that shallow tillage of soil was ineffective for improving the performance of well-planted seedlings.

Ref ID : 204
204. Mead, D.J. Response of young Pinus radiata to cultivation and fertiliser near Motueka, New Zealand. *New Zealand Journal of Forestry Science* 20:268-278, 1990.
Keywords : responses; Pinus; Pinus radiata; Cultivation; fertiliser; New; New Zealand; soil; Forests; effects; fertilizers; treatment; Site preparation; applications; superphosphate; Planting; growth; growth rate; application; Trees; volume; seasons; height; thinning; size; burning; Slash; ripping; discing; Conifers; boron; persistence; nitrogen; phosphorus; mechanical methods; nitrogen fertilizers; phosphorus fertilizers; Boron fertilizer; forestry; trials; soils; site; Theses; P
Notes : Two trials were carried out on infertile soils in the former Motueka State Forest to study the long-term effects of fertilizer treatments and site preparation. Heavy broadcast applications of superphosphate (112 kg P/ha at planting and 75 kg P/ha at 7 yr old) improved growth rates of Pinus radiata during the 11-year study period by two to three times over the untreated plots. However, even these rates were unable to maintain P concentrations at non-limiting levels for more

than a few years after application. Boron fertilizer prevented dieback, although there was no response in tree volume. Individual-tree doses of N fertilizer (17 g/tree) applied with P and B in the first two growing seasons, resulted in a 0.6-m height growth increase at 5 yr old compared with plots treated with P and B alone. However, a volume response was not detectable at 7 yr old. Application of 150 kg N/ha with P and B after thinning at 7 yr old led to a 12% volume increase at 11 yr old compared with the P plus B treatment. However, this was a short-term response. There was no response to N in the absence of P and B. Associated with the response to P were increases in branch size. Site preparation (applied after burning of crushed slash) by ripping to 0.75 m depth improved growth rates at 7 and 11 yr old; discing had no effect. The increase in volume as a result of ripping was 13 and 27 m3/ha at 7 and 11 yr old, respectively.

Ref ID : 205
205. Messina, M.G. and Barton, I.L. Early growth and survival of Acacia melanoxylon: effect of weed control and fertiliser. *New Zealand Journal of Forestry Science* 15:111-116, 1985.
Keywords : growth; survival; Acacia; effects; weed; weed control; control; fertiliser; weeds; herbicides; treatment; Cultivation; fertilizers; Fertilizer application; application; site; New Zealand; increment; P; superphosphate; Trees; interactions; responses; Acacia melanoxylon; potassium; urea; nitrogen; phosphorus; Site preparation; chemical treatment; mechanical methods; management; nitrogen fertilizers; phosphorus fertilizers; Forestry practices; New
Notes : The effects of pre-planting herbicide treatment and spade cultivation, and post-planting fertilizer application on early growth and survival of A. melanoxylon were studied for 3 yr at a site in northern New Zealand. Ht. and diam. increment responded linearly to increasing rates of P (applied as superphosphate) up to the max. rate applied, 30 g/tree P. N applied as urea (20 g/tree N) had no effect on ht. or diam. growth. Tree growth was unaffected by N X P and fertilizer X pre-planting treatment interactions. Mo, K and micronutrients did not significantly affect growth. Diam. and ht. growth showed positive responses to pre-planting treatment. Survival was not significantly affected by pre-planting treatment or fertilizer application.

Ref ID : 206
206. Mhando, M.L., Maliondo, S.M., and Mugasha, A.G. Early response of Eucalyptus saligna to site preparation and fertilisation at Sao Hill, Tanzania. *Forest Ecology and Management* 62:303-311, 1993.
Keywords : responses; Eucalyptus; site; Site preparation; Tanzania; Eucalyptus saligna; effects; survival; growth; Trees; treatment; boron; Tillage; roots; diameter; height; dieback; performance; Broadleaves; NPK fertilizers; fertilizers; mortality; Forest plantations; NPK; comparisons
Notes : The effect of site preparation and fertilization on survival and growth of Eucalyptus saligna over 4 years and 10 months in southern Tanzania is discussed. Percentage tree survival was not significantly affected by either treatment, ranging from 88 to 100%. However, addition of NPK or boron (B) to tillage treatments improved root collar diameter, diameter at breast height and height growth compared with unfertilized tillage treatments. In comparison, strip tillage with or without the addition of NPK increased incidence of tree terminal dieback. However, terminal dieback rate was not increased by complete tillage with or without addition of B. In general, results suggest that for improved initial performance of E. saligna at Sao Hill, complete tillage should replace strip tillage, and NPK be applied in addition to B.

Ref ID : 207
207. Minore, D. and Weatherly, H.G. Yarding-method and slash-treatment effects on compaction, humus, and variation in plantation soils. *Research Note Pacific Northwest Research Station, USDA Forest Service* No. PNW-RN-476, 6 pp:6 pp. 1988.
Keywords : effects; compaction; Humus; Variation; plantations; soils; soil; resistance; Tests; Oregon; Slash; treatment; Losses; tractors; burning; soil compaction; stumps; skidding; cable methods; damage; Logging; USA; Soil physics; Site preparation; methods; Theses; site; machines
Notes : Soil penetration resistance and soil humus frequency were measured on 86 progeny test plantations in SW Oregon in order to determine the effects of yarding method and slash treatment on these factors. A disturbance index was calculated for each plantation. Compaction and humus loss were more severe on tractor-yarded, machine-piled sites than on cable-yarded, broadcast-burned sites. On tractor-yarded sites, machine piling and burning of slash did not increase compaction or humus loss significantly more than broadcast burning. Within-site variation in soil compaction was greater on tractor-yarded, broadcast-burned plantations than on tractor-yarded sites from which stumps were removed.

Ref ID : 208
208. Minore, D. and Weatherly, H.G. Effects of site preparation on Douglas-fir seedling growth and survival. *Western Journal of Applied Forestry* 5:49-51, 1990.
Keywords : effects; site; Site preparation; Seedlings; seedling growth; growth; survival; treatment; burning; resistance; soil; Humus; plantations; Oregon; Slash; soil compaction; compaction; Losses; removal; quality; Trees; Conifers; mechanical methods; USA; Pseudotsuga menziesii; tractors; machines; Pseudotsuga; height; mechanical; soils; vegetation; site quality
Notes : The effects of 5 site preparation treatment combinations (A: cable yarding + broadcast burning - B: tractor yarding + broadcast burning - C: machine piling + broadcast burning - D: machine piling + off-site burning - and E: machine piling + off-site burning + tilling) on Douglas fir (Pseudotsuga menziesii) growth and survival were studied in

1984-87. Seedling height, potential seedling height, survival percentages, soil-penetration resistances, and occurrence of visible soil humus were evaluated on 149 progeny-test plantations in western Oregon. Survival was not improved by mechanical site preparation (survival at 5 years was 84.8% for treatment A, 73.7% for C and 78.1% for E). Seedlings grown on compacted soils with low humus, associated with piling slash off site, did not grow as tall during their first 5 years as seedlings grown on similar sites where slash had been broadcast-burned (height 77 cm for treatments D and E, compared to 93 cm for A). Mechanical site preparation was not essential for Douglas fir survival, as long as competing vegetation is controlled. Increased soil compaction, loss of humus, and reduced 5 year height growth associated with mechanized slash removal indicated detrimental effects on site quality as well as tree growth.

Ref ID : 209
209. Moffat, A.J., Armstrong, A.T., and Collyer, E.L. Site preparation for tree establishment on lowland clay soils. *Quarterly Journal of Forestry* 88:35-41, 1994.
Keywords : site; Site preparation; Trees; establishment; clay soils; soils; trials; effects; techniques; Cultivation; ploughs; ploughing; ridges; Planting; Fraxinus; Fraxinus excelsior; Grasses; Forests; UK; growth; soil; Soil water; soil water potential; water; weeds; weed competition; Waterlogging; winter; Broadleaves; Soil types; weed; competition
Notes : Results are reported from a trial to examine the effects of different ground preparation techniques (no cultivation, 2-m wide shallow plough cultivation, ploughing in 2 directions to create a single ridge 30 cm high) before planting ash (Fraxinus excelsior) 1+1 bare-root transplants on a heavy clay site under grass at the edge of Alice Holt Forest in Hampshire, UK. Tree growth and soil water potential were monitored for 2 yr. Growth was strongly related to soil water supply, intensity of weed competition, and soil cracking. Best tree growth occurred on ploughed soil; moisture deficits in summer retarded growth more than waterlogging in winter.

Ref ID : 210
210. Mohd.-Basri, H. and Nik-Muhamad, M. Effects of soil compaction on growth of three-year-old Acacia mangium Willd. stand in Setul, Negri Sembilan, Malaysia. *Malaysian Forester* publ. 1992?., 50:50X: 3, 250-257, 1987.
Keywords : effects; soil; soil compaction; compaction; growth; Acacia; Acacia mangium; Malaysia; Peninsular Malaysia; Site preparation; standards; spacing; treatment; applications; fertilizers; establishment; pruning; thinning; Trees; physical properties; height; diameter; bulk density; density; techniques; Broadleaves; Soil physics; increment; plantations; Silviculture; Logging; burning; mechanical methods; Forest plantations; site; manual; methods; mechanical; soil disturbance; determination; available
Notes : An A. mangium stand was established in undulating lowland south of Kuala Lumpur, Peninsular Malaysia, which included a former and compacted primary log-landing site (matau) of about 0.4 ha. Site preparation was the standard manual slash-and-burn method with no mechanical soil disturbance, except for the matau area which was ploughed once to about 30 cm depth. Spacing was 3X3 m. Silvicultural treatments included 2 applications of fertilizer (CIRP - Christmas Island Rock Phosphate applied at 170 g/plant), one at establishment (in April 1984) and the second 6 months later, and two prunings at 6 months and 2.5 years old. There was no thinning. Stand growth at 3 years old was assessed and soil sampled in 20X20 m plots, each with about 49 trees, for determination of selected physical properties. Three plots were located inside the matau and three outside it, but they were on comparable terrain and within the same soil series (Tropeptic Haplorthox). Height and diameter growth were significantly less on the matau site, and compaction, as indicated by bulk density, was greater by >35%. This corresponded to a total pore space reduction of about 30%. Available soil moisture content was, however, unaffected (6.7% on the matau site and 8.2% outside it). It is concluded that a more effective site preparation technique is required in soil compacted areas.

Ref ID : 211
211. Morris, L.A. and Lowery, R.F. Influence of site preparation on soil conditions affecting stand establishment and tree growth. *Southern Journal of Applied Forestry* 12:170-178, 1988.
Keywords : site; Site preparation; soil; stand establishment; establishment; Trees; growth; reviews; effects; burning; treatment; soil properties; pines; USA; discing; Conifers; ecology; Pinus 'Southern'; Tillage; mechanical methods; Southern States of USA; mechanical; chopping; windrowing; subsoiling
Notes : A review is given of studies on the effects of selected mechanical and burning site preparation treatments on soil properties that influence the establishment of pine [Pinus 'Southern'] in the S. USA. The data indicate that many common treatments, including chopping, shearing and windrowing have little value for improving soil conditions. Only discing, bedding and subsoiling are likely to have large positive effects on the soil and thus on tree growth.

Ref ID : 212
212. Morris, L.A. and Pritchett, W.L. Effects of site preparation on Pinus elliottii-P. palustris flatwoods forest soil properties. *General Technical Report, Pacific Northwest Forest and Range Experiment Station, USDA Forest Service* No. 163, 243-251; 16:243-251, 1983.
Keywords : effects; site; Site preparation; Pinus; Forests; forest soils; soil; soil properties; Pinus elliottii; ecosystems; organic matter; nutrients; storage; plantations; nitrogen; Theses; bulk density; density; soil temperature; temperature; soils; mineralization; seasons; Soil types; Physical properties of soil; Soil types ecological; physical properties; Forestry practices; Soil chemistry; Conferences; I.U.F.R.O.Symposium on Forest Site and Continuous Productivity; USA; Florida; Georgia; intensive; methods; chemical; organic; P

Notes : Results from three investigations in Pinus elliottii Engelm. -P. palustris Mill. flatwoods ecosystems were used to evaluate the effects of minimal disturbance and intensive methods of preplanting site preparation on physical, chemical and biological soil properties. Organic matter and nutrient concentrations of the mineral soil were only slightly altered by site preparation; however, forest floor nutrient storage was severely reduced in the intensively prepared (windrowed) plantations. Nitrogen, P, K, Ca and Mg contents of the forest floor were 19, 1, 1, 8 and 2 kg/ha, respectively, in the intensively prepared plantations. Storage of these nutrients in undisturbed forests and minimally disturbed plantations was at least ten times greater. Surface soil bulk density of intensively prepared plantations was slightly greater (0.1 g/cm3) than bulk density in minimally prepared plantations or undisturbed forests. Maximum soil temperatures at 10-cm depth were increased from 24_C in the undisturbed forest to 28_C and 32_C in the minimally and intensively prepared plantations, respectively. Surface soils of intensively prepared plantations were subject to larger moisture fluctuations and tended to be drier than the surface soils in either minimally prepared plantations or undisturbed forests. Increased soil temperatures and more pronounced wetting and drying cycles accelerated N mineralization in intensively prepared plantations. This accelerated mineralization appeared to cause a reduction in mineralizable N contents of the surface soil by the second growing season.

Ref ID : 213
213. Morris, L.A., Pritchett, W.L., and Swindel, B.F. Displacement of nutrients into windrows during site preparation of a flatwood forest. *Soil Science Society of America Journal* 47:591-594, 1983.
Keywords : nutrients; windrow; site; Site preparation; Forests; Slash; Pinus; Pinus elliottii; Pinus palustris; pines; Florida; soil; wood; P; Theses; nutrient reserves; LOSSES FROM SOIL; forest soils; site prepartion; Forestry practices; Losses; Cycling; relation to logging; mechanical methods; Conifers; USA
Notes : Nutrient displacement into windrows during site preparation, which followed the harvest of a natural stand of slash (Pinus elliottii Englm.) - longleaf (Pinus palustris Mill.) pine, was examined on a 36-ha flatwoods site in northcentral Florida. Almost 150 m of windrow were formed per hectare of site-prepared area. The average width of the windrows was 4.2 m. The windrows averaged 2.5 m2 in cross-sectional area and occupied approximately 6% of the harvested area. Total weight of the soil, fine wood, and coarse wood components were 154, 12, and 14 t/ha, respectively. Total N, P, and K contents were 373, 18, and 27 kg/ha of harvested area. These quantities of nutrients were equivalent to the quantities which would be removed in six bolewood harvests, and represented > 10% of the site's nutrient reserves.

Ref ID : 214
214. Morrison, D.(., Bloomberg, W.J., Wallis, G.W., Lee, Y.J., Siwecki, R., Thies, W.G., Russell, K.W., Pas, J.B., and Hood, I.A. Evaluation of impact - Advances in control. *Proceedings of the Sixth International Conference on Root and Butt Rots of Forest Trees* Victoria and Gympie,Queensland, Australi-31, 1983 [edited by, 1984.
Keywords : impact; control; roots; diseases; Losses; British Columbia; Forests; pines; Poland; coniferous forests; North America; Armillaria; effects; site; Site preparation; Pinus; Pinus radiata; New Zealand; root and butt rots; assessment; Canada,British Columbia; USA,Oregon; USA,Washington; Inonotus weirii; remote sensing; damage; photography; Pseudotsuga menziesii; Pinus sylvestris; Heterobasidion annosum; resistance; Tree breeding; Armillaria mellea; Conferences; Sixth International Conference on Root and Butt Rots of Forest Trees; Canada; USA; conversion; New
Notes : Five papers: Bloomberg, W.J. Surveying for root disease losses in British Columbia forests. 359-371 [10 ref., 1 pl.] Wallis, G.W.; Lee, Y.J. Detection of Phellinus [Inonotus] weirii using large-scale 70 mm aerial photography. 372-376 [10 ref.] In Douglas fir stands on southern Vancouver Is., British Columbia. Siwecki, R. Selection of Scots pine resistant to Fomes annosus/Fr./Cke. [Heterobasidion annosum]. 377-378. - In Poland. Thies, W.G.; Russell, K.W. Controlling root rots in coniferous forests of northwestern North America. 379-386 [33 ref.] Phellinus [Inonotus] weirii and Armillaria mellea. Pas, J.B. van der; Hood, I.A. The effect of site preparation on the incidence of Armillaria root rot in Pinus radiata four years after conversion from indigenous forest in Omataroa Forest, New Zealand. 387-397 [14 ref.].

Ref ID : 215
215. Morrison, I.K., Foster, N.W., and Hazlett, P.W. Carbon reserves, carbon cycling, and harvesting effects in three mature forest types in Canada. *Impacts of harvesting and site preparation on carbon cycling processes in forests* Scotland, 24-30 May:24-30 May 1992 [edited, 1993.
Keywords : carbon; Cycling; Harvesting; effects; Forests; types; Canada; ecosystems; Ontario; Distribution; pines; Pinus; Pinus banksiana; soil; Acer; Acer saccharum; Picea; Picea mariana; leaves; roots; Biomass; fruits; litter; Losses; Atmosphere; respiration; leaching; removal; impact; Site preparation; fertility; nutrients; growth; productivity; Forest litter; Logging; soil organic matter; whole tree logging; Conferences; Impacts of harvesting and site preparation on carbon cycling processes in forests; carbon cycle; Forest trees; site; organic; Upland; New; returns; methods; intensive
Notes : Three mature natural forest ecosystems on typical sites north and east of Lake Superior, Ontario, Canada, were contrasted in terms of their content and distribution of organic carbon (C). Total carbon reserves were lowest in a 62-year-old jack pine (Pinus banksiana) stand on a sandy outwash soil, highest in an old-growth (up to 300-year-old) sugar maple (Acer saccharum) stand on an upland till soil, and intermediate in a 110-year-old black spruce (Picea mariana) stand on a shallow upland till soil. Annual net carbon fixation was substantially higher in the sugar maple than in the jack pine stand. Allocation of assimilated carbon varied: in the sugar maple stand, greater amounts went to the formation of leaves and fine roots; in the jack pine stand, new carbon was apportioned in the order woody biomass > leaves > roots > flowers and fruits. Calculations of residence time (taking into account litter, fine root, and solution inputs)

suggest that turnover of carbon is approximately three times more rapid in the sugar maple than in the jack pine forest floor. Residual carbon (taking into account inputs, accretion and losses) for return to the atmosphere was likewise approximately three times greater in the sugar maple than in the jack pine forest floor. If not for respiration, all subsoil organic carbon could be accounted for by leaching inputs less outputs in approximately 100 years, indicating rapid turnover of carbon in the subsoil as well. Removal of carbon by different harvesting methods was calculated. In general, conventional (shortwood or tree-length) systems would result in removals of approximately 20% of the total (organic) carbon reserve from either the maple or the spruce site, with more intensive harvesting systems removing up to 32-35%. In contrast, conventional harvesting in the pine stand would remove approximately 33% of the total carbon, with more intensive regimes removing around 38-44%. The impact of site preparation method varied. Jack pine and black spruce sites could be susceptible to fertility loss as a result of full-tree harvesting because of the large amounts of carbon and nutrients stored in the forest floor rather than in the mineral soil.

Ref ID : 216
216. Mroz, G.D. and Berner.JF (Compilers) Artificial regeneration of conifers in the upper Great Lakes region 1982. *1983, 435 pp* Michigan, USA; Michi:USA, 1983.
Keywords : Artificial regeneration; regeneration; Conifers; regions; Wisconsin; Forests; forestry; Michigan; site; Site preparation; production; Planting; plantations; maintenance; Conferences; Artificial regeneration of conifers in the Upper Great Lakes region 1982; USA
Notes : Proceedings of a symposium held in Oct. 1982 at Green Bay, Wisconsin, sponsored by Mead Paper, Champion International, the USDA Forest Service and the School of Forestry, Michigan Technological University. There are 44 papers on topics including site evaluation, species selection, site preparation, stock production, planting and seeding, early plantation maintenance, and future considerations.

Ref ID : 217
217. Murav'ev, S.A. Changes in the agrophysical properties of soddy, medium-podzolic clayloam soils when they are prepared for forest plantations. *1964, Lesn* Arhangel'sk 7 (4), 1:1964 (21-4).X, 1964.
Keywords : soils; Forests; Forest plantations; plantations; ploughing; stumps; stump removal; removal; chemical; chemical properties; soil; mechanized; Cultivation; soil compaction; compaction; P; ploughs; environment; furrows; survival; roots; development; pines; Norway; Picea abies planting site preparation; Pinus sylvestris planting site preparation; regeneration; Regeneration,artificial; Regeneration site preparation machines for; Regeneration site preparation removal of roots; Regeneration site preparation stump removal; Silviculture; Soils chemistry effect of cultivation
Notes : An area of Spruce/Birch/Aspen was felled in 1953 and prepared in 1958 by ploughing or by clearing large patches (6.8 sq. m.) with a root-rake; another area felled in 1959 was prepared in 1960 by ploughing, with or without preliminary stump removal. Study of the physical and chemical properties of the top 25-cm. layer of soil showed that mechanized cultivation signicantly reduced soil compaction and the content of mobile Al, while increasing the contents of K, P and N. The plough slice forms a better micro-environment than the furrow bottom or the large patches, and survival and root development of Scots Pine and Norway Spruce were much better on the plough slice.

Ref ID : 218
218. Murray, M.(., Packee, E.C., Pfister, R.D., Draper, D.A., Hamilton, E.H., Viereck, L.A., Dyrness, C.T., Cleve, K., Zasada, J.C., Corns, I.G.W., Annas, R.M., and Stahl, P.H. Forest classification at high latitudes as an aid to regeneration. Proceedings of a fifth international workshop. *General Technical Report, Pacific Northwest Forest and Range Experiment Station, USDA Forest Service* No. PNW-177, 56 pp.;56 pp. 1984.
Keywords : Forests; classification; regeneration; Alaska; forestry; Forest management; management; development; models; succession; vegetation; site; productivity; floodplains; Alberta; application; Site preparation; methods; Vegetation types; boreal forest; North America; Conferences; Forest classification at high latitudes as an aid to regeneration; site class assessment; USA,Alaska; ecology; seral stages; natural regeneration; site factors; Artificial regeneration; USA; land
Notes : Contains 7 papers given at the workshop held in Aug. 1983 sponsored by the School of Agriculture and Land Resources, University of Alaska in cooperation with the Alaska Division of Forestry and the Alaska State Society of American Foresters: Packee, E.C. An ecological approach to forest management. 5-15 [20 ref.] Pfister, R.D. Development and use of an ecological classification system. 16-19 [7 ref.] Draper, D.A.; Hamilton, E.H. The importance of predictive models of forest succession to silvicultural management. 20-24 [31 ref.] Viereck, L.A.; Dyrness, C.T.; Cleve, K. van. Potential use of the Alaska vegetation system as an indicator of forest site productivity in interior Alaska 25-34 [8 ref.] Zasada, J.C. Site classification and regeneration practices on floodplain sites in interior Alaska 35-39 [14 ref.] Corns, I.G.W.; Annas, R.M. Ecological classification of Alberta forests and its application for forest management. 40-52 [41 ref.] Stahl, P.H. How to choose site preparation methods based on site classification 53-56 [2 ref.].

Ref ID : 219
219. Nambiar, E.K.S. and Cellier, K.M. Nitrogen fertilisers in establishing Pinus radiata plantations on sandy soils: an evaluation of their use. *Australian Forestry* 48:242-251, 1985.
Keywords : nitrogen; fertiliser; Pinus; Pinus radiata; plantations; sandy soils; soils; analysis; fertilizers; Fertilizer

application; application; P; South Australia; Australia; Victoria; responses; age; Theses; growth; control; weeds; organic matter; site; availability; Trees; methods; leaching; Losses; roots; Distribution; pines; Australia,South Australia; Australia,Victoria; Plant nutrition; nitrogen fertilizers; Soil types textural; organic
Notes : An analysis was made of results of experiments on N fertilizer application in P. radiata stands on sandy soils in SE South Australia and W. Victoria. Only 2 out of 10 experiments showed a significant response to applied N after age 2 yr, and it is doubtful whether these increases in growth would be sustained through to maturity. The control of weeds and the organic matter left after site preparation appeared to be the two most important factors determining N availability and therefore the response of trees to applied N. Methods of applying fertilizers should take account of potential leaching losses and the root distribution of the young pines.

Ref ID : 220
220. Neary, D.G., Morris, L.A., and Swindel, B.F. Site preparation and nutrient management in southern pine forests. *Forest soils and treatment impacts* Sixth North American:University of Tennes-144, 1984.
Keywords : site; Site preparation; nutrients; management; pines; Forests; intensive silviculture; Silviculture; USA; methods; windrowing; productivity; soil; litter; Logging; reviews; Losses; ecosystems; interactions; Upland; Conferences; Forest soils and treatment impacts; Pinus 'Southern'; Soil chemistry; Pinus; Cycling; burning; chemical treatment; mechanical methods; Soil fertility; Southern States; responses; Forestry practices; intensive
Notes : Site preparation is an integral part of intensive silviculture of pines in southern USA, but the methods used, e.g. windrowing and piling, have been implicated in the long-term decline in productivity. Soil and litter redistribution can displace several times the amounts of nutrients removed by conventional logging. A review is given of studies of the major mechanisms affecting nutrient losses from forest ecosystems and of the interaction between major soil nutrients and site preparation methods. The nutrients balance data are integrated into a procedure for predicting changes in site productivity in Coast Plain flatwoods and wet mineral flats and Piedmont uplands.

Ref ID : 221
221. Neustein, S.A. Slash disposal for regeneration. *1967, Proc* Munich 1967 Pt. IV,Sect. 23, 1967 (456-64). [10 refs.].X, 1967.
Keywords : Slash; disposal; regeneration; trials; forestry; Forestry Commission; Afforestation; burning; Larix; Larix decidua; Pinus; costs; crops; Larix decidua planting site preparation; Larix decidua slash disposal; Larix leptolepis planting in slash; Larix leptolepis slash disposal; Picea sitchensis planting in slash; Picea sitchensis slash disposal; Pinus sylvestris planting in slash; Pinus sylvestris planting site preparation; Pinus sylvestris slash disposal; Planting; Planting,in fresh slash; Silviculture; Slash effect on planting costs; Pinus sylvestris
Notes : From the work described and previous small-scale trials and field experience of the U.K. Forestry Commission, it is concluded that replanting through evenly distributed, untouched slash is much cheaper than would be expected by foresters whose main experience has been in the afforestation of bare ground. Sitka Spruce slash presents the greatest hindrance, but even when it is still green, replanting through it is cheaper than treating it in any way other than in situ burning, which is probably not feasible in small-scale operations. Larix decidua and L. leptolepis slash present very little hindrance, and even the roughest Pinus sylvestris slash results in replanting costs only 3/4 of those for Sitka Spruce. Adequate stocking of the replanted crop can be achieved.

Ref ID : 222
222. Nyland, R.D., Leaf, A.L., and Bickelhaupt, D.H. Litter removal impairs growth of direct-seeded Norway spruce. *Forest Science* 25:244-246, 1979.
Keywords : litter; removal; growth; Norway; Slash; pines; Pinus; Pinus resinosa; plantations; measurement; comparisons; Seedlings; P; Mn; Picea abies; Humus; increment; foliage; chemistry; Forest litter; Soil morphological features; horizons; responses; Forestry practices; Site preparation; nutrient uptake by plants; New; USA; New York
Notes : Norway spruce was broadcast sown on 10- X 20-m plots from which slash and litter had been removed, on a former 35-yr-old red pine (Pinus resinosa) plantation in eastern New York. After 9 yr, measurements of ht. and of length and wt. of lateral terminals in the outer 2-m zone, and in the centre of the plots, showed significantly less growth in the central zone. In comparison, growth of seedlings in narrow 1.2- X 5-m scarified plots was not impaired. Foliar analyses showed significantly less N, P, K, Ca, Mn, and Fe, in the seedlings in the central zone of the plots.

Ref ID : 223
223. Orlander, G. Effect of planting and scarification on the water relations in planted seedlings of Scots pine. *Studia Forestalia Suecica* No. 173, 17pp.; 39 r:17pp. 1986.
Keywords : effects; Planting; scarification; water; water relations; Seedlings; pines; plant; Sweden; soil; mounds; Humus; control; water stress; water uptake; uptake; treatment; Site preparation; mechanical methods; Pinus sylvestris; Plant water relations; Pinus; types; Forestry practices; site
Notes : Needle conductance, needle potential and plant water conductance were measured for 4 yr in seedlings at four sites in Sweden planted in soil prepared in 4 ways: (a) scarified patch, (b) mound of mineral soil on scarified patch, (c) mound of mineral soil on upturned humus, and (d) untreated. Established naturally regenerated seedlings at the same sites were selected as controls. Planted seedlings suffered from water stress (plant water conductances only 2-46% those of controls), and water uptake was reduced for several years after planting. Treatments (a) and (b) were more

effective than (c) or (d).

Ref ID : 224
224. Orlander, G., Gemmel, P., and Hunt, J. Site preparation: a Swedish overview. *FRDA Report Victoria, B* No. 105, vi + 62 pp.vi + 62 pp. 1990.
Keywords : site; Site preparation; aspect; forestry; Sweden; British Columbia; survival; growth; Seedlings; mortality; site types; types; natural regeneration; regeneration; Direct sowing; sowing; effects; reviews; increment; Forests; productivity; Canada; reforestation; methods
Notes : A translation of a Swedish publication (Sveriges Skogsvardsforbunds Tidskrift (1989) No. 3) on the biological aspects of site preparation. A brief introduction has been added to compare forestry conditions in Sweden and British Columbia. Eight chapters cover special problems with reforestation, factors affecting survival and growth of seedlings, mortality causes, site preparation methods, special site types, seedling stock, natural regeneration vs direct sowing, and long-term effects of site preparation.

Ref ID : 225
225. Outcalt, K.W. Influence of bed height on the growth of slash and loblolly pine on a Leon fine sand in northeast Florida. *Southern Journal of Applied Forestry* 8:29-31, 1984.
Keywords : height; growth; Slash; pines; Florida; Seedlings; site; discing; treatment; yields; wood; increment; diameter; Pinus; volume; Pinus taeda; Planting; planting methods; USA,Florida; Pinus elliottii; Site preparation; mechanical methods; USA
Notes : Genetically improved seedlings were planted in March 1972 on a flatwoods site, which had received discing, low bedding, or high bedding treatments. After 10 yr, there was n.s.d. in slash pine growth in disced or low bedded plots, although high bedding produced greater vol. growth. Loblolly pine responded more, showing a clear trend of increasing growth and yield with higher beds. Slash pine produced more wood vol. than loblolly pine on disced plots. There were no species differences on low bedded plots, but loblolly pine produced a greater vol. on high bedded plots.

Ref ID : 226
226. Outcalt, K.W. Establishing Choctawhatchee sand pine using strip site preparation. *Southern Journal of Applied Forestry* 12:178-181, 1988.
Keywords : pines; site; Site preparation; Pinus; Broadleaves; Georgia; USA; Planting; discing; age; plantations; diameter; fires; treatment; costs; Conifers; Pinus clausa; Economics; mechanical methods; tractors; machines; chopping; survival; height; fire; methods
Notes : Choctawhatchee sand pine (Pinus clausa var. immuginata) was planted in 1973 and 1974 on 2 sandhills sites with low-quality broadleaves in Georgia, USA. The sites had received strip site preparation in July 1972 with a V-blade on the front of the tractor pulling the planting machine, with a KG-blade or by chopping and discing. Survival to age 5 was better in the 1974 than in the 1973 plantation. Survival, diameter, height and volume/acre at age 11 in the 1974 plantation (the 1973 plantation was destroyed by fire) were not significantly different between methods of strip preparation. Overall, the minimum treatment, where a V-blade was used on the tractor pulling the planting machine, performed best and was cheapest because no separate site preparation costs were involved (planting costs were the same in all treatments).

Ref ID : 227
227. Outcalt, K.W. and Brendemuehl, R.H. Sand pine survival and growth on prepared and unprepared sites. *Southern Journal of Applied Forestry* 8:96-99, 1984.
Keywords : pines; survival; growth; site; Pinus; Pinus clausa; P; chopping; scrub; Florida; Trees; stems; Site preparation; mechanical methods; Pinus clausa immuginata; increment; volume; diameter; height; USA,Florida; USA
Notes : Ocala sand pine (Pinus clausa var. clausa) and Choctawhatchee sand pine (P. clausa var. immuginata) were planted in Jan.-Feb. 1969 on sites prepared by double chopping and on unprepared sites in scrub oak stands in the sandhills of NW Florida. Trees were measured and survival recorded at 1, 2, 3, 5, 9 and 10 yr old. Although survival was lower on unprepared plots, both varieties still had acceptable stocking at 10 yr old. Chopping, however, increased ht., diam., and vol. growth. Total stem vol./acre was 3-4 X greater on chopped sites after 10 yr.

Ref ID : 228
228. Ovington, J.D., Waring, H.D., Florence, R.G., Tanton, M.T., Hopkins, E., Campbell, K.G., Shepherd, K.R., Hill, L., Stewart, J.P., Bachelard, E.P., Dexter, B.D., Gentle, S.W., and Brown Papers presented to the Pinus radiata Symposium, Department of Forestry, Australian National University, Canberra, 25 - 28 August, 1970. Volumes 1 & 2. *1971, 296 pp* Australia, Australia:Australian National, 1971.
Keywords : Pinus; Pinus radiata; forestry; volume; aspect; biology; pines; plantations; soil; P; litter; decomposition; nutrients; communities; site; diseases; Insects; Australia; reviews; establishment; techniques; Nurseries; Site preparation; weed; weed control; control; fertilizers; technology; improvement; quality; Trees; Tree breeding; cultural; thinning; pruning; development; Economics; profitability; costs; returns; Losses; woody weeds; weeds; Harvesting; Silviculture; size; effects; transport; Forests; case studies; Tasmania; mosses; wood; management; methods; yields; application; South Australia; simulation; Logging; roads; requirements; Forest plantations; conversion; materials;

research; extension; extension services; Reports; investment; policy; multiple use; general information; Conifers; radiata pine
Notes : A collection of 55 papers divided by subject into 12 sessions; all references are listed in alphabetical order at the end of Vol. 2. (1) Some aspects of the biology of Radiata Pine [RP] plantations (J.D. Ovington); Some soil relationships of P. radiata [P.r.] (H.D. Waring); Litter decomposition and nutrient release in P.r. plantations (R.G. Florence); The biological community (M.T. Tanton); Significance of site in areas marginal for P.r. (E. Hopkins); and Disease and insect problems in exotic Pinus spp. plantations in south-eastern Australia, with particular reference to P. radiata D. Don (K.G. Campbell). (2) A review of plantation establishment techniques for RP (K.R. Shepherd); Nursery technique (L. Hill); Site preparation (J.P. Stewart); Weed control (E.P. Bachelard and B.D. Dexter); and Fertilizer technology - P.r. (S.W. Gentle). (3) Improvement in log quality : a review (A.G. Brown); The improvement of P.r. through tree breeding (L. Pederick); The improvement of log quality through cultural techniques (W.G. Forrest); Value resulting from cultural techniques of thinning and pruning (N. Humphreys); Site and silvicultural influences on log quality in RP (J.P. Wright); and Development of sawlog regimes for RP (E.H. Bunn). (4) Economics of silvicultural operations (N.B. Lewis); Estimating the profitability of silvicultural operations : costs, returns and the price of time (A.J. Watt); Economic appraisal of losses due to herbaceous and woody weeds (J.G. Jack); and Harvesting implications to silviculture (T.D. Blight). (5) Plantation location (G.S. Lugton); The economics of plantation size and location (A.G. Hanson); Effects of transport costs on plantation location (J.W. Way); Integrated forest industries (M.W. Edgerley); and A case study : criteria for location of plantations in Tasmania (P.T. Unwin). (6) Existing and potential markets for RP : a review (R.W. Muncey); Preservation as it applies to the present and future progress of the RP plantation industry in Australia (J.S. Moss); Existing and potential markets for coniferous wood and fibre (E.D. Parkes); and Consumer preferences for different wood and non-wood products (N. Ladkin). (7) Analytical aids for management (L.T. Carron) [discusses methods of yield determination]; Plantation management for the seventies : objectives and methods (B.F. Gibson) [optimization by simulation]; Analytical aids to management and their application to industry (M.J. Hall) [yield forecasting]; Regulation of yield with particular reference to South Australia (A. Keeves); and Some considerations of spatial pattern for the simulation of initial stand structure in thinning studies (M.R. Rudra). (8) Logging systems (K.W. Groves); Road requirements for harvesting forest plantations (D.M. Stodart); Logging pulpwood (M. Goudie); and Harvesting Radiata logs (C.M. Kerruish). (9) Log conversion and utilisation : a review (W. Gottstein); Structural plywood (P. Moglia); Particle board (P. McConchie); and Log conversion and utilisation - RP sawn timber (J.M. Willington). (10) Pinus structural plywood (C.D. McPhail and J.G. Easterbrook); The end uses of particleboard (R.E. Schmierer); and Sawn RP as a structural material (B. Rumball). (11) Research, marketing and extension (D. Barnes); Research, marketing, and extension services - Government [sector] (E.B. Huddleston); Research and extension services in Universities (A. Davies); and RP research, marketing and extension - industry (E.J. Roughana) [describes the work of the RP Association of Australia on behalf of the RP industry in South Australia, and includes a list of planned technical publications and a critical report (by D. Barnes and N. Ladkin) on forest products research effort in Australia]. (12) Investment in RP (D.A.N. Cromer); Private investment and industry policies (W.G. Chandler); The policy background to the softwood plantation programme (C.S. Cree); The multiple use of P.r. plantations (R.W. Boden); and Opportunities for small scale investment in RP plantations (P. Britton).

Ref ID : 229
229. Page, H.H.,Jr. Six-year growth response of longleaf pine (Pinus palustris Mill) seedlings to varying intensities of site preparation treatments. *Forestry Research Report Smurfit Group, plc* No. 4, 10 pp.; 4 ref:10 pp. 1990.
Keywords : growth; responses; pines; Pinus; Pinus palustris; Seedlings; site; treatment; Site preparation; Florida; effects; fertilizers; application; control; performance; techniques; burning; Theses; improvement; age; Trees; height; diameter; volume; Broadleaves; USA; mechanical methods; weed control; nitrogen; phosphorus; plantations; woody weeds; cultural control; weeds; plant competition; growth rate; trials; intensive; Fertilizer application; diammonium phosphate; competition; chopping
Notes : A trial was established in northern Santa Rosa County, Florida, in 1983 to determine the effects of intensive site preparation (bedding), fertilizer application (diammonium phosphate) and competition control (woody and non-woody) on the performance of Pinus palustris. The underlying site preparation technique was shearing and raking on 4 replicates and chopping and burning on 2. The effects of these factors could not be tested directly, but did not appear to alter the responses. Five treatment combinations produced significant improvements over the untreated plots at age 6 for all tree growth responses, ie. height, diameter at breast height, basal area/tree and volume index/tree. Plots that received bedding or fertilizer application alone did not produce better growth than untreated plots. All treatments that included competition control gave significant growth gains. Only treatments including both fertilizer application and competition control produced greater height growth than no treatment from age 4 to age 6.

Ref ID : 230
230. Page-Dumroese, D. Susceptibility of volcanic ash-influenced soil on northern Idaho to mechanical compaction. *Intermountain Research Station, USDA Forest Service* Research Note INT-40, 1993.
Keywords : soil; Idaho; mechanical; compaction; Harvesting; site; Site preparation; productivity; soils; density; effects; bulk density; Forests; forest soils; organic; organic matter; Logging; Slash; growth; impact; depletion; soil compaction; stand development; development; forest productivity; ash-cap soils; logging effects; soil density; site productivity
Notes : Timber harvesting and mechanical site preparation can reduce site productivity if they excessively disturb or

compact the soil. Volcanic ash-influenced soils with low undisturbed bulk densities and rock content are particularly susceptible. This study evaluates the effects of harvesting and site preparation on changes in the bulk density of ash-influenced forest soils in northern Idaho. Three different levels of surface organic matter were studied. Soil samples were taken before and after harvesting to determine the extent and depth of compaction. Soil bulk densities increased significantly after extensive compaction from site preparation, especially where little logging slash and surface organic matter were left on the soil surface. As site preparation intensity increased, bulk density increased significantly at greater depths in the soil profile. Although ash-influenced soils have naturally low bulk densities, they can easily be compacted at levels that limit growth. This experimental site has been designated as part of the Forest Service's long-term site productivity study into the impacts of organic matter depletion and soil compaction on stand development.

Ref ID : 231
231. Page-Dumroese, D.S., Jurgensen, M.F., Graham, R.T., and Harvey, A.E. Soil chemical properties of raised planting beds in northern Idaho forest. *Research Paper Intermountain Research Station, USDA Forest Service* No. INT-419, i + 7 p:i + 7 pp. 1989.
Keywords : soil; chemical; chemical properties; Planting; Idaho; Forests; Logging; organic matter; habitats; types; altitude; nutrients; treatment; Site preparation; mounds; Soil chemistry; USA; activity; organic; site
Notes : Following logging activities, surface organic matter and mineral soil were mounded mechanically to form raised planting beds on 2 widely different habitat types at low and high altitudes in Idaho. Soil nutrient concentrations of the planting beds were compared with both scalped and undisturbed treatments on each site at various times of year.

Ref ID : 232
232. Page-Dumroese-DS, Jurgensen-MF, Graham-RT, and Harvey-AE Soil physical properties of raised planting beds in a northern Idaho forest. *Research Paper, Intermountain Research Station, USDA Forest Service* No. INT-360, 6pp.; 2:6pp. 1986.
Keywords : soil; soil physical properties; physical properties; Planting; Idaho; Forests; Site preparation; techniques; density; organic matter; effects; storage; water; nutrients; forest soils; mechanical methods; Soil water; Soil physics; temperature; Soil chemistry; carbon; forestry; USA; mounding; organic; site; scarification; bulk density; treatment; Seedlings; seedling growth; growth; survival
Notes : Raised planting beds (prepared by mounding organic matter and mineral soil) were compared with conventional site preparation techniques (scalping or scarification) in terms of bulk density, temp., m.c. and organic matter content of the soil at 2 sites at different alt. and with a range of environmental conditions. Organic matter content and soil moisture were greater, while bulk density was less, in the mounded and scarified treatments than in the scalped treatment. Mounding had little effect on soil temp. It is hoped that mounding will increase storage of water and nutrients in most forest soil, thus improving seedling growth and survival.

Ref ID : 233
233. Paivanen, J. Strategies for amelioration on poor sites [based on experience in N. Europe]. *Ford, E* D. C.; Atterson, J.J. (Editors)X: The e-aged forest plantati, 1979.
Keywords : site; amelioration of forest sites; Europe,northern; Site preparation; drainage,land; Europe

Ref ID : 234
234. Palmgren, K. Microbiological changes in forest soil following soil preparation and liming. *Folia Forestalia, Institutum Forestale Fenniae* No. 603, 27 pp.; 49:27 pp. 1984.
Keywords : Forests; forest soils; soil; soil preparation; pH; nutrients; nutrient content; survival; growth; pines; Finland; Tests; methods; site; Site preparation; lime; Trees; Pinus sylvestris; fertilizers; Tillage; basic slag; calcium; mechanical methods; Soil biology; microorganisms; Soil chemistry; Pinus; liming materials; Soil types ecological; Forestry practices; responses
Notes : Results are given of qualitative and quantitative changes in the microflora, changes in the pH and nutrient content of the soil, and the survival and growth of Scots pine in 2 studies in Finland: - (1) established in 1967 (sampled in 1977) to test 4 methods of site preparation and fertilization with lime; and (2) established in 1972-3 (soil sampled in 1973, trees inventoried in 1984) to test 2 further methods of site preparation and fertilization with basic slag.

Ref ID : 235
235. Parke, J.L., Linderman, R.G., and Trappe, J.M. Effects of forest litter on mycorrhiza development and growth of Douglas-fir and western red cedar seedlings. *Canadian Journal of Forest Research* 13:666-671, 1983.
Keywords : effects; Forests; Forest litter; litter; development; growth; Seedlings; regeneration; site; Conifers; Planting; Slash; burning; removal; soil; soil organic matter; organic matter; forest soils; soils; Thuja; Thuja plicata; mycorrhizas; types; Humus; Fungi; nutrients; Theses; activity; mycorrhizal fungi; ecology; USA,Oregon; Pseudotsuga menziesii; Soil biology; Site preparation; Soil morphological features; Forestry practices; USA; Oregon; slash burning; organic; amendments
Notes : Preparation of forest regeneration sites for conifer planting often includes slash burning or physical removal of soil organic matter. Experiments were conducted to determine if organic matter contributes to the mycorrhizal fungus inoculum potential in forest soils and to compare the growth of Douglas fir and western red cedar (Thuja plicata) in

untreated or pasteurized soils from undisturbed or cleared and burned forest sites with and without addition of untreated or pasteurized litter. Mycorrhizas were abundant on Douglas fir seedlings grown in undisturbed forest soil but developed similarly on red cedar seedlings in either type of soil. Litter and humus were found to include inoculum of both vesicular-arbuscular (VA) and ectomycorrhizal fungi. Litter amendment usually enhanced growth of host seedlings, but growth enhancement could not be fully attributed to addition of mycorrhizal inoculum or nutrients provided by litter. These findings suggested that other biological factors stimulated the growth of conifer seedlings and (or) activity of mycorrhizal fungi.

Ref ID : 236
236. Payandeh, B. and Sutton, R.F. Modeling early plantation performance: identification of critical factors. *Scandinavian Journal of Forest Research* 4:75-86, 1989.
Keywords : plantations; performance; Picea; Picea mariana; Picea glauca; pines; Pinus; Pinus banksiana; Ontario; Canada; analysis; treatment; provenance; Seedlings; NPK fertilizers; fertilizers; application; Planting; Trees; growth; Planting stock; age; Site preparation; Conifers; stand establishment; Stand characteristics; types; mechanization; mechanical methods; regression analysis; models; machines; furrows; light; NPK; Fertilizer application; height; survival; equations; site; Fertilizing
Notes : Four-year data (1973-77) on spring outplanted black spruce (Picea mariana), white spruce (Picea glauca) and jack pine (Pinus banksiana) in Ontario, Canada, (described more fully in an earlier paper) were subjected to stepwise multiple linear regression analysis with mixed models containing both continuous and categorical variables. Several treatments had been imposed on two provenances of seedlings of each species, including machine-and hand-planting in furrows or hand-planting on untreated ground, and heavy, light, or no NPK fertilizer application immediately after planting. Furrow depth, initial height, verticality, and direction of lean of each newly planted tree, and first- to fourth-year survival, growth, and condition were recorded. For each species, survival and total height equations are tabulated to show the proportion of variability explained by qualitative variables (site and stock factors), planting stock characters, and plantation age. Age accounted for 13-92% of the total variability in survival and growth. Planting without site preparation and heavy fertilizing were both significantly detrimental to survival and growth, but light fertilizing was sometimes beneficial. Provenance had little or no influence on results.

Ref ID : 237
237. Pehl, C.E. Site preparation influences on young loblolly pine plantations in east Texas. *Southern Journal of Applied Forestry* 7:140-145, 1983.
Keywords : site; Site preparation; pines; plantations; Texas; stems; Logging; Slash; Pinus; Pinus taeda; foliage; wood; soils; productivity; soil; bulk density; density; treatment; analysis; Variation; chemistry; mechanical methods; burning; Soil chemistry; nutrient contents; Soil physics; Chemical constituents of plants; major elements; USA,Texas; Forestry practices; nutrients; Soil types; forest soils; USA; windrow
Notes : Study plots were clear felled in 1972 and prepared in 1974 as follows: (a) all stems over 1 inch in d.b.h. were felled and left on site; (b) all stems over 1 inch d.b.h. were felled and burned; (c) logging slash and standing stems were chopped and burned in 1972, and rechopped in 1974; and (d) stems and logging slash were piled into windrows off the plot, which was disced. Plots were planted with Pinus taeda in spring 1974. After 5 yr, trees/acre, d.b.h., and total ht. were recorded. Foliage, stem wood and soils were sampled. There were n.s.d. in productivity or soil bulk density between treatments. Analysis of variance showed that ht. variation was more influenced by soil than treatment. Total soil N, extractable Ca and K for treatment (b) were significantly higher than in (d) but n.s.d. from (a) and (c). There were n.s.d. in foliage chemistry, but the Ca content of stemwood in (d) was significantly lower than (c) although n.s.d. from (a) or (b).

Ref ID : 238
238. Pehl, C.E. Residual effects of site preparation on growth and surface soil properties of Pinus taeda L. plantations. *Forest Ecology and Management* 9:1-11, 1984.
Keywords : effects; site; Site preparation; growth; soil; soil properties; Pinus; Pinus taeda; plantations; treatment; leaves; discs; soils; Texas; bulk density; density; organic matter; nitrogen; P; discing; nutrients; Trees; stand development; development; height; stems; size; USA,Texas; mechanical methods; burning; Forestry practices; Soil chemistry; USA; organic
Notes : After 5 yr, four site preparation treatments: (1) cut and leave; (2) cut, leave and burn; (3) chop and burn; (4) shear, pile, burn and disc; on three soils in eastern Texas were evaluated by determining soil bulk density, organic matter, total nitrogen and extractable P, K, Mg, Ca and foliar P, K, Ca and Mg concentrations. Surface soil (0-8 cm) properties did not vary significantly except for N and Ca concentrations which were lowest for soils in (4); increased N and Ca concentrations below the 0-8 cm depth indicated the lower surface concentrations were a residual effect of discing. Foliar nutrient concentrations did not differ significantly except for foliar N concentrations which were lower for trees in (4). Residual treatment effects on stand development were evaluated by measuring fifth year stand density, d.b.h. and total height. Although the parameters were not significantly different, stands in (4) tended to have more stems of larger size than the other treatments.

Ref ID : 239
239. Pehl-CE and Shellnutt-HE Jr. Forest floor and soil nutrient conditions in the Georgia Sandhills. *Georgia Forest*

Research Paper No. 62, 11 pp.; 24 r:11 pp. 1986.
Keywords : Forests; soil; nutrients; Georgia; Slash; pines; plantations; Turkey; Site preparation; herbicides; Forest litter; Soil chemistry; site types; mechanical methods; chemical treatment; USA; scrub; nutrient cycles; site; methods; soil disturbance; chopping
Notes : The forest floor and soil were sampled beneath a 22-yr-old slash pine [Pinus elliottii] plantation and an adjacent scrub oak association (predominantly turkey oak [Quercus laevis] with scattered longleaf pine [P. palustris]). Concentrations of nutrients in the forest floor and the relatively small values for soil extractable nutrients indicated the importance of the forest floor to the nutrient cycle on excessively drained Sandhill sites. Site preparation methods that minimize surface soil disturbance, e.g. chopping or herbicides, are recommended for such sites.

Ref ID : 240
240. Perry, D.A., Meyer, M.M., Egeland, D., Rose, S.L., and Pilz, D. Seedling growth and mycorrhizal formation in clearcut and adjacent, undisturbed soils in Montana: a greenhouse bioassay. *Forest Ecology and Management* 4:261-273, 1982.
Keywords : Seedlings; seedling growth; growth; soils; Montana; pines; soil; Logging; Slash; bulldozers; Forests; roots; effects; treatment; fertilizers; size; clear felling; nutrient cycle; Site preparation; mechanical methods; burning; growth and development; Soil water; Pinus; Picea; Pseudotsuga menziesii; Forestry practices; responses; seedling emergence; water relations
Notes : Seedlings, including those of lodgepole pine, Douglas fir and Engelmann spruce, were grown in soil from areas logged 13-16 yr previously in which logging slash was windrowed by bulldozers (W), or windrowed by hand and burned (B), or in soil from adjacent, undisturbed forest (U). In general, seedlings in (W) or (B) were shorter and had fewer root tips than those in (U); effects on seedling weight were consistent. Treatment with N fertilizers eliminated size differences due to soil source.

Ref ID : 241
241. Perry, D.A., Molina, R., and Amaranthus, M.P. Mycorrhizae, mycorrhizospheres, and reforestation: current knowledge and research needs. *Canadian Journal of Forest Research* 17:929-940, 1987.
Keywords : reforestation; research; Site preparation; reviews; technology; Nurseries; interactions; mycorrhizal fungi; Fungi; environment; Trees; Seedlings; rhizosphere; roles; mycorrhizas; ecosystems; nutrients; Cycling; soil; Soil structure; plant; Conferences; Roots in forest soils: biology and symbioses; ecology; forestry; site; inoculation; plants
Notes : A discussion of the influence of harvest and site preparation on mycorrhiza formation and of the influence of mycorrhiza formation on reforestation success is followed by a review of inoculation technology in nurseries. Finally, 3 broad areas of research are discussed: interactions between mycorrhizal fungi and the environment; interactions between tree seedlings and processes occuring within the rhizosphere or mycorrhizosphere; and the role of mycorrhizas and associated organisms in ecosystem processes, e.g. nutrient cycling, soil structure and interactions between plants.

Ref ID : 242
242. Pfeifer, A.R. Factors that contribute to basal sweep in lodgepole pine. *Irish Forestry* 39:7-16, 1982.
Keywords : sweep; pines; deformation; roots; root systems; Trees; Planting; site; ploughing; natural regeneration; regeneration; Nurseries; containers; Direct sowing; sowing; Cultivation; stem forms; crook and sweep Pinus contorta; deformation Pinus contorta; use of containers; conditioning Pinus contorta; Site preparation; mechanical methods Pinus contorta; planting methods Pinus contorta; Irish Republic; Conifers; root system
Notes : Deformation of the root system in trees affected by basal sweep is described and illustrated. Trees established on an Irish cutaway midland bog by slit planting of 1+1 transplants on sites prepared by double mouldboard ploughing showed more basal sweep and root deformation than those established by natural regeneration on the same uncultivated site. Recommendations are made for future nursery and etablishment practice, and include stock conditioning, the use of containers, direct sowing and discontinuing the use of ribbon ploughing for site cultivation.

Ref ID : 243
243. Phillips, D.R. Proceedings of the fourth biennial southern silvicultural research conference. Atlanta, Georgia. November 4-6, 1986. *General Technical Report Southeastern Forest Experiment Service, USDA Forest Service* No. SE-42, viii + 59:viii + 598 pp. 1987.
Keywords : research; Conferences; Georgia; pines; fires; Seedlings; Site preparation; management; growth; yields; pests; Pest management; forestry; Silviculture; Conifers; Broadleaves; Southern Silvicultural Research Conference; Nurseries; Artificial regeneration; natural regeneration; Forest influences; Insect pests; USA; regeneration; fire; production; interactions; site
Notes : Three abstracts and 93 papers are presented in 13 categories: Pine regeneration; Prescribed fire; Hardwood regeneration; Pine-hardwood regeneration; Seedling production; Soil-site-stand relationships; Silviculture-economic relationships; Interactions and influences; Site preparation; Management of established stands; Growth and yield; Pest management; and Vegetative management. Three poster presentations are summarized. Five papers are included from the general session on World forestry trends affecting southern silviculture.

Ref ID : 244

244. Pienaar, L.V., Page, H.H., and Rheney, J.W. Yield prediction for mechanically site-prepared slash pine plantations. *Southern Journal of Applied Forestry* 14:104-109, 1990.
Keywords : yields; Slash; pines; plantations; equations; Pinus; Pinus elliottii; Georgia; Florida; Planting; density; thinning; estimation; management; Conifers; Site preparation; Yield forecasting; USA; site; wood
Notes : Simultaneous yield prediction and projection equations are presented for both thinned and unthinned, site-prepared slash pine (Pinus elliottii) plantations in the lower coastal plain of Georgia and North Florida. The equations were developed from permanent sample plot data representing different planting densities and thinning intensities at 29 sites. An equation is also presented for estimation of yields of different solid wood products, thus allowing evaluation of various management regimes.

Ref ID : 245
245. Pienaar, L.V. and Shiver, B.D. Dominant height growth and site index curves for loblolly pine plantations in the Carolina flatwoods. *Southern Journal of Applied Forestry* 4:54-59, 1980.
Keywords : height; growth; site; pines; plantations; Drainage; soil; determination; Trees; crown; stems; discs; age; Site preparation; Harrowing; productivity; equations; analysis; Pinus taeda; site quality; water relations; Soil water; growth and development; drainage,land; effects; site class assessment; soil factors; mathematics; responses; North Carolina; South Carolina; Conifers; STATISTICAL ANALYSIS; USA
Notes : Data were collected in summer, 1977, from 181 sample plots assigned to 6 of 7 possible drainage classes on the basis of soil series determination. Two trees were selected from dominant and codominant crown classes in each plot, felled, and total ht. measured. Stem discs were removed at 5-ft intervals and the past ht. growth reconstructed. Company records provided age and site preparation (including bedding, KG-ing [scalping ?], harrowing and roller-chopping) data. Plots were ranked according to tree ht., and the rankings at 9 and 18 yr old were compared for different drainage classes. Well-drained sites showed a tendency to lose rank, and represented all observed productivity classes evenly at 18 yr old. Moderately well-drained sites showed no clear trend, while somewhat poorly drained plots showed a slight tendency to increase in rank and very poorly drained sites showed a marked trend to increase in rank. The ht. growth equation was fitted to ht./age data from the stem analysis trees and solved for the different drainage categories. Except for the very poorly drained sites all drainage categories produced curves of the same general shape so that data could be pooled. Site index equations and curves are given for the pooled drainage classes and separately for the very poorly drained sites.

Ref ID : 246
246. Potter, M.K. and Lamb, K.M. Root development of Radiata Pine in the gravel soils of Eyrewell Forest, Canterbury. *New Zealand Journal of Forestry* 19:264-275, 1974.
Keywords : roots; development; radiata pine; pines; soils; Forests; Reports; Trees; Pinus; Pinus radiata; regeneration; Direct sowing; sowing; Nurseries; damage; wind; ripping; Planting; soil; analysis; growth; root system; planting methods; Site preparation; resistance; growth and development; systems,distribution; mechanical methods; methodology; Conifers; natural regeneration
Notes : Reports a study to assess the comparative root development of 2-to 4-year-old trees of Pinus radiata grown from natural regeneration, direct sowing, hand-planted nursery stock and machine-planted nursery stock, at Eyrewell Forest, Canterbury, where damage by strong NW winds calls for measures to increase windfirmness. Ground ripping was done before sowing or planting to prevent inhibition of root development by the compacted gravel soil. Analysis of root growth showed strong root alignment along the ripped lines in the machine-planted trees; the alignment was less pronounced in hand-planted trees and trees grown from direct sowing. Trees from direct sowings had a well developed taproot, a moderately well distributed lateral root system and the best root/shoot ratio.

Ref ID : 247
247. Pritchett, W.L. Site preparation and fertilization of slash pine on a wet savanna soil. *Southern Journal of Applied Forestry* 3:86-90, 1979.
Keywords : site; Site preparation; Slash; pines; soil; Florida; Planting; stems; burning; discing; Seedlings; NPK; survival; application; P; growth; effects; Andropogon; understorey; Pinus elliottii; fertilizers; NPK fertilizers; mechanical methods; responses; Forestry practices; Conifers; USA; Fertilizing
Notes : [See FA 36, 3324] A 60-acre plot in Florida, clear felled in spring 1967, was prepared for planting in June by removing residual stems and (a) burning, (b) burning with flat discing, or (c) burning with bedding. Seedlings were planted successfully in Jan. 1969, and fertilized with 10 combinations of NPK. Survival and ht. after 8 yr. were greatest in (c) and least in (a), vol. production/acre (calculated from ht. and d.b.h.) being twice as much in (c) as in (a). Application of P increased survival, ht., d.b.h., vol., and P content of needles and soil within 2 yr on (a), (b) and (c). On (a) only, K applied with N and P improved growth more than N and P alone. The addition of N alone had no effect. Effects of fertilizing and bedding were essentially additive. Fertilizing also improved the proportion of useful forage species, such as bluestem (Andropogon spp.) in the understorey.

Ref ID : 248
248. Putz, F.E. Reduction of root competition increases growth of slash pine seedlings on a cutover site in Florida. *Southern Journal of Applied Forestry* 16:193-197, 1992.

Keywords : roots; competition; growth; Slash; pines; Seedlings; site; Florida; Pinus; Pinus elliottii; Broadleaves; light; Trees; canopy; height; diameter; Biomass; soil; Site preparation; Planting; techniques; plant competition; light regime; Forest trees; Plant nutrition; Forest plantations; USA; P
Notes : Slash pine (Pinus elliottii) seedlings (1+0) planted on a clear felled site dominated by 6-yr-old coppiced broadleaves and woody vines benefited from reduction in root competition following trenching but not from increased light following guy-wiring of overtopping trees. Over 2 yr, increased canopy openness (from 10 to 30%) did not affect height, diameter or aboveground biomass of seedlings. Trenching resulted in increased foliar N and P concentrations, higher soil moisture content and a doubling of aboveground growth. Results support the use of site preparation and planting techniques that reduce root competition for pine seedlings.

Ref ID : 249
249. Pyatt, D.G. and Craven, M.M. Soil changes under even-aged planatations. *Ford, E* D. C.; Atterson, J.J. (Editors)X: The e-aged forest plantati, 1979.
Keywords : soil; reviews; effects; Afforestation; stand development; development; Upland; site; UK; peat; peat soils; soils; Norway; pines; Scotland; Site preparation; iron; Picea sitchensis; Picea abies; Pinus contorta; Forest influences; Stand characteristics; Soil water; depletion by trees
Notes : A review of the effects of afforestation and stand development in the soil moisture regime and aeration of upland sites in the UK, dealing in turn with iron-pan, gley and deep peat soils. Data are presented on the annual moisture characteristics of unplanted sites and sites planted with Sitka spruce, Norway spruce and lodgepole pine in Scotland. The need for site preparation to break the iron pan is discussed.

Ref ID : 250
250. Pye, J.M. and Vitousek, P.M. Soil and nutrient removals by erosion and windrowing at a southeastern U.S. Piedmont site. *Forest Ecology and Management* 11:145-155, 1985.
Keywords : soil; nutrients; removal; Erosion; windrowing; site; Losses; pines; Logging; regeneration; treatment; whole tree logging; discs; Site preparation; application; herbicides; Hexazinone; Glyphosate; methods; effects; trials; P; equations; Slash; burning; Theses; rotations; productivity; water; mechanical methods; Pinus taeda; USA,North Carolina; Soil chemistry; nutrient contents; Forestry practices; Losses from soil systems; USA; North Carolina; windrow; rotation; site productivity
Notes : Soil losses from various loblolly pine logging and regeneration practices were investigated at a moderately sloping site. Treatments were stem-only or whole-tree logging in combination with chop and burn or shear, pile and disc site preparation, and the repeated application of herbicide (hexazinone and glyphosate) or none. Logging method had no effect on erosion rates over the year measured. Erosion on the chop and burn plots (excluding skid trials) was negligible. Erosion on the disced plots over the same year without and with herbicide was 4 and 10 t/ha respectively, representing 5 and 10 kg/ha of total N and 1.3 and 2.5 kg/ha of total P. The measured erosion rates agreed well with Universal Soil Loss Equation estimates. Mineral soil losses due to windrowing were unaffected by logging method and equalled 178 t/ha of prepared area. N and P in windrow soil and slash equalled 254 and 61 kg/ha of prepared area, respectively, after burning. These represent a systematic underestimate of nutrient losses during windrowing. Nonetheless, they are greater than losses in whole-tree logging, and they exceed natural inputs expected during a rotation. Losses of this magnitude raise the likelihood of reduced long-term site productivity.

Ref ID : 251
251. Quine, C.P. and Burnand, A.C. Early growth and root architecture of Sitka spruce in relation to cultivation of a peaty ironpan afforestation site. *Scottish Forestry* 45:175-182, 1991.
Keywords : growth; roots; Cultivation; Afforestation; site; ploughing; ripping; Scotland; Picea; Picea sitchensis; survival; age; height; analysis; treatment; development; soil; Conifers; Site preparation; mechanical methods; UK; root systems; peat soils; Soil types; Waterlogging; podzols; forestry; Soil types genetic; methods; Upland
Notes : Three cultivation methods, viz. spaced double mouldboard ploughing (D), complete ploughing (C) and deep ripping (TH), were compared for an upland site in S. Scotland planted with Sitka spruce (Picea sitchensis) in 1982. Survival up to age 6 yr was best on D and poorest on TH; early height growth up to age 8 yr was best on C and poorest on TH. Root architecture analysis failed to identify any differences in uniformity of root spread between cultivation treatments, but showed an unexplained clustering of roots in an uphill direction. All treatments disrupted the ironpan (mean depth 30 cm), which permitted good vertical root development and may have promoted better root-spread by reducing waterlogging in the upper soil profile.

Ref ID : 252
252. Raison, R.J. Possible forest site deterioration associated with slash-burning. *Search* 11:68-72, 1980.
Keywords : Forests; site; slash burning; Australia; ecological; nutrients; nutrient depletion; depletion; intensive; management; clear felling; Slash; burning; rotations; productivity; Losses; fire; Biomass; alternatives; Cycling; research; Soil fertility; Forestry practices; fire effects; nutrient cycle; Site preparation; Soil chemistry; soil; forest productivity
Notes : In Australia the long-term ecological consequences of forest practices which lead to nutrient depletion may be serious. In the absence of fertilisation, cumulative nutrient depletion associated with intensive management (involving clear-felling, slash burning, and short rotations) may lead to serious declines in productivity. As a mechanism for loss of

some important nutrients from a forest site, intense slash fire is likely to be much more significant than harvest of biomass. Until more is known of the full consequences of slash burning, alternatives to its use should be considered wherever possible. Integrative studies on nutrient cycling and other processes controlling sustained forest productivity under management should be given a higher research priority.

Ref ID : 253
253. Raison, R.J. and Crane, W.J.B. Nutritional costs of shortened rotations in plantation forestry. *Forest site and productivity [edited by Gessel, S* 117-125; 27 ref., 1:1 tab. Dordrecht, Ne, 1986.
Keywords : costs; rotations; plantations; forestry; Biomass; Losses; effects; Harvesting; phosphorus; soil; Erosion; leaching; burning; Site preparation; respiration; compaction; management; Forests; nutrients; requirements; forest rotations; rotation; site; soil disturbance
Notes : Changes in forestry operations which increase the biomass used and decrease the length of the rotation used are discussed in relation to the nutritional losses involved. The effects of different species on the length of the rotation and on nutritional demands are considered as are the losses involved in harvesting with special reference to phosphorus. Indirect effects of shortened rotations include soil erosion, leaching, atmospheric transfer due to increased burning during site preparation, increased soil respiration in exposed soil and effects of soil disturbance and compaction. Strategies for management to avoid such losses are considered.

Ref ID : 254
254. Ram-Prasad Effect of different methods of soil working on the growth and survival of Eucalyptus hybrid and E. camaldulensis. *Journal of Tropical Forestry* 4:135-139, 1988.
Keywords : effects; methods; soil; growth; survival; Eucalyptus; Forests; research; Madhya Pradesh; Seedlings; Planting; treatment; ploughing; measurement; height; Broadleaves; Site preparation; mechanical methods; India; Eucalyptus tereticornis; Eucalyptus camaldulensis; types; trials; site
Notes : Trials of different site preparation/planting methods were carried out at the Regional Forest Research Centre, Jabalpur, Madhya Pradesh, using polypotted seedlings of Eucalyptus hybrid [E. tereticornis] and E. camaldulensis. Seedlings were 75-85 cm tall at planting (in July). Treatments tested were: ploughing the entire area to 3 different depths (15, 30 and 40-50 cm); ploughing in 30-cm wide planting strips to the same depths; and traditional pit planting in 30-cm3 pits. Measurements of survival and height growth were made after 2 yr. For E. tereticornis, the best survival and growth were found in the entire ploughing treatments, and in the deepest ploughed planting strip treatment. For E. camaldulensis, the best survival was in the pit planting, but the best growth (and good survival) was found in the deepest entire ploughing treatment.

Ref ID : 255
255. Read, D.J. and Armstrong, W. The effect of soil preparation on water potential and oxygen status of a wet heathland soil in relation to afforestation. *Report on Forest Research, Forestry Commission, UK* 148-149; 2 ref. 1972.
Keywords : effects; soil; soil preparation; water; Afforestation; heathland; heathland soils; ridges; Trees; growth; furrows; ploughing; Site preparation; mechanical methods; wet land; Soil water; Tillage; soil air
Notes : Discusses investigations on soil conditions in riggs (ridges or cambered beds - cf. FA 29, 2276), which indicate that conditions should be considerably more favourable for tree growth and stability than on single furrows or on soil prepared by complete ploughing.

Ref ID : 256
256. Rennie, P.J. Annotated bibliography of openly available published reports, 1950 to 1987 written by Peter J. Rennie. *1988, iii + 74 pp* Ontario, Canada; Can:Canada, 1988.
Keywords : Bibliographies; available; Reports; research; Site preparation; soils; UK; Forests; nutrition; classification; productivity; Air pollution; POLLUTION; Canada; Rennie,P.J. Plant nutrition; site class assessment; Soil chemistry; site; site productivity; air
Notes : The reports are listed chronologically and cover research on nutritional and site-preparation problems on poor soils in the UK during 1947-56 and research on forest nutrition, site classification, site productivity and air pollution in Canada since 1958.

Ref ID : 257
257. Riddle, A. Adding winches to hydraulic excavators - roller crushing. *Technical Note New Zealand Logging Industry Research Organisation* No. TN-11, 2 pp.; 9:2 pp. 1993.
Keywords : hydraulics; excavators; winches; light; scrub; New Zealand; Site preparation; scrub control; Forestry machinery; New
Notes : Brief details are given of the operation of a hydraulic excavator fitted with two winches to enable it to crush light scrub in New Zealand with rollers attached to the winches.

Ref ID : 258
258. Robertson, G.P., Vitousek, P.M., Matson, P.A., and Tiedje, J.M. Denitrification in a clearcut loblolly pine (Pinus taeda L.) plantation in the southeastern US. *Plant and Soil* 97:119-129, 1987.

Keywords : pines; Pinus; Pinus taeda; plantations; denitrification; production; soil; Site preparation; herbicides; treatment; nitrification; nitrate; Losses; nitrogen; leaching; Harvesting; forest soils; Forestry practices; Soil types ecological; Soil chemistry; mechanical methods; chemical treatment; Cycling; Logging; USA; North Carolina; site
Notes : Denitrification and nitrous oxide (N2O) production were examined in intact soil cores removed from a clearcut southern pine site subjected to different harvest, site preparation and herbicide treatments. Rates of N2O production in soil cores incubated with acetylene showed that clearcutting stimulated denitrification but that rates varied with sample date and post-harvest site treatment. The site was harvested in December 1980. In September 1982 denitrification was greater in sheared, piled and disked (SPD) plots than in chopped or reference (uncut) plots; the following May, rates were higher in seven of the eight treatment plots than in the reference plot, and were highest in three of the four herbicide-treated plots. On both sample dates denitrification rates were correlated with nitrification potentials and nitrate pool sizes in the plots, and nitrate added to cores from all treatments significantly stimulated denitrification. Nitrate supply thus appeared to regulate denitrification at this site. Relative to harvest or site preparation losses of nitrogen, denitrification was not a major cause of N loss at this site; under post-harvest conditions, however, denitrification may be of the same magnitude as leaching losses.

Ref ID : 259
259. Rockell, J.D. Problems of afforestation. *1974, 21 pp* New Zealand; NZ Fore, 1974.
Keywords : Afforestation; New; New Zealand; Planting; wood; land; pastures; methods; site; Site preparation; Pinus; Pinus radiata; P; spacing; Grasses; plantations; environment; mountains; control; Trees; regions; management; Nothofagus; Forests; protection; Economics; conversion; land use; forest policy; environmental conservation; agriculture/forestry relations,general
Notes : In New Zealand, continued planting of large areas can be justified in view of increasing world demands for wood. There are 2.3 million ha of undeveloped land, some of it suitable for agriculture (i.e. pasture), but in each case it has to be shown that afforestation is the best use to which this land can be put. In the developed areas, on the other hand, good planting land is not easy to acquire in blocks large enough to suit modern methods of afforestation. Site preparation problems and the choice of Pinus radiata as the best species are noted. Reference is made to establishing P. radiata at very wide spacings so as to produce grass for pasture during the early years of a plantation. A constraint upon afforestation with exotics is the popular concern in New Zealand for conserving the environment. Indeed, on some of the mountain lands controls may even become necessary to prevent the natural spread of introduced tree species if they threaten to change the scenic character of the region. The management of the Nothofagus forests of the South Island is given as an example of the balance that has to be struck nowadays between protection, the economics of indigenous forest working, conversion to vigorous exotics, and the concern of the public for preserving the status quo.

Ref ID : 260
260. Ross, D.W. Western pine shoot borer (Lepidoptera: Olethreutidae) response to site preparation in ponderosa pine plantations. *Journal of Economic Entomology* 82:543-547, 1989.
Keywords : pines; shoots; responses; site; Site preparation; plantations; Borers; effects; treatment; Pinus; seasons; Planting; Oregon; control; ripping; herbicides; spraying; growth; Trees; height; pests; Pest management; management; Forests; Forest pests; Insect pests; Tortricidae; Lepidoptera; Forest trees; Eucosma sonomana; Pinus ponderosa; USA; usage; crops; weeds; chemical control; cultural control; discing; Cultivation; Conifers; Eucosma; ecology; mechanical methods; chemical treatment; vegetation; interactions
Notes : The effects of 6 site preparation treatments on infestations by the tortricid Eucosma sonomana in ponderosa pine (Pinus ponderosa) plantations were compared during the 5th to the 8th growing seasons after planting at 3 sites in south-central Oregon. Treatments included a logged-only control, ripping, disking, brush-blading, herbicide spraying, and herbicide spraying followed by disking. Treatments that produced the greatest reduction in competing vegetation resulted in the best pine growth but also in the highest levels of E. sonomana infestation. Trees that were attacked by E. sonomana were significantly taller at the beginning of the growing season than trees that remained uninfested. The effect of E. sonomana infestation on height growth of the trees showed a significant interaction with total height at the beginning of the growing season; infested trees grew proportionally less than uninfested trees as total height increased. It is concluded that the results of this study illustrate the importance of incorporating pest management considerations into overall forest management plans.

Ref ID : 261
261. Ross, D.W., Scott, W., Heninger, R.L., and Walstad, J.D. Effects of site preparation on ponderosa pine (Pinus ponderosa), associated vegetation, and soil properties in south central Oregon. *Canadian Journal of Forest Research* 16:612-618, 1986.
Keywords : effects; site; Site preparation; pines; Pinus; Pinus ponderosa; vegetation; soil; soil properties; Oregon; methods; Logging; control; ripping; discing; spraying; Glyphosate; Planting; Seedlings; physical properties; survival; growth; P; Variation; herbicides; treatment; nutrients; chemical properties; bulk density; density; Biomass; Trees; mechanical methods; USA,Oregon; chemical treatment; Soil physics; Soil chemistry; weed control; weed trees and shrubs; woody weeds; usage; crops; Forests; weeds; cultural; USA; Forestry practices; Soil fertility; chemical
Notes : A site near Klamath Falls, Oregon was prepared in autumn 1975 by six methods (logging only - control, ripping, brush blading, discing, spraying with glyphosate or glyphosate + discing) followed by planting with ponderosa pine

seedlings in spring 1976. In 1983, soil samples were collected at 0-10 and 15-25 cm depths to determine chemical and physical properties, characteristics of non-coniferous vegetation were determined, and survival and growth of the pines were measured. Concentrations of C, N and P, and to a lesser extent S, were greater in the upper soil zone. The small number of samples and the inherent variation resulted in a lack of statistical significance but trends at both depths were similar. The brush-blade and herbicide + discing treatments caused the greatest reductions in C and nutrients. Ripping had only a minor effect on soil chemical properties. Brush blading and both discing operations increased soil bulk density in the upper, but not the lower, zone. All treatments had significantly less brush biomass than control plots, with brush-blading and herbicide treatments giving the largest reduction in brush biomass. Pine survival was ¦78% on all treatments except ripping (62%) and control (30%). Trees were largest on plots with herbicide + discing treatment. A strong negative correlation existed between amount of brush and pine biomass.

Ref ID : 262
262. Ross-DW and Walstad-JD Vegetative competition, site-preparation, and pine performance: a literature review with reference to southcentral Oregon. *Research Bulletin, Forest Research Laboratory, Oregon State University* No. 58, ii + 21pp.;ii + 21pp. 1986.
Keywords : competition; Site preparation; pines; performance; reviews; Oregon; control; plantations; establishment; effects; mechanical methods; weed control; weeds; cultural control; crops; Forests; USA; methods; vegetation; treatment; site; site productivity; productivity; mechanical
Notes : Methods to control undesirable vegetation during plantation establishment (mainly of ponderosa pine) are discussed in relation to expected silvicultural benefits and possible adverse effects of treatments on long-term site productivity. Mechanical methods are emphasized.

Ref ID : 263
263. Sands, R.(.)., Richard, F., Bigger, C.M., Cole, D.W., Feller, M.C., Kimmins, J.P., Scoullar, K.A., Nwoboshi, L.C., Arimitsu, K., Russell, C.E., Jordan, C.F., North, R.M., Harvey, A.E., Jurgensen, M.F., Larsen, M.J., Morris, L.A., Pritchett, W.L., Lear, D.H., Swank, W.T., Douglass, J.E., Waide, J.B., Edmonds, R.L., McColl, J.G., and Riekerk, H. Effects of management on physical and chemical properties of soil and on yield. *General Technical Report, Pacific Northwest Forest and Range Experiment Station, USDA Forest Service* No. PNW-163, 146-279:146-279.X, 1983.
Keywords : effects; management; chemical; chemical properties; soil; yields; sandy soils; soils; pines; Australia; water; Forests; forest soils; water uptake; uptake; Trees; Harvesting; nutrients; Losses; productivity; Washington; simulation; Forest management; site; Economics; performance; British Columbia; impact; plantations; ecosystems; Nigeria; shifting cultivation; Cultivation; rain forests; Indonesia; forestry; Pinus; Pinus caribaea; wood; production; soil organic matter; organic matter; regeneration; mountains; Site preparation; soil properties; Florida; South Carolina; nitrogen; Eucalyptus; Pinus radiata; environmental impact; intensive silviculture; Silviculture; Pinus elliottii; Conferences; IUFRO; Forest site and continuous productivity; Forest influences; hydrology; Soil fertility; Abies alba; Pseudotsuga menziesii; Picea abies; Gmelina arborea; Pinus palustris; Pinus taeda; Alnus rubra; Eucalyptus pauciflora; Eucalyptus viminalis; ecology; radiata pine; intensive; site productivity; energy; organic
Notes : Some 16 papers were presented including: Sands, R. Physical changes to sandy soils planted to radiata pine. 146-152 [14 ref.] In southern Australia. Richard, F. Water seepage and water balance in forest soils and relations to water uptake by trees in the field. 153-156 [2 ref.] Under a single Douglas fir, and under a silver fir/spruce stand in Switzerland. Bigger, C.M.; Cole, D.w. Effects of harvesting intensity on nutrient losses and future productivity in high and low productivity red alder [Alnus rubra] and Douglas-fir stands. 167-178 [7 ref.] In Washington. Feller, M.C.; Kimmins, J.P.; Scoullar, K.A. FORCYTE-10: Calibration data and simulation of potential long-term effects of intensive forest management on site productivity, economic performance, and energy benefit/cost ratio. 179-200 [27 ref.] Douglas fir in British Columbia. Nwoboshi, L.C. Potential impacts of some harvesting options on nutrient budgets of a Gmelina pulpwood plantation ecosystem in Nigeria. 212-217 [21 ref.] Arimitsu, K. Impact of shifting cultivation on the soil of the tropical rain forest in the Benakat District, South Sumatera, Indonesia. 218-222 [6 ref.] Russell, C.E.; Jordan, C.F.; North, R.M. Jari: a lesson in tropical forestry. 223-228 [18 ref.] In Amazonia, Pinus caribaea increased wood production two-fold but reduced Ca standing stock by 45% compared with native forest. Harvey, A.E.; Jurgensen, M.F.; Larsen, M.J. Effects of soil organic matter on regeneration in northern Rocky Mountain Forests. 239-242 [8 ref.] Morris, L.A.; Pritchett, W.L. Effects of site preparation on Pinus elliottii/P. palustris flatwoods forest soil properties. 243-251 [16 ref.] In Florida. Lear, D.H. van; Swank, W.T.; Douglass, J.E.; Waide, J.B. Forest management practices and the nutrient status of a loblolly pine plantation. 252-258 [31 ref.] In South Carolina. Edmonds, R.L.; McColl, J.G. Forest management effects on soil nitrogen in Eucalyptus pauciflora and Pinus radiata stands in the Australian Capital Territory, Australia. 259-263 [11 ref.] Riekerk, H. Environmental impacts of intensive silviculture in Florida. 264-271 [16 ref.] With Pinus elliottii and Eucalyptus viminalis.

Ref ID : 264
264. Schack, H. and Hildebrand, E.E. Influence of mechanical cultivation of a sandy soil on root growth of forest plants. *Allgemeine Forst und Jagdzeitung* 159:27-34, 1988.
Keywords : mechanical; Cultivation; sandy soils; soil; roots; growth; Forests; plants; plant; Germany; clear felling; felling; burning; stumps; root systems; Trees; pines; Tillage; bulk density; density; water; shear strength; machinery; Site preparation; mechanical methods; German Federal Republic; Pinus sylvestris; Pseudotsuga menziesii; Quercus rubra;

development; Soil physics; compaction; porosity; Soil types; forestry; Soil types textural; organic
Notes : Soil profiles and structure were examined in stands N. of Mannheim, W. Germany, which were undisturbed or had been treated by deep rotary tilling after clear felling or burning (stumps were incorporated into the soil). Root systems were excavated and examined of 10- to 14-yr-old trees, mainly Scots pine, Douglas fir and red oak. Rooting on tilled areas was limited to the homogenized humic top soil, while the deeper mineral soil (partly mixed with organic matter due to tillage) was nearly free of roots. In the mineral soil on treated areas, deep rotary tilling resulted in higher bulk density, reduced pore vol., reduced water conductivity, deterioration in pore continuity, and higher soil shear strength. It is concluded that deep rotary tilling with heavy, vibrating machinery on sandy soil produces irreversible over-consolidation in the subsoil and should be avoided.

Ref ID : 265
265. Schmidt-RA, Miller-T, Holley-RC, Belanger-RP, and Allen-JE Relation of site factors in fusiform rust incidence in young slash and loblolly pine plantations in the coastal plain of Florida and Georgia. *Plant Disease* 72:710-714, 1988.
Keywords : site; site factors; Slash; pines; plantations; Florida; Georgia; soil; Drainage; texture; Site preparation; methods; Cronartium; Forests; Forest management; management; Trees; age; stems; analysis; soils; old fields; Theses; forest inventories; effects; Distribution; models; Fungal diseases; rust diseases; assessment; Forest trees; Conifers; plant pathology; plant pathogenic fungi; USA
Notes : The relation of soil drainage, soil surface texture, site preparation methods and site index to the incidence of fusiform rust, caused by Cronartium quercuum f.sp. fusiforme [C. fusiforme], was examined in >1200 slash pine and 230 loblolly pine plantations in 8 forest management areas of the Florida and Georgia coastal plain. Rust incidence was the percentage of living trees at age 5-6 yr with at least one stem or branch gall. In a combined analysis of all management areas, rust incidence in both pine species was greatest on sites with well- or moderately well-drained soils with loamy sand or sandy loam surface texture and least on sites with poorly or somewhat poorly drained soils with a sandy surface texture. Individually, some management areas exhibited the same overall trend, but in other areas, especially high rust incidence areas, plantations had high rust incidence regardless of soil drainage or texture class. Old field sites had significantly greater rust incidence, which appears to be the consequence of these sites being located on the better-drained loamy soils. Regionwide, an estimated site index based on soil characteristics was negatively correlated with rust incidence in both pine species. This unexpected trend resulted because of the dependence of the site index system on soil drainage and texture. Within soil drainage/texture classes, the site index was positively correlated with rust incidence in slash pine. These forest inventory data are correlative and do not establish cause and effect. Nevertheless, they do aid understanding of fusiform rust distribution and management. It is concluded that a definitive rust hazard model at the stand level will require quantitative data on alternate host (oak) abundance and dispersal of inoculum.

Ref ID : 266
266. Schonau, A.P.G. Basic silviculture for the establishment of eucalypt plantations with special reference to Eucalyptus grandis. *South African Forestry Journal* No. 134, 4-9; 11 ref:4-9, 1985.
Keywords : Silviculture; establishment; plantations; Eucalyptus; Eucalyptus grandis; climate; soil; topography; productivity; site; Site preparation; fertilizers; requirements
Notes : The climate, soil, topography, soil productivity, site preparation and fertilizer requirements of E. grandis are described. The requirements of other eucalypt species are thought to be similar.

Ref ID : 267
267. Schonau, A.P.G. Requirements for intensive silviculture. *South African Forestry Journal* No. 150, 40-49; 33 r:40-49, 1989.
Keywords : requirements; intensive; intensive silviculture; Silviculture; forestry; research; South Africa; Africa; development; application; Afforestation; Losses; soil; Trees; Site preparation; fertilizers; treatment; weeds; weed control; control; Coppice; management; Broadleaves; techniques; pines; education; Forests; Conferences; Forestry research 1988: future needs in South Africa; information; crops; availability; land; production; methods; site; climate; landscape; weed; thinning; Training; competition
Notes : A paper presented at the symposium 'Forestry Research 1988: future needs in South Africa', Pretoria, September 1988. The fundamentals of intensive silviculture in South Africa are not a recent development but were already indicated at the beginning of the 20th century. The greater emphasis placed on its application today is due to the increased demand for timber and the limited availability of suitable areas for afforestation. As a result, more and more land is being afforested where tree-growing conditions are limited and require greater silvicultural input in order to achieve acceptable production levels. In addition, it has been shown that intensive methods are profitable and become more important on marginal sites where a potential loss situation can be turned into a profitable one. This paper describes the basic requirements for intensive silviculture, such as an understanding of the limitations set by soil, climate and landscape, and the requirements of various tree species. South African silvicultural expertise in site preparation, fertilizer treatment, weed control, thinning and coppice management for broadleaves is discussed. Australian experience has shown that intensive silvicultural techniques apply also to pine species. The proper implementation of intensive silviculture in South Africa is greatly hampered by inadequate forestry education and training (too few forest managers receive formal forestry training), and a lack of job competition at all levels.

Ref ID : 268
268. Schonau, A.P.G. and Boden, D.I. Silvicultural techniques in the establishment of Eucalyptus grandis. *Mededeling, Fakulteit Bosbou, Universiteit Stellenbosch* No. 98, Vol. I, 269-:Vol. I, 269-294, 1983.
Keywords : techniques; establishment; Eucalyptus; Eucalyptus grandis; trials; South Africa; Africa; slopes; ripping; methods; spraying; herbicides; Planting; Theses; fertilizers; mixtures; application; application rates; Site preparation; chemical treatment; mechanical methods; Conferences; Jubilee Symposia,Faculty of Forestry,Stellenbosch University; site
Notes : Results of trials at 6 sites in South Africa suggest that complete site preparation should be practised when the slope is <10_. When the slope is 10-15_ ripping is the best method, and when it is >15_ line spraying with a herbicide should be used. Planting pits of diam. not more than 0.5 m are recommended in these latter 2 cases. Fertilizer mixtures and application rates for the various conditions are given.

Ref ID : 269
269. Schonau, A.P.G., Themaat, R.V., and Boden, D.I. The importance of complete site preparation and fertilizing in the establishment of Eucalyptus grandis. *Proceedings of the Forest Seed, Nursery and Establishment Research Working Group, 3rd Meeting, Saasveld Forestry Research Station, George, South Africa, 1980* 1-18; 19 ref. South, 1981.
Keywords : site; Fertilizing; establishment; Eucalyptus; Eucalyptus grandis; Site preparation; methods; Cultivation; ripping; spraying; Glyphosate; fertilizers; Fertilizer application; application; NPK; Planting; South Africa; Africa; growth; treatment; mortality; control; Grasses; analysis; costs; Trees; ploughing; weed control; mechanical methods; chemical treatment; herbicides; Conferences; Forest Seed,Nursery and Establishment Research Working Group; NPK fertilizers; responses; Forestry practices
Notes : Eleven site preparation methods (full cultivation or various combinations of ripping, spraying with glyphosate and preparation of pits) with either no fertilizer application or application of NPK one week after planting were compared for 3 yr on a site in South Africa. Full cultivation gave by far the best results. Fertilizer improved growth in all treatments, but also increased mortality. Large-diam. pits (1 m) gave better growth than smaller pits. Control of grasses with glyphosate increased growth and reduced mortality and deficiency symptoms of E. grandis. Analysis of the cost structure confirmed that full cultivation should be practised wherever possible, combined with application of 150 g NPK per tree. In areas where ploughing is not possible, the recommended method is to prepare small pits (0.5 m diam.) combined with spraying with glyphosate along the tree lines before planting and application of 150 g NPK per tree.

Ref ID : 270
270. Schonau, A.P.G., Verloren-van-Themaat, R., and Borden, D.I. The importance of complete site preparation and fertilising in the establishment of Eucalyptus grandis. *South African Forestry Journal* No. 116, 1-10; 19 re:1-10, 1981.
Keywords : site; establishment; Eucalyptus; Eucalyptus grandis; Site preparation; responses; age; Cultivation; effects; mortality; growth; Planting; chemical control; control; Grasses; Glyphosate; growth rate; application; superphosphate; Trees; weed control; fertilizers; phosphorus; chemical methods; mechanical methods; herbicides; plantations; chemicals; Forestry practices; Broadleaves; Fertilizing; chemical
Notes : The background and results are described of an experiment involving the response to site preparation and fertilizing of E. grandis up to 3 years of age. Full cultivation gave the best results. Fertilizing gave an added advantage and had the greatest effect when site preparation was poorest, but it also increased mortality. For optimum growth of E. grandis the diam. of the planting pit is more important than pit depth. Chemical control of grasses with glyphosate before planting increased growth and decreased mortality and deficiency symptoms of E. grandis. During the third year the current growth rate in plots which were ripped was better than on plots prepared in other ways. It is recommended that full cultivation should be practised on all sites where this is possible, together with an application of 150 g ammoniated superphosphate per tree. From authors' summary.

Ref ID : 271
271. Schory, E.A.,Sr. Progress Report: Tropical Forestry Project. *1957, Florida Forest Service, Fort Myers, Fla* , 1957.
Keywords : Reports; forestry; projects; development; Planting; bare rooted; Eucalyptus; Seedlings; site; Site preparation; Cultivation; Eucalyptus tereticornis; Eucalyptus grandis; Eucalyptus spp.planting methods; Planting stock barerooted; Planting season; Research,organization and programmes
Notes : [Cf. F.A. 18 No. 2384.] The most significant developments reported were: Successful planting out in the field of bare-rooted Eucalyptus (E. grandis and E. tereticornis) seedlings; successful summer planting of Eucalypt and other hardwoods; and confirmation of the need for adequate site preparation and cultivation for hardwood seedlings.

Ref ID : 272
272. Schrey, H.P. and Bergfeld, U. Changes in soil structure in deep-ploughed forest soil in the first five years. *Forst und Holzwirt* 40:327-331, 1985.
Keywords : soil; Soil structure; Forests; forest soils; soil physical properties; physical properties; ploughing; horizons; porosity; effects; growth; pines; Quercus; Theses; Soil physics; Soil types; cambisols; Site preparation; mechanical methods; German Federal Republic; Pinus sylvestris; Quercus petraea; forestry; Soil types ecological; site; regions
Notes : Soil physical properties were studied at slightly podzolized brown earth sites in the Geest-Mitte region, Lower

Saxony, ploughed to 80 cm depth in 1977-81. Ploughing (which brought sandy horizons to the surface) led to a distinct increase in soil porosity which was sustained for at least 5 yr. Positive effects are discussed of ploughing on growth of Scots pine and Quercus petraea planted at these sites.

Ref ID : 273
273. Schuler, G. Effects of intensive soil cultivation with a novel rotary cultivator on the nutrient regime of a forest site. *Forsttechnische Informationen* 44:69-72, 1992.
Keywords : effects; intensive; soil; Soil cultivation; Cultivation; rotary cultivators; Cultivators; nutrients; Forests; site; stumps; pines; Germany; comparisons; horizons; chemical properties; treatment; Losses; Sorption; forestry; Planting; plant; Plant nutrition; nutrition; Broadleaves; mulching; Krohn cultivator; Tillage; amelioration of forest sites; Site preparation; mechanical methods; Quercus robur; Soil chemistry; Chipping; wood residues; forest soils; Soil types ecological; equipment; chemical
Notes : A recently developed rotary cultivator [manufactured by Krohn, Germany], which comminutes debris and stumps and incorporates them, was used to cultivate a windthrown area of Scots pine [Pinus sylvestris]/oak [Quercus robur]/beech [Fagus sylvatica]/Norway spruce [Picea abies] in Germany prior to replanting with oak. For comparison, on another area the debris was comminuted with a mulcher one year later, without incorporation into the mineral topsoil, and then planted with oak. Data are presented on the depth and condition of the soil horizons, and the physical and chemical properties of the soil. The comparison indicated that the rotary cultivator treatment causes considerable nutrient losses, a low base saturation in the topsoil, and higher Al coating of the sorption complexes of the soil. Accordingly, great caution should be exercised in using the forestry rotary cultivator for preparing a planting site because of the possible adverse consequences for plant nutrition.

Ref ID : 274
274. Schulte-Karring, H. and Schroder, D. Total rehabilitation of forest soil - a prerequisite for the successful re-establishment of forests. *Forsttechnische Informationen* 44:65-69, 1992.
Keywords : rehabilitation; Forests; forest soils; soil; Germany; soils; loosening; application; fertilizers; lime; implements; Theses; rotary cultivators; Cultivators; amelioration of forest sites; Tillage; Krohn cultivator; Site preparation; mechanical methods; equipment; Land improvement; forestry; Soil types ecological; methods
Notes : Results are given from 35 years' experience in Germany with the Ahrweiler method of rehabilitating exhausted forest soils. It consists basically of deep loosening of the soil, plus the deep application and incorporation of fertilizers (lime etc.). The MM100 and MM50 implements have been developed for these operations; they have curved tines which make elliptical movements in the soil, breaking and loosening it to depths of 0.7-1 m and 0.6 m respectively. The recently developed Krohn rotary cultivator is discussed in the context of the Ahrweiler experience.

Ref ID : 275
275. Schumann, A.W., Little, K.M., and Snell, C.J. Pine establishment problems occurring in old-field soils: 1990 to 1994. *ICFR Bulletin Series* No. 6/94, 37 pp.; 59:37 pp. 1994.
Keywords : pines; establishment; old fields; soils; soil; Pinus; Seedlings; mortality; projects; Reports; surveys; USA; growth; improvement; nitrogen; application; phosphorus; performance; soil sterilization; treatment; survival; herbicides; Insects; mycorrhizas; ploughs; compaction; effects; reviews; Forest plantations; nitrogen phosphorus fertilizers; nutrient deficiencies; Soil biology; Soil fertility; Site preparation; site factors; soil management; research; Afforestation; agricultural land; stand establishment; South Africa; trials; NP; methods; site; roles
Notes : Pine (Pinus) seedling mortality on previously cropped South African soils has recently become an important and widespread occurrence (especially in recent projects in the NE Cape and Natal), and causes high establishment failures. This paper reports results from 6 pot/laboratory experiments, 13 field trials, 2 investigative surveys, many observational experiments, and a study tour to the USA, all carried out to investigate the causes of the problem. Growth improvement was repeatedly achieved by nitrogen application, and induced phosphorus deficiency was avoided by the use of N-P compounds such as monoammonium phosphate. Mild soil disinfectants also improved performance, but complete soil sterilization achieved the best results, and also corrected the N-deficiency problem. A more environmentally sound and practical method was to scalp and fertilize the sites (as learnt from the tour to the USA) - this treatment significantly improved survival and growth, and gave results as good as, or better than, those obtained from complete soil sterilization. Other factors investigated and not entirely discounted were the roles of residual herbicides, allelochemicals, nematodes, soil insects, pathogens, mycorrhizas, soil impediments (such as plough pans and compaction), and the effects of ridging. A literature review of similar problems elsewhere in the world is included.

Ref ID : 276
276. Schuster, C.J. Rehabilitation of soils damaged by logging in south-west Western Australia. *Research Paper, Forests Department, Western Australia* No. 54, 8 pp.; 10 re:8 pp. 1979.
Keywords : rehabilitation; soils; Logging; Australia; Western Australia; soil; ripping; fertilizers; application; growth; Eucalyptus; Seedlings; survival; Eucalyptus diversicolor; Soil physics; compaction; Site preparation; burning; mechanical methods; Soil cultivation; Fertilizer application; Forestry practices; responses
Notes : Deep soil ripping, fertilizer application and an ashbed of burned logging debris all increased ht. growth of planted Eucalyptus diversicolor seedlings. Ripping also increased survival.

Ref ID : 277
277. Schutz-CJ and Gessel-SP Monitoring the long-term effects of management practices on site productivity in South African forestry. *Forest site and productivity* 137-144; 3 fig.; 20, 1986.
Keywords : effects; management; site; site productivity; productivity; forestry; crops; Conifers; nutrients; soil; Logging; Trees; Losses; Erosion; burning; Site preparation; soil properties; Soil fertility; plant effects; South Africa; yields; nutrient depletion; depletion; Soil structure; litter
Notes : The effect of successive crops of conifers on the yield and other factors is reviewed. Nutrient depletion and its effect on yields, changes in soil structure due to logging and due to the effect of the tree stands, loss of topsoils by erosion, burning and site preparation, effects of burning on soil properties and the importance of litter and effects of excessive litter are considered.

Ref ID : 278
278. Shiver, B.D. and Fortson, J.C. Effect of soil type and site preparation method on growth and yield of flatwoods slash pine plantations. *Southern Journal of Applied Forestry* 3:95-100, 1979.
Keywords : effects; soil; Soil types; types; site; Site preparation; methods; growth; yields; Slash; pines; plantations; analysis; measurement; Georgia; Florida; South Carolina; soils; roots; treatment; survival; Pinus elliottii; Southeastern States of USA; mechanical methods; Soil fertility; Soil morphological features; horizons; spodic horizons; responses; Forestry practices; Conifers; USA
Notes : Analysis of measurements collected from 310 plots in Georgia, Florida and South Carolina showed that in plantations in areas where debris had been removed during site preparation (by bulldozing, rootraking or KG-ing[? scalping]) site indices were significantly higher; bedding made n.s.d. Plantations on spodic soils (which can impede root growth) had significantly lower site indices than those non-spodic soils, although they were usually less than 2 ft at 25 yr old. Neither site preparation treatment nor soil affected vol. or % survival. From authors' summary.

Ref ID : 279
279. Shiver, B.D., Rheney, J.W., and Oppenheimer, M.J. Site-preparation method and early cultural treatments affect growth of flatwoods slash pine plantations. *Southern Journal of Applied Forestry* 14:183-188, 1990.
Keywords : Site preparation; methods; cultural; treatment; growth; Slash; pines; plantations; effects; burning; Pinus; Pinus elliottii; Georgia; Florida; fertilizers; seasons; vegetation; control; spraying; applications; height; diameter; improvement; Fertilizer application; application; soil; interactions; age; responses; Theses; controlled burning; Forest plantations; chopping; weed control; chemical control; Glyphosate; Triclopyr; increment; plant height; Spodosols; forest soils; diammonium phosphate; Soil types; herbicides; USA; site; competition
Notes : A study was established in 1979 to evaluate the effects of site preparation by burning, chopping and bedding on growth of slash pine (Pinus elliottii) plantations on Spodosols and non-Spodosols in the flatwoods area of southeast Georgia and Florida. In addition, a fertilizer treatment (250 lb/acre of diammonium phosphate at the start of the second season) and complete vegetation control (spraying with Roundup [glyphosate] before site preparation and repeated applications of Roundup and Garlon [triclopyr] to keep plots free of competition) were imposed on the site preparation treatments. Height and diameter of slash pine are reported after 8 yr. Complete vegetation control provided the most consistent improvement in slash pine growth. Fertilizer application and bedding also gave significant improvements regardless of soil group. There was a significant soil group X treatment interaction for height. Burning had an adverse effect on Spodosols. Chopping improved height growth on non-Spodosols, but had little to improve growth on Spodosols between ages 5 and 8. On non-Spodosols, only complete vegetation control continued to provide significant growth response between these ages.

Ref ID : 280
280. Shoulders-E Proceedings of the third biennial Southern Silvicultural Research Conference. Atlanta, Georgia, November 7-8, 1984. *General Technical Report, Southern Forest Experiment Station, USDA Forest Service* No. SO-54, ix + 589p:ix + 589pp. 1985.
Keywords : research; Conferences; Georgia; Seedlings; Site preparation; establishment; management; Genetics; Trees; growth; pests; Forests; Forest influences; Silviculture; Nurseries; Artificial regeneration; natural regeneration; Plant nutrition; mycorrhizas; Insect pests; USA; production; site; stand establishment; vegetation; nutrition; yields; Pest management; interactions
Notes : The collection of 107 papers is presented in 13 sections: Seedling production (8 papers); Site preparation (9); Stand establishment (19); Stand management (11); Genetics (4); Vegetation management (10); Soil-site relationships (4); Tree nutrition (10); [Mycorrhizal] Symbiotic relationships (3); Growth and yield modeling (13); [Insect] Pest management strategies (3); Interactions (6); and Forest influences (7).

Ref ID : 281
281. Sijde, H.A. Results of an establishment trial with Pinus elliottii on the Transvaal Highveld. *South African Forestry Journal* No. 131, 44-47; 4 re:44-47, 1984.
Keywords : establishment; trials; Pinus; Pinus elliottii; site; Site preparation; treatment; weeds; weed control; control; fertilizers; pines; plantations; survival; Trees; growth; crops; Forests; South Africa; weed

Notes : In a factorial experiment comprising 3 site preparation treatments, 2 weed control and 2 fertilizer treatments, it was found that weed control was the only important factor in establishing pine plantations, favourably affecting both survival and tree growth.

Ref ID : 282
282. Sirmon, G.A. and Dennington, R.W. Longleaf pine management on the DeSoto National Forest - a case study. *Southern Journal of Applied Forestry* 13:34-40, 1989.
Keywords : pines; management; Forests; case studies; history; Mississippi; Pinus; Pinus palustris; Artificial regeneration; regeneration; Planting; Seedlings; natural regeneration; shelterwood; shelterwood system; techniques; Site preparation; vegetation; handling; Conifers; Silviculture; USA; bare rooted; site
Notes : A brief account is given of the history of DeSoto National Forest, Mississippi, and the need to regenerate longleaf pine (Pinus palustris). Artificial regeneration by planting bare-rooted seedlings and natural regeneration by the shelterwood system have both resulted in a success rate of about 90% when appropriate silvicultural techniques were used. The success was attributed to better site preparation that controlled competing vegetation and improved seedling culture, care and handling.

Ref ID : 283
283. Slay, J.M., Lockaby, B.G., Adams, J.C., and Vidrine, C.G. Influences of site preparation on forest soil chemical properties in the Southern Coastal Plain. *Journal of Soil and Water Conservation* 42:373-376, 1987.
Keywords : site; Site preparation; Forests; forest soils; soil; chemical; chemical properties; techniques; Louisiana; treatment; fuelwood; herbicides; application; P; organic matter; pH; soil organic matter; applications; effects; nutrients; Revegetation; Biomass; forestry; Soil chemistry; USA; mechanical methods; ecology; chemical treatment; nitrogen; potassium; calcium; magnesium; carbon; windrow; herbicide application; organic
Notes : Changes in soil chemical properties were evaluated for four site preparation techniques in northern Louisiana. The treatments were chop-and-burn, windrow, fuelwood harvest, and fuelwood harvest followed by a herbicide application. Chemical analyses consisted of total Kjeldahl N, extractable P, exchangeable K, Ca, Mg, percent organic matter, and pH. Values for pH significantly increased following all treatments. Soil organic matter decreased following treatment applications. There was a general increase in K, Ca, and Mg with the fuelwood treatment and decreases in those elements with the fuelwood plus herbicide treatment. The chop-and-burn and windrow treatments had intermediate effects on soil nutrient levels. An evaluation of revegetation following site preparations showed that biomass was significantly higher with the fuelwood treatment and significantly lower with the fuelwood harvest plus herbicide. The remaining two treatments were intermediate. Concentrations of K, Ca, Mg, and organic matter generally followed the treatment biomass pattern.

Ref ID : 284
284. Slay, J.M., Lockaby, B.G., Adams, J.C., and Vidrine, C.G. Effects of site preparation on soil physical properties, growth of loblolly pine, and competing vegetation. *Southern Journal of Applied Forestry* 11:83-86, 1987.
Keywords : effects; site; Site preparation; soil; soil physical properties; physical properties; growth; pines; vegetation; bulk density; density; treatment; fuelwood; application; Louisiana; Seedlings; porosity; seedling growth; survival; Pinus taeda; mechanical methods; USA; Soil physics; chemical treatment; herbicides; Triclopyr; competition; increment; Pinus; usage; crops; Forests; weeds; control; management; Forestry practices; soil density; Soil pore system; windrow
Notes : Bulk density was determined in soil samples collected before and 1 yr after 4 site preparation treatments ((a) chop and burn, (b) windrow, (c) fuelwood harvest and (d) fuelwood harvest followed by application of Garlon 4 [triclopyr]) were applied in July 1984 to a site in NW Louisiana. Dry wt. of competing vegetation was recorded one yr after site preparation. Loblolly pine seedlings (1+0) were planted in Jan. 1985 and ht. and diam. at ground level were recorded 1 yr later. Bulk density and total porosity were n.s.d. between treatments before site preparation. Treatment (b) increased bulk density and porosity at 0-3 inches while treatments (c) and (d) increased bulk density at 3-9 inches. Competing vegetation was significantly less with (d) and significantly more with (c) than with other treatments. Seedling growth was inversely related to wt. of competing vegetation. Seedling survival was n.s.d. between treatments.

Ref ID : 285
285. Smethurst, P.J. and Nambiar, E.K.S. Effects of slash and litter management on fluxes of nitrogen and tree growth in a young Pinus radiata plantation. *Canadian Journal of Forest Research* 20:1498-1507, 1990.
Keywords : effects; Slash; litter; management; nitrogen; Trees; growth; Pinus; Pinus radiata; plantations; site; Site preparation; soil; Soil water; water; temperature; nutrition; podzols; South Australia; Australia; weed; Planting; treatment; soils; soil water content; ploughing; mineralization; clear felling; felling; leaching; weeds; Conifers; mechanical methods; Soil chemistry; soil organic matter; soil temperature; leaf water potential; forestry; Soil morphology; Forest litter
Notes : The effects of site preparation practices on soil water and temperature, fluxes of mineral N, needle water potential, and tree nutrition and growth were studied from 1984 to 1987 in a young Pinus radiata plantation growing on a sandy podzol near Mount Gambier, South Australia. All plots were kept weed free from time of planting. Treatments were slash and litter retained (SL), litter only retained (L), litter ploughed (LP), and slash and litter removed (SLR). Soils without slash or litter cover (LP and SLR) were up to 4_C warmer on average than soils overlaid by slash or litter and were subjected to greater extremes of temperature. Treatments had relatively little effect on soil water content and

needle water potential in trees. C in surface soil increased from 1.14 to 1.83% after incorporation of litter by ploughing, but decreased to 1.37% during the next 40 months. Smaller but significant decreases in C also occurred in other treatments. LP and SLR led to the highest rates of N mineralization in the 1st year. During the first 3 years after clear felling, rates of N mineralization increased in SL, L and LP, but decreased in SLR. During the 4th year, rates of N mineralization were low (20-30 kgN/ha p.a.) in all treatments. Over 4 years, 211, 170, 210 and 147 kgN/ha were mineralized in treatments SL, L, LP and SLR, respectively. Rates of mineralization and leaching were strongly correlated (R2 = 0.82) with each other and leaching below 30 cm depth accounted for 75-85% of N mineralized irrespective of treatment. Incorporation of litter by ploughing doubled concentrations of mineral N during the first summer after planting and increased early tree growth.

Ref ID : 286
286. Smith, C.T. Is plantation forestry good or bad for soils? *New Zealand Forestry* 39:19-22, 1994.
Keywords : plantations; forestry; soils; soil; productivity; nutrients; nutrient availability; availability; quality; depletion; Forests; soil physical properties; physical properties; machinery; Site preparation; establishment; Harvesting; soil compaction; compaction; Erosion; classification; New Zealand; projects; Reports; soil degradation; Forest plantations; Soil fertility; soil classification; site; site productivity; New
Notes : Plantation forestry can be either good or bad for soils and site productivity. Plantation forestry is likely to improve soils where it results in increased nutrient availability; and to reduce soil quality where it leads to soil nutrient imbalances or depletion. Forests generally improve soil physical properties; however, machinery used for site preparation, establishment, and harvesting has the potential to reduce site productivity due to soil compaction and erosion. A classification system proposed for New Zealand soils [see Hunter, I. R.; Dyck, W. J.; Mees, C. A.; Carr, K. Site degradation under intensified forest harvesting: a proposed classification system for New Zealand. IEA/BE Project A3 (CPC-10) Report No. 7 (1988)] and the potential for site degradation under plantation forestry provides a preliminary basis for preventing declines in site productivity. The validity of this classification system is being tested at several locations throughout New Zealand.

Ref ID : 287
287. Smith, R.B. and Wass, E.F. Impacts of two stumping operations on site productivity in interior British Columbia. *Information Report Pacific and Yukon Region, Forestry Canada* No. BC-X-327, vi + 4:vi + 43 pp. 1991.
Keywords : impact; site; site productivity; productivity; British Columbia; stumps; control; roots; diseases; growth; Seedlings; Pseudotsuga; Pseudotsuga menziesii; Pinus; Pinus contorta; Larix; soil; chemical properties; Forest plantations; Site preparation; soil physical properties; Soil chemistry; stump removal; Larix occidentalis; stand development; Canada; chemical
Notes : Two clearcuts in southern interior British Columbia where stumps had been removed to control root disease were studied with adjacent unlogged and logged but not stumped portions to determine whether stumping affected growth of planted seedlings (Pseudotsuga menziesii, Pinus contorta and Larix occidentalis), particularly through changes in soil physical and chemical properties.

Ref ID : 288
288. Smith, W.H. and Dowd, M.L. Biomass production in Florida. *Journal of Forestry* 79:508-511, 515, 1981.
Keywords : Biomass; biomass production; production; Florida; projects; for energy; technology; plant; Slash; pines; Pinus; Pinus clausa; Eucalyptus; Eucalyptus viminalis; Casuarina; site; Site preparation; Planting; density; rotations; Genetics; trials; yields; methods; volume; Pinus elliottii; Eucalyptus robusta; Melaleuca quinquenervia; Taxodium distichum; Eucalyptus grandis; energy; Fuel plantations; USA; plants; rotation
Notes : A project investigating biomass production for energy is described, which is the major part of a Low Energy Technology programme promoted by the University of Florida Institute of Food and Agricultural Sciences, and commenced in 1979. The programme is mostly concerned with woody plants. A series of plots as planted with slash pine, sand pine (Pinus clausa), Eucalyptus viminalis, E. grandis, E. robusta, Melaleuca quinquenervia, Casuarina (3 spp.) and Taxodium distichum to investigate the opt. combination of site preparation, fertilization, planting density and rotation length for biomass production. Genetic selection was included in the trials. Preliminary estimates are tabulated of biomass dry yield - derived from similar plantings established for other purposes. First harvests showed that culture methods designed for biomass production yield greater volume than those for conventional timber production.

Ref ID : 289
289. Sokolovskaya, N.A., Revut, I.B., Markova, I.A., and Shevlyakov, I.R. The role of soil density in forest regeneration. *Lesovedenie* No. 2, 44-51; 10 ref:44-51, 1977.
Keywords : roles; soil; soil density; density; Forests; regeneration; Seedlings; Picea; Picea abies; Abies; Nurseries; forest soils; soils; types; mechanical; soil preparation; effects; plant; growth; growth and development; development; trials; light; germination; Seeds; ploughs; Cultivation; Artificial regeneration; Soil physics; density,compaction; relation to site factors; Site preparation; mechanical methods; USSR; Conifers
Notes : Seedlings and transplants of Picea abies were grown in pots of 38 litres capacity, filled with nursery or forest soils of various densities. Investigations were also made in the field on felled areas in two Spruce forest types where various kinds of mechanical soil preparation had been carried out. Soil density had a direct effect on plant growth and

development. In the pot trial, the optimum soil density for sandy-loam and light clay-loam soils was 1.15-1.28 g/cm3; on heavy clay-loam soil the optimum density was 1.0-1.1g/cm3 for seedlings and 1.0-1.2 g/cm3 for transplants. Growth decreased with increasing soil density above the optimum values, and at 1.45 g/cm3 the field germination of Spruce seeds was adversely affected. In the field investigations, soil conditions were better in the plough slices, and some practical recommendations are made as to the cultivation of felled areas in preparation for replanting.

Ref ID : 290
290. Somerville, A. Root anchorage and root morphology of Pinus radiata on a range of ripping treatments. *New Zealand Journal of Forestry Science* 9:294-315, 1979.
Keywords : roots; morphology; Pinus; Pinus radiata; ripping; treatment; Trees; New Zealand; resistance; natural regeneration; regeneration; site; stems; root systems; effects; Distribution; responses; Logging; mechanics; systems,distribution; Site preparation; mechanical methods; Wind damage; relation to site and stand characteristics; salvage fellings and logging; Conifers; New
Notes : Root anchorage was measured of 62 trees 111/2 yr old in the Canterbury Plains, New Zealand, by winching over and recording resistance by strain gauge. Hand-planted stock and natural regeneration were compared with machine-planted stock on sites produced by (a) shallow ripping (45 cm depth), (b) deep ripping (to 120 cm depth) at wider intervals, (c) a combination of (a) and (b) at right angles, and (d) deep ripping twice at right angles. Anchoring ability was increased by (b)-(d) which reduced uprooting relative to stem failure. Root systems were excavated and examined: total root wt. was greater in naturally regenerated trees but was unaffected by ripping treatment. The main effect on root distribution was an increase in sinker roots giving better anchorage. Roots were significantly aligned along rips. Uprooting is the predominant windthrow response locally and has the advantage that recovery logging need not be immediate.

Ref ID : 291
291. South, D.B., Zwolinski, J.B., and Donald, D.G.M. Interactions among seedling diameter grade, weed control, and soil cultivation for Pinus radiata in South Africa. *Proceedings of the international conference on forest vegetation management held at the School of Forestry, Auburn University, Auburn, Alabama, USA, 27 April 1 May 1992 [edited by Gjerstad, D* G. R.; Mitchell, R.R. J.-Journal, 1993.
Keywords : interactions; Seedlings; diameter; weed; weed control; control; soil; Soil cultivation; Cultivation; Pinus; Pinus radiata; South Africa; Africa; weeds; survival; growth; performance; Planting; application; Glyphosate; Hexazinone; hoeing; augers; ripping; discing; treatment; herbicides; standards; volume; height; chemical control; Site preparation; Tillage; physical control; increment; plant height; Planting stock; quality; Conferences; cultural weed control; integrated control; size; seedling growth; Forest plantations; plantations; Forest vegetation management; site; manual; methods; mechanical
Notes : Survival and growth was assessed of Pinus radiata seedlings planted on 26 September 1989 at a site in the southern Cape Province, South Africa. Second-year performance was examined in relation to (i) initial groundline diameter, (ii) intensity of weed control (manual release before and 1 year after planting, or application of glyphosate 3 months prior to planting plus hexazinone 7 months after planting plus additional hoeing), and (iii) method of soil cultivation (pitting by hand or with a mechanical auger, ripping or ripping plus discing). Seedlings with a 2-mm groundline diameter averaged 62% survival, whereas 5-mm seedlings averaged 85% survival. Use of large-diameter stock improved survival regardless of soil cultivation or weed control treatments. Total weed control with herbicides and hoeing improved survival for plots that received ripping or discing treatments. However, seedling survival was decreased where herbicides were used on plots where pits were used. In general, seedlings with larger diameters grew better than those with smaller diameters. However, small-diameter seedlings with total weed control grew better than large-diameter seedlings with standard weed control. Average seedling volume after 2 years was 33% greater for high-grade seedlings (2.4 dm3) than for low-grade seedlings (1.8 dm3). However, there were interactions between soil cultivation and weed control treatments for height and diameter growth. With the standard method of weed control, ripping improved height and diameter growth. Total weed control with herbicides and hoeing greatly improved growth for all treatments, and as a result, little or no differences in average seedling volume were observed between pitting and ripping treatments.

Ref ID : 292
292. Spittlehouse-DL and Stathers-RJ Seedling microclimate. *Land Management Report Ministry of Forests, British Columbia* No. 65, vi + 28 pp.;vi + 28 pp. 1990.
Keywords : Seedlings; soil; wind; temperature; soil temperature; Site preparation; regeneration; Forests; microclimate; site; vegetation; soil factors; Theses; light; air; air temperature; reforestation
Notes : Microclimate is affected by macroclimate, site, vegetation and soil factors. The influence of these factors in the light, precipitation, humidity, wind, air temperature, soil moisture and soil temperature regimes of seedlings on reforestation sites is discussed. Examples are presented of ways in which site preparation can modify microclimate.

Ref ID : 293
293. Squire, R.O., Farrell, P.W., Flinn, D.W., and Aeberli, B.C. Productivity of first and second rotation stands of radiata pine on sandy soils. II. Height and volume growth at five years. *Australian Forestry* 48:127-137, 1985.
Keywords : productivity; rotation; radiata pine; pines; sandy soils; soils; height; volume; growth; rotations; comparisons;

site; quality; litter; Logging; Residues; crops; establishment; nutrients; organic matter; mulches; soil; Pinus radiata; increment; site class assessment; Site preparation; Soil fertility; Soil types; Pinus; plantations; Soil types textural; Australia; Victoria; organic; site productivity
Notes : [See FA 42, 1698] Results of growth after 5 yr are presented for a comparison of the productivity of first rotation (1R) and second rotation (2R) growth on the same sites and on matched sites. The experiment included plots on both high and low quality sites. The non-burning of litter and logging residue before establishing the 2R crop was the only major difference in establishment practice between the 2 rotations. Both on matched sites and the same sites there was no evidence of a decline in 2R growth at 5 yr. 2R growth was greater than that of 1R in both height and volume, especially on the low quality sites. It is concluded that on infertile sandy soils, retention of litter and logging residue as a source of nutrients and organic matter for the next crop, as well as a mulch to conserve soil moisture, should at least maintain site productivity in the second rotation.

Ref ID : 294
294. Sternak-A Effect of site preparation and mineral fertilizers on root system development of Scots pine on former agricultural land. *Sylwan* 128:33-41, 1984.
Keywords : effects; site; Site preparation; fertilizers; roots; root system; development; pines; agricultural land; land; Trees; Poland; ploughing; Planting; NPK fertilizers; growth; mechanical methods; Conifers; root systems; old fields; rotation; furrows; scarification; treatment; NPK
Notes : Root systems of 5 yr old trees were excavated on old field sites in Poland prepared for a second rotation by (a) complete ploughing to a depth of 70 cm or (b) partial ploughing to produce planting furrows in strips with combined scarification; half of each treatment received NPK fertilizer at 100:80:100 kg/ha. NPK increased root length, depth and DM in all cases, but differences resulting from site preparation were greater with values for (a) both with or without NPK always higher than for (b).

Ref ID : 295
295. Stewart, R.E. Chapter 7. Site preparation. *Regenerating Oregon's forests [edited by Cleary, B* 100-129; 134 ref., 1:12 pl. Corvallis, Or, 1978.
Keywords : site; Site preparation; methods; burning; Theses; plantations; reviews; chemical methods; mechanical methods; USA; mechanical; chemical
Notes : Priorities for site preparation are listed and the 4 methods used in the Pacific Northwest (mechanical, prescribed burning, chemical, and combinations of these) are described in detail. Factors influencing choice of method are discussed and suggested methods are given for burns and logged ares, existing plantations, and areas of brush. [See next abstract].

Ref ID : 296
296. Stransky, J.J. Site preparation effects on soil bulk density and pine seedling growth. *Southern Journal of Applied Forestry* 5:176-180, 1981.
Keywords : site; Site preparation; effects; soil; bulk density; density; pines; Seedlings; seedling growth; growth; Forests; Texas; treatment; Slash; seasons; survival; stems; cultivation,soil; Soil physics; density,compaction; burning; mechanical methods; Pinus taeda; Forestry practices; responses; Conifers; USA; competition
Notes : Three pine/broadleaved forest sites in E. Texas were clear-felled in Aug. and Sept. 1972, and prepared in 4 ways in 1974: (a) no treatment; (b) burned; (c) chopped and burned; or (d) cut with a KG blade, cultivated, and the slash burned. One-yr-old loblolly pine seedlings were planted in 1974-1975. Soil bulk density was measured after 1 and 3 growing seasons, and pine survival, ht. and diam. growth recorded after 5 yr. Soil bulk densities of plots with treatments (c) and (d) were significantly greater than those with treatments (a) and (b). Av. survival, ht. and diam. growth of pines were also significantly higher after treatments (c) and (d), probably because of reduced competition from broadleaved woody stems.

Ref ID : 297
297. Stransky, J.J., Halls, L.K., and Watterston, K.G. Soil response to clearcutting and site preparation in east Texas. *General Technical Report, Southeastern Forest Experiment Station, USDA Forest Service* SE-24, 54-58; 20 ref:54-58, 1983.
Keywords : soil; responses; site; Site preparation; Texas; Forests; soil pH; pH; organic matter; burning; potassium; calcium; magnesium; treatment; phosphorus; nutrients; pines; Seedlings; vegetation; Conferences; Southern Silvicultural Research Conference; Soil chemistry; Soil types; forest soils; clear felling; Forestry practices; USA; chopping; organic; mechanical
Notes : On an east Texas forest site, clearcutting and site preparation did not change the soil pH. Chopping and KG blading significantly reduced organic matter in the surface soil, while burning slightly increased it. Organic matter showed a positive and significant relationship to potassium, calcium and magnesium. All site treatments increased phosphorus and potassium, with the greatest increase on the burned plots. Calcium and magnesium contents also increased with burning but decreased with KG blading. Burning appeared better than the other treatments for maintaining or improving the soil nutrient regime. However, planted loblolly pine seedlings survived and grew best with mechanical treatments that controlled competing vegetation.

Ref ID : 298
298. Stransky, J.J., Roese, J.H., and Watterston, K.G. Soil properties and pine growth affected by site preparation after clearcutting. *Southern Journal of Applied Forestry* 9:40-43, 1985.
Keywords : soil; soil properties; pines; growth; site; Site preparation; Texas; felling; Pinus; Pinus taeda; Seedlings; burning; nutrients; Soil chemistry; chemistry; P; pH; chopping; Logging; Slash; phosphorus; potassium; calcium; magnesium; mechanical methods; Forestry practices; Soil types; forest soils; Soil types ecological; USA
Notes : Plots in SE Texas were burned, chopped, KG-bladed or left untreated following clear felling in 1972, and 1-yr-old Pinus taeda seedlings were planted in spring 1974. Soil samples were collected as 1-inch diam. cores to 5 inches depth before felling and 1, 3 and 5 yr after site preparation. Burning appeared to affect soil nutrients least. KG-blading altered soil chemistry (P, K, Ca, Mg, pH) more than chopping, probably because logging slash was raked off the plots. Pines survived and grew best on mechanically-prepared areas, producing 1.5-3.3X more vol. than on untreated or burned areas by the end of the 8th yr.

Ref ID : 299
299. Sutton, R.F. Plantation establishment symposium. *Symposium Proceedings, Great Lakes Forest Research Centre, Canada* No. O-P-5, vi + 123:vi + 123 pp. + 1 app, 1977.
Keywords : plantations; establishment; Ontario; natural resources; Forests; research; forestry; production; quality; Distribution; site; Site preparation; Planting; tending; performance; analysis; Conferences; Silviculture; plantations,general; silvicultural aspects; Planting stock; grading,quality; handling,packing,transport; tending of stands and trees; Canada
Notes : The symposium, sponsored by the Ontario Ministry of Natural Resources and the Great Lakes Forest Research Centre (Canadian Forestry Service), was held at Kirkland Lake, Ontario, 21-23 Sept., 1978. Abstracts, supporting oral presentations, and discussions of papers presented at the symposium are included; the following main topics were covered: stock production (2 presentations), stock quality (5), holding and distribution (3), site preparation (6), planting (11), tending (3), and performance analysis (6).

Ref ID : 300
300. Sutton, R.F. Mounding site preparation: a review of European and North American experience. *New Forests* 7:151-192, 1993.
Keywords : mounding; site; Site preparation; reviews; history; mounds; effects; Forest management; plantations; temperate zones; Planting; Europe; North America; regions
Notes : A literature review. This practice in the northern boreal and temperate regions is reviewed under the following headings: terminology, history, kinds of mounds, effects of mounding, and mound making.

Ref ID : 301
301. Sutton, R.F. and Riley, L.F. Proceedings of a symposium on the equipment/silviculture interface in stand establishment research and operations: 28 September-03 October 1985, Jasper Park Lodge, Jasper, Alberta, Canada. *Information Report Ontario Region, Forestry Canada* No. O-X-401, vi + 19:vi + 191 pp. 1989.
Keywords : stand establishment; establishment; research; Alberta; Canada; Conferences; interactions; equipment; soil; site factors; work study; techniques; forestry; Forestry machinery; machinery; IUFRO; Equipment/silviculture interface in stand establishment research and operations; Site preparation; Silviculture; site
Notes : The conference was organized by IUFRO Working Party S3.02-01 Stand Establishment Operations. The 15 papers are in sessions on the interactions between engineering, biological and operational factors, interactions between equipment and soil or site factors, silvicultural prescriptions and work study technique for forestry machinery.

Ref ID : 302
302. Sutton, R.F. and Weldon, T.P. Jack pine establishment in Ontario: 5-year comparison of stock types _ Bracke scarification, mounding, and chemical site preparation. *Forestry Chronicle* 69:545-553, 1993.
Keywords : pines; establishment; Ontario; comparisons; types; scarification; mounding; chemical; site; Site preparation; performance; Pinus; Pinus banksiana; herbicides; treatment; Trees; soil; seasons; survival; height; increment; responses; growth; mounds; size; effects; stems; volume; growth rate; Forest trees; Canada; Planting stock; containers; bare rooted stock; mechanical methods; Glyphosate; Planting; seedling growth; Forestry machinery; Bracke scarifier; mechanical; Silt loam soils; P
Notes : Field experimentation was begun in 1984 to assess performance of jack pine (Pinus banksiana) (2+0 bare-root and FH408 Japanese paperpot) in relation to mechanical site preparation, including Bracke scarification with and without supplementary mounding, and site preparation using Roundup [glyphosate] herbicide. Twenty treatments encompassed 4480 trees in 40-tree plots split equally between bare-root and paperpot stock. The study site, about 200 km north of Sault Ste. Marie, Ontario, had deep silt loam soil. After 3 growing seasons, survival was significantly higher among bare-root than among paperpot stock, but survival no longer differed significantly ($P < 0.05$) between stock types 2 years later. In years 4 and 5, the rate of increase in mean total height of bare-root stock was 11% less than that of paperpot stock, although bare-root stock was 40 and 4.7 cm greater in mean total 5th-year height and 5th-year height increment, respectively. Paperpot stock needed mechanical site preparation more than did bare-root stock. By the end of year 5,

positive responses of survival and growth to mounding had become clear in both stock types; however, although mound size had little or no effect on survival or total height, mean stem volume was significantly ($P < 0.01$) greater on 20-litre (mineral matter) than on 10-litre mounds. Fifth-year mean stem volume was also significantly ($P < 0.01$) greater on mineral-on-organic (M/O) than on mineral-on-mineral (M/M) mounds. Chemical site preparation had no effect on relative growth rates beyond year 3. Indices that combined survival with total height or stem volume after 5 years showed the significant ($P < 0.01$) superiority of: 20-litre vs. 10-litre mounds, M/O vs. M/M mounds and chemical vs. no-chemical site preparation.

Ref ID : 303
303. Sutton, R.F., Weldon, T.P., and Haig, R.A. Conventional Bracke site preparation as effective as mounding. *Frontline, Technical Note Ontario Region, Forestry Canada* No. 1, 4 pp.; 11 ref:4 pp. 1991.
Keywords : site; Site preparation; mounding; survival; height; growth; Planting; Pinus; Pinus banksiana; Picea; Picea mariana; Bracke scarifier; scarifiers; Ontario; bare rooted stock; mechanical methods; scarification; mounds; Forestry machinery; increment; Planting stock; Canada; methods; bare rooted
Notes : Survival and relative height growth were recorded 5 yr after planting Pinus banksiana and Picea mariana on sites prepared by Bracke scarifier or Bracke mounder in Ontario. Results did not appear to justify mounding as a method of site preparation for bare-rooted stock.

Ref ID : 304
304. Sutton, R.F., Weldon, T.P., Smith, G.K.M., and Haig, R.A. Mounding and herbicide treatments increase performance of planted jack pine. *Frontline, Technical Note Ontario Region, Forestry Canada* No. 7, 3 pp.; 5 ref.3 pp. 1991.
Keywords : mounding; herbicides; treatment; performance; pines; Forest trees; mounds; Site preparation; Pinus banksiana; Canada; Ontario; Planting stock; Forest plantations; bare rooted stock; container grown plants

Ref ID : 305
305. Swindel, B.F., Conde, L.F., and Smith, J.E. Windrowing affects early growth of slash pine. *Southern Journal of Applied Forestry* 10:81-84, 1986.
Keywords : windrowing; growth; Slash; pines; measurement; Trees; soil; site; watersheds; effects; weeds; competition; nutrition; Site preparation; mechanical methods; USA,Florida; Pinus elliottii; increment; basal area; Pinus; height; volume; USA; Florida; windrow; weed
Notes : Measurements were made of 5-yr-old trees, in beds 16, 28, 40 and 76 ft from the centre of windrows, on 2 soil series on an intensively prepared site in a catchment in Bradford Experimental Watersheds [Florida]. Slash pine on beds nearest the windrow had 9, 33 and 45% more ht., b.a. and vol., respectively, than trees 40 ft away. There was no effect from soil series. The total effect of the windrow was probably underestimated because weed competition was also greater near windrows. It is concluded that the results were due to variable soil nutrition resulting from windrowing.

Ref ID : 306
306. Swindel, B.F., Marion, W.R., Harris, L.D., Morris, L.A., Pritchett, W.L., Conde, L.F., Riekerk, H., and Sullivan, E.T. Multi-resource effects of harvest, site preparation, and planting in pine flatwoods. *Southern Journal of Applied Forestry* 7:6-15, 1983.
Keywords : effects; site; Site preparation; Planting; pines; Reports; Catchment areas; Forests; Florida; management; treatment; burning; windrowing; Harrowing; chopping; control; sediment; sediment production; production; water; WATER QUALITY; quality; yields; Flora; mammals; water yield; storms; Streams; soil; nutrients; composition; types; plant; species diversity; winter; density; watersheds; forest ecology; Logging; hydrology; USA; intensive
Notes : [See also FA 43, 7302] A report, incorporating published results and results in press, of studies of 3 catchment areas (of 165 (a), 120 (b) and 345 acres (c)) in naturally regenerated, 40-yr-old slash/longleaf pine forest in the lower Coastal Plain, N. central Florida. Areas (a) and (b) were harvested, prepared and replanted over the period Nov. 1978 to Nov. 1979, under (a) less ecologically disruptive and (b) more disruptive management regimes than those typical in the area. Treatment for (b) included burning, windrowing and harrowing and bedding. Site (a) was prepared only by chopping and bedding and (c), the control, was not treated. Effects on sediment production, water quality and yield, flora and small mammal populations were monitored. Water yield increased during treatment. This increase was substantially greater when more of the area was harvested and intensively prepared as in (b). Treatment increased stormflow, especially for medium-sized storms. Peakflow rates increased only when the stream channel was exposed to more intensive site preparation in (b). Changes in water quality were small and transient: concn. of K, Ca and suspended sediment increased in (a) and (b) relative to the control (c). There was substantial soil and nutrient relocation with windrowing. Floral composition was altered by both types of site preparation, the frequency of herbaceous species increasing while that of woody species decreased. Plant species diversity was initially increased by less intensive practices. Winter bird densities increased.

Ref ID : 307
307. Switzer, G.L., Wylie, A.E., Geary, T.F., and King, J.P. Symposium on increasing timber production [in Spain]. *Comunicaciones, Instituto Nacional de Investigaciones Agrarias, Recursos Naturales* 145 pp. 1977.

Keywords : production; Conferences; Forests; forestry; site; Site preparation; Trees; effects; Afforestation; wood; crops; Spain; forests and forestry; research; Silviculture; Forest management; research,forestry; silvicultural planning; site class assessment; controlled
Notes : The symposium was held at Lourizan, 27-29 Jan. 1975. The introductory address by the President of INIA and the address and recommendations on the conference theme by the head of the visiting delegation from the US Forest Service (A.E. Wylie), are followed by papers read by the US delegates and the subsequent discussions:Switzer, G.L. Observations on the forestry sector in Spain.Wylie, A.E. The organization and administration of research.Switzer, G.L. Evaluating site productivity.Geary, T.F. Site preparation and improvement.King, J.P. Tree improvement.Switzer, G.L. Effects of afforestation on the environment.King, J.P. Controlled use of fire.Geary, T.F. Other factors.Geary, T.F. Production of wood and forage.Switzer, G.L. Forest wild life and timber production.Wylie, A.E. Choices between forest crops.

Ref ID : 308
308. Tabbush, P.M. Planting stock survival. *Scottish Forestry* 42:120-128, 1988.
Keywords : Planting; Planting stock; survival; surveys; Upland; Scotland; Picea; Picea sitchensis; pastures; costs; quality; effects; plant; handling; roles; Site preparation; Artificial regeneration; assessment; UK; site
Notes : Surveys at the end of 1981 on 96 upland sites in Wales, N. England and Scotland planted with Picea sitchensis in 1980 showed that av. survival on restocked clear-felled areas was 60% and that on ploughed upland pasture was 85%. Costs of such poor survival are estimated to be about ú350/ha. Factors affecting survival are discussed, including planting stock quality, effects of plant handling, and role of site preparation. Possibilities are explored for achieving 90% survival at the first attempt.

Ref ID : 309
309. Tan-KC Effects of disturbance and burning during land preparation on the rates of growth of two fast-growing tree species. *Malaysian Forester* publ. 1989, 49:49X: 3-4, 382, 1986.
Keywords : effects; burning; land; land preparation; growth; Trees; plantations; Planting; Forests; soil; Logging; damage; Tools; establishment; Site preparation; Soil fertility; Sabah; Malaysia; Eucalyptus; Gmelina arborea; site; soil disturbance; tractors; activity; descriptions; Theses; height; soils
Notes : Investigations are reported with Eucalyptus deglupta and Gmelina arborea in the commercial plantations of the Sabah Softwoods Sdn. Bhd. Observation plots were established for each species at 2 sites at the time of planting (in 1978 and 1980). Planting was done on recently (about 1 yr old) logged over forest and plots included 4 conditions: undisturbed/unburnt, grossly disturbed/unburnt, undisturbed/burnt and grossly disturbed/burnt. Soil disturbance was caused mainly by tractor activities during the logging of the high forest. Detailed growth data are given for each species over 6 yr, together with soil profile descriptions and analytical data. One year after planting, the main effect of soil disturbance was a 30% depressions of d.b.h. while the effect of burning was a 40% enhancement of d.b.h. Even after 6 yr these differences (respectively 15% and 20%) were still statistically significant. Height growth was also affected. It is concluded that a good burn during the preparation of the land for planting, and the minimization of damage to the soils during logging operations, are important silvicultural tools in the establishment of plantation forests.

Ref ID : 310
310. Taylor, G.G.M. Ploughing practice in the Forestry Commission. *1970, For* Lond. No. 73, 1970 p:1970 pp.44. [22 refs, 1970.
Keywords : ploughing; forestry; Forestry Commission; Planting; site; Soil types; classification; Cultivation; nutrition; competition; effects; equipment; models; furrows; specifications; ploughs; tractors; Site preparation; Site preparation ploughing; Great Britain ploughing & ploughs; Great Britain
Notes : Summarizes the experience of the Commission in ploughing before planting ca. 600,000 acres during the 20 years from 1948 to 1967. The current, 1970, planting programmes involve the ploughing of 40,000 acres/year. Ploughing practice is discussed in relation to: site considerations-the soil-type classification used is described and diagnostic characteristics are given in an appendix; silvicultural considerations-drainage, cultivation, nutrition, competition and other effects; and ploughing equipment - models developed and/or used by the Commission are described and illustrated by photographs and by cross-sectional diagrams of the furrow patterns, and specifications of ploughs and tractors are given in an appendix. Recommended practices are discussed and tabulated, and the probable trend of future technological advances in equipment is outlined.

Ref ID : 311
311. Tew, D.T., Morris, L.A., Allen, H.L., and Wells, C.G. Estimates of nutrient removal, displacement and loss resulting from harvest and site preparation of a Pinus taeda plantation in the Piedmont of North Carolina. *Forest Ecology and Management* 15:257-267, 1986.
Keywords : nutrients; removal; Losses; site; Site preparation; Pinus; Pinus taeda; plantations; North Carolina; Biomass; utilization; Trees; methods; P; burning; Theses; soil; Cycling; Logging; mechanical methods; USA; clear felling; Forestry practices; windrow; intensive
Notes : Biomass and nutrient removal and redistribution were estimated for combinations of two levels of harvest utilization (stem-only vs. complete tree) and two methods of site preparation (chop/broadcast burn vs. shear/pile/disc).

Stem-only harvest removed (per ha) 57 kg N, 5 kg P, 35 kg K, 52 kg Ca and 14 kg Mg. Complete-tree harvest increased N, P, K, Ca and Mg removal over stem-only harvest by 216, 304, 152, 254 and 151% respectively, although biomass removal was increased by only 65%. Estimated displacement of N and P into windrows during site preparation depended on harvest utilization, but generally exceeded harvest removals by at least 200%. Nutrient losses resulting from broadcast burning were small, primarily due to ineffectual burns. Removals, displacements and/or losses of nutrients during harvest and intensive site preparation were equal for both harvest utilization levels. These amounted to 714 kg/ha of total N in biomass and soil, and 46, 154, 481 and 88 kg/ha of P, K, Ca and Mg, respectively, in biomass and Mehlich III soil extractions.

Ref ID : 312
312. Thies, W.G. and Nelson, E.E. Bulldozing stumps and nitrogen fertilization affect growth of Douglas-fir seedlings. *Canadian Journal of Forest Research* 18:801-804, 1988.
Keywords : stumps; nitrogen; growth; Seedlings; treatment; stump removal; removal; application; nitrate; clear felling; felling; Washington; Pseudotsuga; Pseudotsuga menziesii; height; Planting; seedling growth; nitrogen fertilizers; fertilizers; Site preparation; mechanical methods; USA; responses; forestry
Notes : Eight treatments involving stump removal (either all stumps removed or the plot left undisturbed) and broadcast application of ammonium nitrate (N at 0, 336, 672 or 1345 kg/ha) were applied to 0.04-ha circular plots in a clear felling on the Olympic Peninsula, Washington. Pseudotsuga menziesii seedlings were planted several months after treatment; d.b.h. and height were recorded 5 and 8 yr after planting. Results showed that either bulldozing stumps or application of nitrogen increased seedling growth. After 8 yr, bulldozing had increased seedling height and d.b.h. by 23 and 43%, respectively; increases caused by nitrogen fertilizer were 13 and 17%, respectively.

Ref ID : 313
313. Thompson, D.A. Ploughing of forest soils. *Leaflet, Forestry Commission, UK* No. 71, 23 pp.; 11 r:23 pp. 1984.
Keywords : ploughing; Forests; forest soils; soils; Trees; specific; soil; Soil types; types; ploughs; costs; assessment; Site preparation; mechanical methods; forestry; Cultivation; UK
Notes : [See FA 41, 743] A discussion of the benefits of ploughing -which has as a primary objective improving rooting conditions for young trees, ploughing specific soil types (freely draining, impeded impervious, or varied soils), practical considerations, and suggested procedures. Appendices cover plough types, costs and assessment of benefits.

Ref ID : 314
314. Thomson, A.J. and McMinn, R.G. Height growth rates of young white spruce and lodgepole pine. *Canadian Journal of Forest Research* 19:257-261, 1989.
Keywords : height; growth; growth rate; pines; Planting; Planting stock; types; Picea; Picea glauca; Pinus; Pinus contorta; British Columbia; treatment; soil; increment; measurement; slopes; age; effects; Trees; size; Conifers; Variation; Site preparation; mechanical methods; Canada; bare rooted stock; containers; site; vegetation
Notes : Growth of different planting stock types (bare root/container/transplant) of white spruce (Picea glauca) and lodgepole pine (Pinus contorta) was measured between 1973 and 1984 on sites in British Columbia which had received the following treatments: scalping, where the surface soil and vegetation had been removed by bulldozing; mixing, where the vegetation had been incorporated into the underlying soil; clipping, where the vegetation was clipped; and untreated. Height increments varied with measurement period but had a pronounced peak at approximately 9 yr old. The slope of the linear regression of height vs. age up to 10 yr old gave estimates of average annual growth rates which were used to compare stock type and treatment effects. The growth rate of a tree of a particular size at the time of the first measurement after outplanting could not be predicted with confidence. However, the pattern of growth rates in a stock type of a species subjected to a particular site treatment exhibited characteristics that could be used to differentiate species, stock and site treatment effects. In white spruce, there was a tendency for growth rate to be related to size at first measurement, although with high variability around the trend. In lodgepole pine, growth rate was independent of tree size at first measurement, and showed less variability.

Ref ID : 315
315. Thomson, A.J. and McMinn, R.G. Effects of stock type and site preparation on growth to crown closure of white spruce and lodgepole pine. *Canadian Journal of Forest Research* 19:262-269, 1989.
Keywords : effects; types; site; Site preparation; growth; crown; pines; Picea; Picea glauca; Pinus; Pinus contorta; Seedlings; British Columbia; treatment; roots; fertilizers; control; slopes; height; age; increment; measurement; Distribution; projects; Trees; density; size; Conifers; Canada; mechanical methods; Planting stock; bare rooted stock; containers; forecasting; Stand characteristics; stand development; Theses; vegetation; growth rate; methods
Notes : Growth of white spruce (Picea glauca) and lodgepole pine (Pinus contorta) seedlings was studied on 6 installations in British Columbia, each containing different stock types and site preparation treatments. Stock types included styroplugs from different cavity sizes, bare root stock, and transplant stock; site preparations included no treatment, scalping, inverting, and mixing. Fertilizer was also used with some of these treatments on some installations. Site preparation treatments that gave some degree of vegetation control generally led to higher growth rates, but there was considerable variability between and within installations. The slope of the linear relation of height vs. age up to 10 yr old gave an estimate of early growth which was suitable for comparing treatments, whereas average height increment in

a later measurement period gave a better estimate of growth for projection purposes. A normal distribution of growth rates around a mean for a particular stock type and site preparation method was used in conjunction with height-d.b.h. and crown width-d.b.h. relations to project growth of trees to crown closure, assuming different densities. The age at crown closure depended on both growth rate and density, and average size at crown closure depended primarily on density.

Ref ID : 316
316. Tiarks, A.E. Effect of site preparation and fertilization on slash pine growing on a good site. *General Technical Report, Southeastern Forest Experiment Station, USDA Forest Service* SE-24, 34-39; 12 ref:34-39, 1983.
Keywords : effects; site; Site preparation; Slash; pines; Planting; Pinus; Pinus elliottii; application; phosphorus; height; growth; age; treatment; lime; Trees; Cronartium; stems; volume; Conferences; Southern Silvicultural Research Conference; phosphorus fertilizers; responses; Forestry practices; fertilizers; mechanical methods; USA,Louisiana; Cronartium fusiforme; damage; rust diseases; USA; Louisiana
Notes : Thirteen years after planting, slash pine (Pinus elliottii Engelm. var. elliottii) was still responding to a preplant application of 88 lb of phosphorus per acre. Bedding and flat disking improved height growth through age 13, but the effects of the site preparation treatments declined after age 10. Lime did not affect tree growth. Fusiform rust (Cronartium quercuum f. sp. fusiforme) infection of the main stems was about 84 percent for all treatments. Still, the volume increase from phosphorus application and bedding compare favorably with the expected increase in volume on poorer sites now being operationally bedded and fertilized.

Ref ID : 317
317. Timmis, R. Stress resistance and quality criteria for tree seedlings: analysis, measurement and use. *New Zealand Journal of Forestry Science* 10:21-53, 1980.
Keywords : resistance; quality; Trees; Seedlings; analysis; measurement; models; growth; environment; materials; hydraulics; information; leaves; decision making; Nurseries; treatment; site; Site preparation; Pseudotsuga menziesii; physiology; Planting stock; Tsuga heterophylla; grading,quality; pre conditioning/adaptation to site; methodology; systems analysis and simulation; physiology,plant; research; frost
Notes : A model is developed for predicting the growth of a seedling, in any environment, from data for its functional capabilities (e.g. photochemical efficiency), material properties (e.g. hydraulic conductivities), environmental coefficients (e.g. temp. range for growth) and tolerance limits (e.g. to frost), and information about its current state, e.g. leaf area, m.c. Some data are presented for western hemlock, Douglas fir, etc. The potential of the model for practical decision-making about nursery treatment, site preparation etc. is discussed.

Ref ID : 318
318. Tolay, U., Hizal, A., and Donmez, E. Methods of preparation of fine textured soils for reforestation of the coppice conversion site at Kerpe and their effects on soil physical conditions and plantation establishment. *Doga Bilim Dergisi, D2 Tarim ve Ormancilik* 7:171-175, 1983.
Keywords : methods; soils; reforestation; Coppice; conversion; site; effects; soil; plantations; establishment; Site preparation; Turkey; Forests; forest soils; growth; Pinus; Pinus pinaster; Rippers; Cultivation; survival; discs; Harrowing; Planting; mechanical methods; Soil cultivation; Soil types; clay soils; forestry; soil preparation
Notes : Various site preparation methods were compared in this plantation area on the Kocaeli Peninsula near Izmit, Turkey. The brown forest soil contained 47% clay, 31% silt. The best growth of young Pinus pinaster plantations (no details given) was obtained after deep soil preparation with winged Komatsu rippers, without soil turnover, and fine cultivation of the topsoil. Survival was improved by disc harrowing in the first years after planting.

Ref ID : 319
319. Trettin, C.C., Gale, M.R., Jurgensen, M.F., and McLaughlin, J.W. Carbon storage response to harvesting and site preparation in a forested mire in northern Michigan, USA. *Suo* 43:281-284, 1992.
Keywords : carbon; storage; responses; Harvesting; site; Site preparation; Michigan; USA; effects; types; wetlands; Forests; vegetation; Picea; Picea mariana; Larix; Larix laricina; Pinus; Pinus banksiana; treatment; Trees; discs; trenching; organic matter; decomposition; measurement; soil; Planting; assessment; productivity; composition; plant; plant communities; communities; Conferences; Carbon cycling in boreal peatlands and climatic change; forestry; clear felling; peatlands; Vegetation types; carbon cycle; pinopsida; Logging; organic
Notes : The effects of different types of silvicultural disturbances on carbon pools and wetland processes in a forested mire in Michigan, USA were studied. Forest vegetation consisted of Picea mariana, Larix laricina and Pinus banksiana. The treatments were: whole tree harvesting (WTH); WTH followed by disc trenching; WTH followed by bedding. Bedding, trenching, and WTH caused a significant reduction in whole-soil carbon pools. WTH caused a 35% reduction in carbon storage on the site. Changes in organic matter decomposition as a result of trenching and bedding further reduced carbon storage by 16-23%. Measurement of the soil carbon pools in the tree planting zone did not provide an accurate assessment of the treatment effect. Renewal of carbon accumulation would depend on the productivity and composition of the regenerating plant community and on the rate of decomposition of organic matter.

Ref ID : 320

320. Trettin, C.C., Jurgensen, M.F., Gale, M.R., and McLaughlin, J.W. Soil carbon in northern forested wetlands: impacts of silvicultural practices. *Carbon forms and functions in forest soils [edited by McFee, W J. M.]*. 1995., 437-4:437-461, 1995.
Keywords : soil; carbon; wetlands; impact; peatlands; Theses; Distribution; effects; Drainage; Harvesting; Site preparation; water; soil organic matter; Land types; forestry; management; Books; Soil types ecological; forest soils; Conferences; North American Forest Soils Conference; Carbon forms and functions in forest soils; Vegetation types; Silviculture; reviews; site
Notes : Three categories of forested wetlands are distinguished: mineral soil, histic-mineral soil, and peatlands. These categories reflect the degree to which the wetlands have accumulated soil C. The distribution and function of C in northern forested wetlands are reviewed. The effects of silvicultural practices (drainage, harvesting, site preparation) on soil C levels and soil and water processes are examined. The potential for recovery of soil C following disturbance by silvicultural practices is discussed.

Ref ID : 321
321. Turvey, N.D. and Cameron, J.N. Site preparation for a second rotation of radiata pine: soil and foliage chemistry, and effect on tree growth. *Australian Forest Research* 16:9-19, 1986.
Keywords : site; Site preparation; rotation; radiata pine; pines; soil; foliage; chemistry; effects; Trees; growth; rotations; Victoria; Logging; Slash; burning; removal; windrowing; stumps; mounds; ploughing; ploughs; weeds; weed control; control; nutrients; Planting; bulk density; density; age; treatment; survival; cations; cation exchange capacity; available; P; soil density; competition; water; chemical treatment; mechanical methods; Australia; Pinus radiata; crops; herbicide application; yields; Soil chemistry; Forestry practices; chemical; weed; wood; slash burning
Notes : Results are reported of 2 experiments in eastern Victoria on the effects on growth of second-rotation radiata pine of maceration of logging slash with a chopper roller, broadcast burning of slash, removal and windrowing of stumps and slash, mound-ploughing with a Rome bedding plough, and chemical weed control. Mound-ploughing resulted in an increase in nutrient concn. in the planting line, a reduction in soil bulk density in the mound and a 45% increase in wood vol. at age 8.5 yr. There was a similar increase in growth as a result of weed control, and the two treatments combined resulted in a greater than twofold increase in wood vol. Windrowing slash without weed control resulted in tree ht. and diam. less than those of the untreated control, but windrowing followed by weed control increased wood vol. by 75%. Non-treatment of the logging slash resulted in lower tree survival and wood vol. per unit area than if the slash had been chopper-rolled or burnt. Five years after treatment, slash burning had resulted in a 14-19% reduction in the surface soil of exchangeable Ca and Mg and cation exchange capacity; exchangeable K was translocated down the profile and available P was about 1 p.p.m. higher, but individual tree growth was not affected. The combination of chopper-rolling of slash, mound-ploughing and weed control ensured early survival of trees and improved growth due to increased nutrient concn. in the planting line, reduced soil density in the mound and reduced competition for water.

Ref ID : 322
322. Turvey-ND and Cameron-JN Site preparation for a second rotation of radiata pine: growing costs and production of wood and kraft pulp. *Australian Forestry* 49:160-165, 1986.
Keywords : site; Site preparation; rotation; radiata pine; pines; costs; production; wood; growth; age; establishment; Victoria; treatment; sandy soils; soil; ploughing; weeds; weed control; control; Slash; chemical treatment; Economics; mechanical methods; management; Conifers; Australia; soils; regions; weed
Notes : Growth of radiata pine measured at age 8.5 yr in 2 second rotation establishment experiments in Victoria was extrapolated over a 30-yr rotation with the objective of identifying those treatments which were best suited economically and silviculturally to the sandy soils of the study region. Rome ploughing and weed control both singly and together significantly increased wood vol. and pulp production and resulted in the lowest growing costs of wood and pulp. The combination of chopper-rolling slash, Rome ploughing and weed control was recommended, as it produced one of the greatest quantities and the cheapest wood and pulp.

Ref ID : 323
323. Tuttle, C.L., Golden, M.S., and Meldahl, R.S. Effect of surface soil removal on selected soil properties and loblolly pine seedlings after the first growing season. *General Technical Report, Southeastern Forest Experiment Station, USDA Forest Service* SE-24, 18-22; 23 ref:18-22, 1983.
Keywords : effects; soil; removal; soil properties; pines; Seedlings; seasons; Alabama; survival; bulk density; density; control; nutrients; height; growth; organic matter; Conferences; Southern Silvicultural Research Conference; Pinus taeda; Site preparation; Forestry practices; Losses; forest soils; Erosion; USA; site; organic
Notes : The effects of removal of 0, 2.54 and 7.62 cm of topsoil were tested on five sites in east-central Alabama. Results of the first year's data showed: (1) an increase in seedling survival on plots where the topsoil was removed; (2) higher bulk density on the treated areas than on the control; and (3) soil nutrient levels were significantly reduced after one growing season. Other variables (height growth, organic matter, etc.) were also tested but did not exhibit significant differences after 1 year.

Ref ID : 324
324. Tuttle, C.L., Golden, M.S., and Meldahl, R.S. Surface soil removal and herbicide treatment effects on soil properties

and loblolly pine early growth. *Soil Science Society of America Journal* 49:1558-1562, 1985.
Keywords : soil; removal; herbicides; treatment; effects; soil properties; pines; growth; Pinus; Pinus taeda; Seedlings; height; volume; plant; plant competition; competition; P; organic matter; seasons; nutrients; leaching; bulk density; density; site; Site preparation; Forestry practices; Losses; Losses from soil systems; mechanical methods; USA,Alabama; Erosion; weed control; Soil chemistry; assessment; USA; Alabama; Mn; organic
Notes : Neither soil removal nor herbicide treatment alone significantly increased loblolly pine (Pinus taeda) seedling height after 3 yr, although in combination they did increase height. Soil removal and herbicide treatments produced significantly higher 3-yr volumes, apparently due to nonpine plant competition reduction. Removal of 2.54 or 7.62 cm of surface soil resulted in significant decreases in Ca, K, Mn, P, N, and organic matter in the surface 30 cm after three seasons. Mobile nutrients (Ca, Mg, and K) were also apparently leaching through the surface layers on the removal treatments. Surface soil bulk density was increased by soil removal. Soil nutrient concentrations decreased and bulk densities increased as the quantity of soil removed increased. The degree of nutrient and organic matter reductions imply that the total site potential may have been lowered, particularly on the heavy soil removal treatment.

Ref ID : 325
325. Tuttle, C.L., Golden, M.S., and Meldahl, R.S. Effect of soil removal and herbicide treatment on soil properties and early loblolly pine growth. *Bulletin, Alabama Agricultural Experiment Station, Auburn University* No. 588, 22 pp.; 31:22 pp. 1987.
Keywords : effects; soil; removal; herbicides; treatment; soil properties; pines; growth; Planting; Pinus; Pinus taeda; Seedlings; Alabama; old fields; vegetation; survival; height; volume; nutrients; bulk density; density; competition; productivity; Site preparation; USA; forestry; Soil fertility; forest soils; Soil types ecological; ecology; chemical treatment; Soil chemistry; Soil physics; carbon; usage; Forests; soils; fertility; organic matter; types; site
Notes : Three levels of surface soil removal (nil, 1 inch and 3 inches) prior to planting of loblolly pine (Pinus taeda) seedlings were applied to four Alabama sites: an old field site in the Piedmont and old field, cutover and log deck (loading area) sites in the Hilly Coastal Plain. Half of the plots received herbicide. The effects on competing vegetation; on 3-year pine seedling survival, height and volume; and on soil nutrients, OM and bulk density are presented. Soil removal reduced competition and increased short-term pine survival and growth, but also reduced soil nutrients and OM and compacted the soil. Long-term reductions in soil productivity are discussed.

Ref ID : 326
326. Unger, P.W. and Kaspar, T.C. Soil compaction and root growth: a review. *Agronomy Journal* 86:759-766, 1994.
Keywords : soil; soil compaction; compaction; roots; growth; reviews; effects; crops; production; Reports; research; Theses; Distribution; water; nutrients; nutrient uptake; uptake; plant; yields; Tillage; management; root system; soils; rotations; rooting depth; root length
Notes : Adverse effects of soil compaction on crop production have been recognized for many years. The objectives of this report were to briefly review the early literature, review the contributions of Dr. Howard M. Taylor (1924-1991) and co-workers, examine the current status of soil compaction and root growth research, and identify research needs related to soil compaction and root growth. These studies showed that root growth and distribution were altered to the point that water and nutrient uptake, and, hence, plant growth and yield, were reduced when soil strength reached critical levels due to natural or induced compaction.That research formed the basis for our current knowledge confirming the effects of compaction on root growth and the alleviation of compaction through soil and tillage management. Usually, not all parts of a root system are equally exposed to compaction under field conditions. Hence, because of compensatory growth by unimpeded parts of the system, only the distribution and not the total length of roots may be altered. Even if compaction limits root growth, weather events sometimes enhance or diminish the effect of root limitation on crop growth. To reduce risks in dry years and to use applied nutrients efficiently, managing soils through the use of tillage and related practices and growing of deep-rooted crops in rotations will help avoid or alleviate compaction, thus improving root distribution and increasing rooting depth.

Ref ID : 327
327. Utzig, G.F. and Walmsley, M.E. Evaluation of soil degradation as a factor affecting forest productivity in British Columbia. A problem analysis. Phase I. *FRDA Report Victoria, B* No. 025, ix + 122 pp:ix + 122 pp. 1988.
Keywords : soil; soil degradation; Forests; forest productivity; productivity; British Columbia; analysis; Losses; Harvesting; Site preparation; degraded soils; forestry; rehabilitation; costs; planning; Logging; Canada; mechanical methods; damage; Soil fertility; skidding; windrowing; scarification; site; methods; soils; activity; returns; alternatives
Notes : An analysis of the causes, nature and extent of soil degradation, and the potential resultant losses in productivity. Ground skidding has the greatest potential to cause soil degradation during harvesting, and windrowing and blade scarification are considered the most harmful site preparation methods. Total area of degraded soils resulting from all forestry activity in 1976-85/86 was over 400 000 ha, and over 49 000 ha for the year 1985/86. Potential reduction in productivity over the period is estimated at 400 000 m3/yr and is increasing by 50 000 m3 per yr. Rehabilitation costs range from $500 to $5000/ha and seldom returns the site to original productivity, whereas costs for prevention/reduction of degradation are estimated at $250-$1800/ha through alternative harvesting methods and 0-$200/ha for improved pre-harvest planning. Significant reductions in degradation can be achieved without significant cost, and prevention is both more effective and cheaper than rehabilitation.

Ref ID : 328
328. van der Paas, J.B. and Hood, I.A. The effect of site preparation on the incidence of Armillaria root rot in Pinus radiata four years after conversion from indigenous forest in Amataroa Forest, New Zealand. *NZFS Reprint No.* 1721, 1983.
Keywords : effects; site; Site preparation; Armillaria; roots; Pinus; Pinus radiata; conversion; Forests; New; New Zealand; root rot; indigenous forest

Ref ID : 329
329. Vanclay, J.K. and Anderson, T.M. Initial spacing effects on thinned stem volumes of slash pine in south east Queensland. *Research Note, Department of Forestry, Queensland* No. 34, 9 pp.; 2 ref:9 pp. 1982.
Keywords : spacing; effects; stems; volume; Slash; pines; Queensland; quality; site; Site preparation; Trees; thinning; equations; research; Pinus elliottii; volume determination; increment; growth habit; Australia,Queensland; Australia; New
Notes : Stands established in 1969 at square spacings of 1.8, 2.1, 2.4, 2.7 or 3.0 m were each thinned in 1980 to b.a. of 17.5, 24.5 or 30 m2/ha (60, 80 or 100% of limiting b.a.) or left unthinned. Spacing, stock quality and site preparation significantly affected stem form and vol. of the thinned trees but thinning intensity did not. It is suggested that a new vol. equation should be calculated for commercial pulp thinnings in slash pine, and that a new form-class vol. equation should be developed for research use, to allow vol. to be estimated independently of initial spacing.

Ref ID : 330
330. Vaughn, S.B. and Kluender, R.A. Criteria for environmental protection planning for harvesting and site preparation. *1982, 14 pp* DC, USA; American Pu:USA, 1982.
Keywords : environmental protection; protection; planning; Harvesting; site; Site preparation; legislation; treatment; roads; impact; Logging; Trees; Planting; wildlife; Reports; effects; Economics; USA; forestry; environment; Forest products industries; ecology; Erosion
Notes : A discussion of: applicable laws and legislation; treatment of roads and trails; minimum impact logging; site preparation; tree planting practices; and wildlife diversity. The report concludes that the most critical areas for attention (with relation to environmental effects) are roads and trails, site preparation, and stream-side filter strips. Recommendations are made for companies to plan operations based on minimum site impact, combined with economic factors. Suggestions are presented for best practices.

Ref ID : 331
331. Vitousek, P.M. and Andariese, S.W. Microbial transformations of labelled nitrogen in a clear-cut pine plantation. *Oecologia* 68:601-605, 1986.
Keywords : transformations; nitrogen; pines; plantations; transformation; effects; Forests; Forest management; management; soil; North Carolina; nitrate; mineralization; treatment; Residues; discing; nitrification; availability; vegetation; microorganisms; clear felling; Tracer techniques; USA; forestry; Soil chemistry; Pinus; Soil biology; Site preparation; mechanical methods; intensive; windrow; site
Notes : Labelled nitrogen was used to evaluate the effects of intensive forest management on soil nitrogen transformations in North Carolina. The total release of N into inorganic forms (ammonium plus nitrate) was much greater than net N mineralization in all treatments. Immobilization of N by microbes was greatest in minimally-treated harvested plots (residues chopped in situ), while the turnover of N within soil microbes was greatest in intensively-treated plots (bulldozing residues plus some soil into windrows and discing). Ammonium was immobilized 2.4-3.2 times more rapidly than nitrate in harvested plots; nitrification in disturbed sites could thus increase the availability of N to regrowing vegetation.

Ref ID : 332
332. Vitousek, P.M., Andariese, S.W., Matson, P.A., Morris, L., and Sanford, R.L. Effects of harvest intensity, site preparation, and herbicide use on soil nitrogen transformations in a young loblolly pine plantation. *Forest Ecology and Management* 49:277-292, 1992.
Keywords : effects; site; Site preparation; herbicides; soil; nitrogen; transformations; pines; plantations; transformation; Trees; stems; treatment; Pinus; Pinus taeda; North Carolina; mineralization; Conifers; nitrogen cycle; Logging; Cycling; logging effects; mechanical methods; USA; tree length logging; whole tree logging; Glyphosate; Hexazinone; Soil chemistry; control; weeds; cultural control; Harvesting; forest soils; nitrification; forestry; Soil types ecological
Notes : Interactive effects of harvest intensity (whole tree versus stem only), site preparation (chop and burn versus shear/pile/disc), and silvicultural treatment (herbicide/pesticide versus none) on soil N pools and transformations were determined in a young (planted 1982) loblolly pine (Pinus taeda) plantation on the North Carolina Piedmont. Harvest intensity had little effect on N transformations after 3 to 5 years, but shear/pile/disc site preparation and especially herbicide treatment caused increased net N mineralization and nitrification in treated plots. Laboratory experiments with 15N yielded reduced rates of N immobilization in the herbicide treated plots, demonstrating long-term consequences of such treatment for soil N transformations.

Ref ID : 333

333. Vitousek, P.M. and Matson, P.A. Mechanisms of nitrogen retention in forest ecosystems: a field experiment. *Science, USA* 225:51-52, 1984.
Keywords : nitrogen; Forests; ecosystems; measurement; Losses; leaching; Erosion; denitrification; soil; pines; plantations; North Carolina; Trees; stems; site; Site preparation; methods; chopping; discing; herbicides; plant; seasons; nitrate; uptake; decomposition; materials; removal; Slash; Harvesting; effects; nitrogen cycle; nutrient cycles; Logging; clear felling; Soil chemistry; chemical treatment; mechanical methods; Pinus taeda; Forestry practices; Cycling; USA; plants; organic
Notes : Measurements were made of nitrogen loss (from leaching, erosion and denitrification) and chemsitry and metabolism in the soil in experimental plots in a cleared 22-yr-old loblolly pine plantation in North Carolina. plots varied in harvest intensity (whole tree or stem only) and site preparation method (chopping or shearing, piling and discing). Herbicides were applied to some. On some plots nitrogen retention processes were studied directly by applying 15N-ammonium sulphate and analysing plants and soil at the end of the first growing season. On the basis of nitrate pool sizes and losses and the pattern of 15N retention, it was concluded that the most important nitrogen retaining process was by microbial uptake during the decomposition of residual organic forest floor material. Removal of such material by shearing, piling and discing resulted in increased nitrate losses. Slash was a relatively minor sink for 15N, so whole-tree harvesting had little effect on nitrate losses.

Ref ID : 334
334. Vitousek, P.M. and Matson, P.A. Intensive harvesting and site preparation decrease soil nitrogen availability in young plantations. *Southern Journal of Applied Forestry* 9:120-125, 1985.
Keywords : intensive; Harvesting; site; Site preparation; soil; nitrogen; availability; plantations; Pinus; Pinus taeda; Alabama; North Carolina; Virginia; Georgia; treatment; mineralization; P; herbicides; herbicide application; application; Soil chemistry; USA; mechanical methods; nitrogen cycle; transformation; Forestry practices; usage; crops; Forests
Notes : Soil samples were collected in May 1983 from 5 sites with 1- to 5-yr-old Pinus taeda plantations in Alabama, North Carolina, Virginia and Georgia given varying harvesting, site preparation and silvicultural treatments. On 2 sites (Alabama, North Carolina), net N mineralization was higher (P = 0.07) in drum chopped plots (7.4-8.2 mg N per g soil) compared with plots that had been sheared, piled and disced (4.2-4.6 mg N per g soil) both following stem-only harvest. Herbicide application on one site (North Carolina) was significantly associated with increased potential net N mineralization.

Ref ID : 335
335. Wang-GL, Chao-Z, Chen-SH, Gao-S, and Xie-FM Long term effects of site preparation in reversed-slope terraced fields on stand growth on hill slopes in loess plateau areas. *Forest Science and Technology* No. 6, 7-9.7-9.X, 1987.
Keywords : effects; site; Site preparation; growth; slopes; Forests; soil; porosity; water; storage; roots; terraces; Distribution; Trees; Soil physics; Soil water; infiltration; increment; Terracing; soil properties; Multipurpose trees; Soil water movement; Broadleaves; China; Shaanxi; methods; soils; P
Notes : Systematic investigations in April-May, 1984 by the Northwest Forest College on different site preparation methods in reversed-slope terraced fields showed that site preparation patterns can have long-term beneficial effects on stand growth. Soils in the reversed-slope terraced fields had a greater porosity facilitating water seepage, storage, aeration and root penetration, and have a high P content. Soil m.c. was 1.74 and 1.61X that of fish-scale pits and level terraces. The horizontal distribution of roots was 25-50% greater than that in other patterns of site preparation. The ht. of black locust trees [Robinia pseudoacacia] was 5-43% greater, d.b.h. was 5-36% greater, and the standing vol. of individual trees was 11.47% greater than on sites prepared using other methods.

Ref ID : 336
336. Watson, W.F., Stokes, B.J., Ragan, J.R., and Dubois, M.R. Intensive utilization and its economic impact on pine plantation establishment. *Southern Journal of Applied Forestry* 16:9-12, 1992.
Keywords : intensive; utilization; Economics; impact; pines; plantations; establishment; costs; Harvesting; Pinus; Pinus taeda; Mississippi; Site preparation; Biomass; growth; survival; standards; Logging; plant residues; Slash; Forest economics; Forest plantations; USA; site; mechanical
Notes : The opportunity to reduce re-establishment costs by intensive utilization during harvesting was evaluated in natural and planted stands of loblolly pine (Pinus taeda) in north Mississippi. Site preparation savings of $25-100/acre were realized in stands where intensive utilization of the above ground biomass was practised. Significant differences in growth or survival were seldom seen in stands established after mechanical site preparation following harvesting to conventional or intensive standards.

Ref ID : 337
337. Weaver, G.H. and Osterhaus, C.A. Economic analysis of planting costs in Loblolly Pine management. *Journal of Forestry* 74:217-219, 1976.
Keywords : Economics; economic analysis; analysis; Planting; costs; pines; management; methods; site; Site preparation; investment; regeneration; Pinus; Pinus taeda; productivity; Artificial regeneration; Conifers; site productivity
Notes : Shows, with an example of the financial implications of planting after three different methods of site preparation, how investment schedules for the regeneration of Pinus taeda can be developed from data on regeneration costs, site

productivity and expected product values, and concludes that only the best sites justify capital-intensive regeneration methods.

Ref ID : 338
338. Webb, R.S., Hollis, C.A., and Swindel, B.F. Incidence of Heterobasidion annosum basidiocarps on two low-hazard Florida soils after clearfelling and site preparation. *Southern Journal of Applied Forestry* 6:39-41, 1982.
Keywords : Heterobasidion annosum; Florida; soils; site; Site preparation; Slash; pines; stumps; felling; Seedlings; Planting; stems; roots; soil; Soil types; types; treatment; thinning; Pinus elliottii; diseases and disorders; decay; control; assessment; Forestry practices; clear cutting; Plant diseases; Fungi; Conifers; USA
Notes : Residual slash pine stumps in sites prepared at 3 levels of intensity were tested for basidiocarps in April 1980, 18 months after clear felling. Dead (3) and dying seedlings were collected in May 1980, after planting in Nov. 1979, and stem and root chips cultured on a selective medium. Although 54-83% of the stumps were infected (n.s.d. between soil types or site preparation treatment), the fungus was not isolated from seedlings. It is suggested that risk of infection could be reduced further by thinning or felling in the summer.

Ref ID : 339
339. Weert, R. Influence of mechanical forest clearing on soil conditions and the resulting effects on root growth. *Weert, R* K. J.51: 2, 325-331, 1974.
Keywords : mechanical; Forests; soil; effects; roots; growth; Soil structure; Surinam; machinery; seasons; land clearance; Soil physics; density,compaction; Site preparation; mechanical methods; agricultural operations; Soil fertility; windrow
Notes : Discusses the best means of clearing the forest mechanically in order to bring it into agricultural use, with reference to observations of the deterioration in soil structure after clearing large areas in interior Surinam with heavy machinery. It is recommended that clearing should be done in the dry season, the distance between windrows should be decreased, and the topsoil should be kept intact as far as possible.

Ref ID : 340
340. Weert, R. and Lenselink, K.J. The influence of mechanical clearing of forest on some physical and chemical soil properties. *Surinaamse Landbouw* 20:2-14. 1972.
Keywords : mechanical; Forests; chemical; soil; soil properties; soil compaction; compaction; machinery; wind; resistance; Soil types; types; water; volume; crops; roots; development; Runoff; soil physical properties; Forestry practices; deforestation; land clearance; Site preparation; mechanical methods; Soil physics; density,compaction; Surinam; available
Notes : A certain degree of soil compaction occurs in the interior of Surinam as a result of forest clearing with heavy machinery. Also, the topsoil may be removed in many places, especially during wind-rowing. The resistance of the soil to compaction mainly depends on soil type and moisture content during clearing operations. Except at extremely high compaction when the micropores are strongly compressed the available water content (% by volume) generally increases with compaction. The soil moisture available for the crop (mm) however mostly decreases because of limited root development due to reduced aeration and increased mechanical impedance. Diffusion and mass flow can be increased by compaction but they are impaired when surface runoff increases and the moisture content of the soil decreases.[13:495.8].

Ref ID : 341
341. Wilhite, L.P. and Jones, E.P.,Jr. Bedding effects in maturing slash pine stands. *Southern Journal of Applied Forestry* 5:24-27, 1981.
Keywords : effects; Slash; pines; discs; stems; analysis; Trees; plantations; Florida; age; growth; Pinus elliottii; planting methods; Planting; methodology; Site preparation; mechanical methods; Conifers; USA
Notes : Discs were removed for stem analysis from dominant trees felled in (a) 45-yr-old unbedded and (b) 35-yr-old bedded plantations in Florida, in April, 1975. From the data, ht. vs. age curves were constructed, and c.a.i. (ht.) calculated. Trees on bedded plots had consistently greater av. ht. but the advantage of bedding declined after 17 yr (10.8 ft taller at age 17, 5.7 ft at age 35). Annual growth on the bedded plot fell below that of the unbedded plot by age 18 yr, and continued to decline until it was 0.34 ft. less at age 35.

Ref ID : 342
342. Wilhite, L.P. and McKee, W.H.,Jr. Site preparation and phosphorus application alter early growth of loblolly pine. *Southern Journal of Applied Forestry* 9:103-109, 1985.
Keywords : site; Site preparation; phosphorus; application; growth; pines; South Carolina; soils; treatment; P; soil; fertilizers; Trees; survival; foliage; herbicides; hand tools; Tools; mechanical methods; Pinus taeda; USA; Pinus; potassium; phosphorus fertilizers; responses; Forestry practices; intensive
Notes : Pines were planted in 1971 or 1973 on 3 sites in South Carolina with poorly drained, somewhat poorly drained and moderately well drained soils, given 1 of 6 site preparation treatments. After 1 yr, plots were treated with (a) 50 lb/acre P, (b) 100 lb/acre K, (c) treatments (a) and (b) together, or (d) left untreated. Soil cores were analysed before fertilizer treatment. Tree ht. and survival were recorded and foliage samples were collected and analysed annually for 5 yr. After 5 yr, the most expensive and intensive treatment (shear-rootrake-bed with P fertilizer and a small amount of

herbicide) had produced the tallest pines. However, growth was good on plots given the least intensive and cheapest treatment (prepared with hand tools, no P fertilizer, and a larger quantity of herbicide). Growth on plots sheared and rootraked was poor. Low foliar N, P and Ca % also indicated that rootraking degraded sites.

Ref ID : 343
343. Williamson, M.J. Cultivation in Northland. *New Zealand Journal of Forestry* 30:218-231, 1985.
Keywords : Cultivation; soils; podzols; pines; Forests; P; site; Site preparation; fertilizers; Fertilizer application; application; techniques; trials; types; soil; vegetation; Vegetation types; mechanical methods; New Zealand; Soil types; luvisols; Pinus radiata; Northland; Forestry practices; Soil types genetic; radiata pine; mechanical
Notes : Up until 1970 the strongly podzolized soils and podzols common in Northland were considered unsuitable for growing radiata pine, and where they occurred within state forest they were either left unplanted or planted with the more tolerant southern pines such as P. taeda or P. elliottii. However, site preparation and fertilizer application techniques adopted since 1970 have extended the range of sites where radiata pine can now be successfully established. Results are reported of several trials in Northland, and recommendations are made on the type of mechanical site preparation to be applied according to soil and vegetation types and the presence or absence of hardpan.

Ref ID : 344
344. Williston, H.L., Jackson, R.S., Burns, E.B., Boyer, W.D., Williams, R.A., McLemore, B.F., Trevison, A., Shoulders, E., Campbell, R.G., and Blackmon, B.G. Proceedings: site preparation workshop - West. *1977, 40 pp* State and Private Fo, 1977.
Keywords : site; Site preparation; Louisiana; Georgia; Alabama; Mississippi; fire; burning; natural regeneration; regeneration; pines; chemicals; control; equipment; fertilizers; soil; damage; Drainage; techniques; soil management; management; plantations; Pinus palustris; Conferences; chemical methods; mechanical methods; USA
Notes : The workshop was held at Alexandria, Louisiana on 27-28 April 1977; speakers were from Georgia, Louisiana, Alabama, and Mississippi. The following papers are included: Jackson, R. S. Use of prescribed fire in site preparation. Burns, E. B. Prescribed burning for site preparation. Boyer, W. D. Use of fire in natural regeneration of longleaf pine [Pinus palustris]. [1 ref.] Williams, R. A. Site preparation for pine regeneration by the use of chemicals. McLemore, B. F. Control of hardwoods with chemicals. [8 ref.] Trevison, A. Site preparation using heavy equipment. Shoulders, E. Site preparation with fertilizers and other ameliorative measures [including repair of soil damage from wet weather operations, drainage, and control of competitive vegetation]. [29 ref.] Campbell, R. G. Site preparation with fertilizers and other ameliorative techniques [outline only]. Blackmon, B. G. Soil management in hardwood plantations [already noticed in FA 40, 2078].

Ref ID : 345
345. Wittwer, R.F., Dougherty, P.M., and Cosby, D. Effects of ripping and herbicide site preparation treatments on loblolly pine seedling growth and survival. *Southern Journal of Applied Forestry* 10:253-257, 1986.
Keywords : effects; ripping; herbicides; site; Site preparation; treatment; pines; Seedlings; seedling growth; growth; survival; Oklahoma; methods; control; Hexazinone; soil; seasons; Biomass; vegetation; Pinus taeda; mechanical methods; USA; chemical treatment; Quercus; usage; crops; Forests; weeds; cultural control
Notes : A native oak/shortleaf pine stand was clear felled in the Ouachita Mts., Oklahoma in 1982. The area was chopped and burned before 4 methods of site preparation were applied: (a) no further treatment (control); (b) ripping to a depth of 18-20 inches in Nov. 1982; (c) hexazinone spray at 1lb/acre in Feb. 1983; and (d) ripping + hexazinone. Loblolly pine seedlings (1+0) were planted in Mar. 1983. Compared with the control, all methods of site preparation increased soil moisture on most dates during the first growing season. Biomass of competing vegetation was reduced by treatments with herbicides and the effects were still apparent after 2 yr. Total ht. of seedlings after 2 yr was increased by 10, 23 and 49% by (b), (c) and (d), respectively. Diam. at ground level was increased 20, 55 and 83%, respectively, by the same treatments. No significant differences in survival were seen between treatments.

Ref ID : 346
346. Wood, J.E., Sutton, R.F., Weldon, T.P., and Rissanen, H. Jack pine establishment: effect of stock type, Bracke scarification, mounding, and chemical site preparation. Three-year results. *Information Report Great Lakes Forestry Centre, Canadian Forestry Service* No. O-X-393, v + 19:v + 19 pp. 1988.
Keywords : pines; establishment; effects; types; scarification; mounding; chemical; site; Site preparation; performance; bare rooted stock; Pinus; spraying; Ontario; assessment; growth; volume; Glyphosate; responses; Conifers; Planting stock; containers; Pinus banksiana; chemical treatment; mechanical methods; Canada; herbicides; usage; crops; Forests; bare rooted; mechanical; survival; seasons; mounds
Notes : A field experiment was begun in May 1984 to assess the performance of 2+0 bare rooted stock and FH408 Japanese paperpot stock of jack pine (Pinus banksiana) in relation to mechanical site preparation (Bracke scarification) with and without both various kinds of mounding in June 1983 and chemical site preparation (spraying Roundup [glyphosate] in August 1983) on deep silt loam about 200 km N. of Sault Ste. Marie, Ontario. Assessments of survival and growth were made annually for 3 yr. The paperpot stock after 3 seasons was larger than the bare rooted stock after 2 seasons. Paperpot stock benefited more than bare rooted stock from mechanical site preparation. Both stock types responded positively to mounding. Shape, volume and type of mound had little effect on survival or growth. There were

consistent indications that glyphosate spraying gave positive (although not significant) growth responses to both stock types.

Ref ID : 347
347. Woodrum, W.G.,II Response of bottomland-planted cherrybark oak seedlings to natural, mechanical, and chemical methods of competition control. *Forestry Abstracts* 44:713. 1983.
Keywords : responses; Seedlings; mechanical; chemical; chemical methods; methods; competition; control; Quercus falcata pagodaefolia; Silviculture; Theses; USA; growth; Improvement planting; herbicides; Glyphosate; Artificial regeneration; protection; Site preparation; mechanical methods; Vegetation types; bottomland forest; Quercus falcata; weeds; chemical control; cultural control; management; Forests

Ref ID : 348
348. Zarnoch, S.J. and Feduccia, D.P. Slash pine plantation site index curves for the West Gulf. *Southern Journal of Applied Forestry* 8:223-225, 1984.
Keywords : Slash; pines; plantations; site; age; Trees; Site preparation; models; equations; site class assessment; increment; simulation; Pinus elliottii; USA
Notes : Data consisting of plantation ages and av. ht. of dominant/co-dominant trees from 247 thinned and unthinned stands on problem-free plots (site preparation not required) were fitted to 5 site index curve models. Av. age was 22 yr (range 9-47 yr) and av. ht. 57 ft (range 12-95 ft). The selected model is a simple 2-parametric equation and gave more resonable results than the others for ages <9 yr.

Ref ID : 349
349. Zobeck-TM, Fryrear-DW, and Pettit-RD Management effects on wind-eroded sediment and plant nutrients. *Journal of Soil and Water Conservation* 44:160-163, 1989.
Keywords : management; effects; sediment; plant; nutrients; Residues; herbicides; Erosion; soil; wind erosion; land management; Losses; usage; Broadleaves; Cycling; sodium; potassium; magnesium; calcium; Soil chemistry; ion exchange capacity; Site preparation; burning; chemical treatment; Grazing; USA; land; Quercus; site; treatment; height; comparisons; Theses; removal
Notes : The following five land management practices were evaluated on a Brownfield fine sand (loamy, mixed, thermic Arenic Aridic Paleustalf) to determine their effects on windblown sediment and plant nutrients: shinnery oak (Quercus havardii) rangeland with 12\thin\400 kg/ha surface residue; a burned rangeland site with 800 kg/ha residue; a cleaned-till abandoned field with 1600 kg/ha residue; a clean-tilled field with 500 kg/ha residue; and a herbicide-treated rangeland with 4400 kg/ha residue. The clean-tilled practice produced the greatest amount of windblown sediment, followed by the burned, abandoned, herbicide, and undisturbed treatments. The selectivity of the erosion process for certain soil nutrients was evaluated by comparing the nutrient levels in the sediment to that of the original surface. Levels of Na, K, Mg, Ca, CEC and OM for relatively bare treatments were generally lower than for treatments with greater amounts of surface residue and increased with height above the soil surface. Comparisons of total nutrients or OM in the windblown sediment showed great differences among treatments and nutrients. OM collected on the burned treatment, for example, was 81 times that collected on the abandoned field. CEC of the burned site was 48 times that collected on the abandoned field. These results demonstrate the selective removal of plant nutrients in wind-eroded sediment and show the relative rate of removal to be dependent upon management practice.

Ref ID : 350
350. Zwolinski, J.B. and Donald, D.G.M. Differences in vegetation cover resulting from various methods of site preparation for pine plantations in South Africa. *Annales des Sciences Forestieres* 52:365-374, 1995.
Keywords : vegetation; methods; site; Site preparation; pines; plantations; South Africa; Africa; composition; height; Biomass; responses; Forests; regeneration; Trees; Pinus; Pinus radiata; treatment; soil; Soil cultivation; Cultivation; techniques; Hoes; ripping; discing; weeds; weed control; control; standards; slashing; Planting; hoeing; application; herbicides; Forest trees; methodology; species diversity; biodiversity; Tillage; surveys; subsoiling; augers; chemical control; cultural control; Forest plantations; botanical composition; physical control; cutting; manual weed control; weed; intensive
Notes : Species composition, height, cover, and biomass of vegetation were examined in response to forest regeneration methods applied in exotic tree plantations of Pinus radiata in South Africa. The experimental treatments involved 4 soil cultivation techniques (digging pits with a hoe, augering, ripping and discing) and 2 levels of weed control (standard - slashing at tree planting and 1 year later, to prevent overtopping, and intensive - hoeing and pulling vegetation, and application of herbicides). Both species cover and composition were significantly affected by the experimental treatments (data are tabulated). However, the most important weed species remained common irrespective of the site preparation technique applied.

Ref ID : 351
351. Zwolinski, J.B., Donald, D.G.M., and Groenewald, W.H. Impact of site preparation on wind resistance of young Pinus radiata. *South African Forestry Journal* No. 164, 27-34; 28 r:27-34, 1993.
Keywords : impact; site; Site preparation; wind; resistance; Pinus; Pinus radiata; effects; treatment; site factors; Forests;

South Africa; Africa; soil; Soil cultivation; Cultivation; diameter; subsoiling; ripping; stumps; weeds; weed control; control; standards; slashing; Planting; Trees; height; Seedlings; Wind damage; damage; discing; roots; Biomass; Soil water; water; groundwater; Planting stock; size; chemical control; weed; chemical; mechanical; P
Notes : Results are presented of an experiment investigating the effect of site preparation treatment and site factors on Pinus radiata resistance to wind in the Bluelilliebush State Forest in the Cape Province, South Africa. Plots were subjected to one of 4 soil cultivation treatments: (1) pitting (450 mm diameter and 200 mm depth); (2) augering (450 mm diameter and 400 mm depth); (3) single line subsoiling (ripping) to 600 mm depth; and (4) removing stumps, subsoiling, disc-ploughing and disc-harrowing. Two levels of weed control were applied to subplots: (1) standard weed control by slashing one year after planting to prevent overtopping of planted trees; and (2) total weed control by chemical and mechanical means. Two height classes of seedlings were planted in sub-subplots: (1) small seedlings (140-200 mm tall); and (2) large seedlings (250-310 mm tall). Wind damage was assessed by measuring the angle of lean from the vertical. Strong winds were recorded in May, June, July and August 1991, but damage occurred only after the gales (39 m/s) during the period from 24-25 May 1991. Incidence of tree damage was greater for augering or pitting than for discing or ripping. Soil P and N contents, resistance of soil to penetration by roots, weed cover, height, biomass, soil water retention and groundwater tables were correlated with incidence of wind damage.

Ref ID : 352
352. Zwolinski, J.B., Donald, D.G.M., and Laar, A. Regeneration procedures of Pinus radiata in the southern Cape Province. Part II: distribution of nutrient elements. *South African Forestry Journal* No. 167, 9-20; 20 re:9-20, 1993.
Keywords : regeneration; Pinus; Pinus radiata; Distribution; nutrients; trials; South Africa; Africa; effects; soil; Soil cultivation; Cultivation; discing; ripping; weeds; weed control; control; application; nutrient deficiencies; foliage; Trees; establishment; litter; treatment; Calcium fertilizers; gypsum; phosphorus fertilizers; Plant composition; chemical composition; Forest plantations; Forest trees; leaves; Artificial regeneration; Site preparation; Soil chemistry; Plant nutrition; mounding; weed
Notes : Part 2 of this series of papers based on experimental data from regeneration trials of Pinus radiata established in 1989 in southern Cape Province, South Africa, describes and discusses (1) the effect of soil cultivation (augering, discing, pitting, ripping, bedding and mounding), weed control and phosphogypsum application on changes in concentrations of nutrients above ground and in different soil strata, (2) nutrient deficiencies and nutrient ratios in the foliage of planted trees, and (3) nutrient budgets during the early stages of regeneration. Prior to the establishment of the experiments, no significant differences between the nutrient concentrations of litter and soil on plots allocated to treatments could be established and no differences amongst soil strata were detected. The observed variability therefore reflects the effect of the experimental treatments.

Ref ID : 353
353. Zwolinski, J.B., Donald, D.G.M., Laar, A., Groenewald, W.H., and Van-Laar, A. Regeneration procedures of Pinus radiata in the southern Cape Province. Part V: post planting mortality and growth of trees in response to the experimental treatments and planting site environment. *South African Forestry Journal* No. 168, 7-21; 46 re:7-21, 1994.
Keywords : regeneration; Pinus; Pinus radiata; Planting; mortality; growth; Trees; responses; treatment; site; environment; Planting stock; models; trials; Site preparation; South Africa; Africa; age; outplanting; effects; analysis; impact; Seedlings; height; diameter; measurement; soil; nutrients; soil density; density; resistance; Soil water; water; groundwater; vegetation; techniques; bulk density; weeds; Forest trees; Forest plantations; Soil chemistry; plant competition; plant height; Artificial regeneration; site factors; size; site characteristics; P
Notes : The work described in the fifth paper in this series [of 5] was motivated by the necessity for making accurate predictions of planting stock mortality, which forms an essential part of any growth prediction model. The data used is from trials in which various site preparation treatments were applied at 2 sites in southern Cape Province, South Africa. Mortality was modelled as a function of age in months over 1 yr after outplanting, using the Gompertz function. The paper examines the effect of violations of the assumptions of the parametric analysis of variance, and applies logistic regression models to detect and evaluate the impact of influential variables. Variables included seedling height and diameter, and measurements of concentrations of various soil nutrients, soil density and penetration resistance, soil water and groundwater, and various vegetation characteristics, both at planting and one year later. Soil and vegetation characteristics are related to the different site preparation techniques used. Significant variables influencing mortality included seedling collar diameter and height, and various site characteristics at planting - mean annual groundwater level, soil P, K, Ca and Mg, soil bulk density and penetration resistance, and height and dry matter of vegetation (weeds). Only one significant variable (soil bulk density) was the same at both sites; all the others identified were different.

Ref ID : 354
354. Zwolinski, J.B., Donald, D.G.M., Laar, A., and Van-Laar, A. Regeneration procedures of Pinus radiata in the southern Cape Province. Part III: changes in organic matter loads in response to the experimental treatments. *South African Forestry Journal* No. 167, 21-25; 13 r:21-25, 1993.
Keywords : regeneration; Pinus; Pinus radiata; organic; organic matter; responses; treatment; trials; South Africa; Africa; Site preparation; soil; soil organic matter; Planting; plantations; Slash; Soil cultivation; Cultivation; techniques; discing; ripping; weeds; weed control; control; application; Forest plantations; Forest trees; Calcium fertilizers; gypsum; phosphorus fertilizers; Pinus pinaster; Artificial regeneration; comparisons; site; P; mounding; weed

Notes : Part 3 of this series of papers based on data from regeneration trials of Pinus radiata established in 1989 in southern Cape Province, South Africa. Comparisons are made between various site preparation treatments at 2 sites of (1) soil organic matter at various depths, and (2) surface organic matter loads, before and after site preparation, and one year after planting. The 2 sites were both cleared P. pinaster plantations - one had been a mature stand from which slash had not been removed but spread evenly over the site, and the second had been a much younger P. pinaster plantation, and had been completely cleared of slash. The soil cultivation techniques used were augering, discing, pitting, ripping, bedding and mounding, weed control operations, and application of phosphogypsum.

Ref ID : 355
355. Zwolinski, J.B., Donald, D.G.M., Laar, A., and Van-Laar, A. Regeneration procedures of Pinus radiata in the southern Cape Province. Part I: modification of soil physical properties. *South African Forestry Journal* No. 167, 1-7; 14 ref:1-7, 1993.
Keywords : regeneration; Pinus; Pinus radiata; modification; soil; soil physical properties; physical properties; South Africa; Africa; information; ripping; discing; weeds; weed control; control; Tests; effects; Seedlings; Forest plantations; Cultivation; Forest trees; Artificial regeneration; trials; Soil physics; Site preparation; mounding; weed; soil preparation
Notes : This paper is the first of a series of five, based on experimental data from regeneration trials of Pinus radiata established in 1989 in southern Cape Province, South Africa. It provides information about the background of the trials and discusses the modification of soil physical properties after various soil preparation/cultivation operations (pitting, augering, ripping, discing, bedding and mounding) and weed control operations. The experiments were established as a split-split-plot trial, with soil preparation being tested on main plots and weed control on subplots within the main plots. The subplots were subdivided in order to test the effect of seedling grade (low-grade versus high-grade).

Ref ID : 356
356. Balneaves, J.B. Planting methods (a review). *NZFS Forest Research Institute Forest Establishment Internal Report No.* 20(Unpublished), 1970.
Keywords : Planting; planting methods; methods; reviews; forestry; Pinus radiata

Ref ID : 357
357. Balneaves, J.B. Some aspects of site preparation in exotic cutovers with emphasis on windrowing (Balmoral Forest). *NZFS Forest Research Institute Forest Establishment Internal Report No.* 66(Unpublished), 1976.
Keywords : aspect; site; Site preparation; windrowing; Forests; cutover; forestry; windrow

Ref ID : 358
358. Balneaves, J.B. Interaction between ripping and weed control on performance of 1.5/0 radiata pine -Okuku, Ashley Forest. *NZFS Forest Research Institute Forest Establishment Internal Report No.* 121(Unpublished), 1980.
Keywords : interactions; ripping; weed; weed control; control; performance; radiata pine; pines; Forests; Pinus radiata

Ref ID : 359
359. Brummer, T. The effect of establishment methods and silvicultural methods in reduction of wind damage at Eyrewell Forest. *NZFS, Forest Research Institute, Forest Establishment Report No.* 99(Unpublished), 1976.
Keywords : effects; establishment; methods; wind; Wind damage; damage; Forests; Pinus radiata; Silviculture

Ref ID : 360
360. Brunsden, G.J. Frost flat establishment; effect of cultivation on minimum temperature. *NZFS Forest Research Institute Forest Establishment Internal Report No.* 29(Unpublished), 1973.
Keywords : frost; establishment; effects; Cultivation; temperature; frost flat

Ref ID : 361
361. Chavasse, C.G.R. Forest nursery and establishment practice in New Zealand. *NZFS Forest Research Institute Symposium No.* 22 Part 1(Nursery Practice), 1981.
Keywords : Forests; Nurseries; establishment; New; New Zealand

Ref ID : 362
362. Chavasse, C.G.R. and Brunsden, G.J. Site preparation by ripping: results of a nationwide questionnaire. *NZFS, Forest Research Institute, Forest Establishment Report No.* 110(Unpublished), 1977.
Keywords : site; Site preparation; ripping; questionnaire

Ref ID : 363
363. Chavasse, C.G.R. and Kearns, E. Frost flat establishment trial R452, Compartment 890, Kaingaroa Forest. *NZFS Forest Research Institute Forest Establishment Internal Report No.* 45(Unpublished), 1973.
Keywords : frost; frost flat; establishment; trials; Forests; forestry; plantation establishment

Ref ID : 364

364. Cosslett, B.J. and Burt, G. First thinning/pruning assessment of five site preparation methods. *NZ Forest Research Institute Project Record No.* 754(Unpublished), 1985.
Keywords : assessment; site; Site preparation; methods; Pinus radiata; thinning; pruning

Ref ID : 365
365. Everts, D. Monitoring of raised planting beds for soil moisture, temperature and compaction. *NZFS Forest Research Institute Forest Establishment Internal Report No.* 94(Unpublished), 1978.
Keywords : Planting; soil; temperature; compaction; soil moisture; Pinus radiata

Ref ID : 366
366. Everts, D. Patch scarification and spot mounding on exotic cutovers. *NZ Forest Research Institute Project Record No.* 427(Unpublished), 1984.
Keywords : scarification; mounding; cutover; forestry

Ref ID : 367
367. Everts, D. V-blading, broadcast burning and windrowing on a radiata pine cutover - a comparative trial. *NZ Forest Research Institute Project Record No.* 509(Unpublished), 1984.
Keywords : burning; windrowing; radiata pine; pines; cutover; trials; Pinus radiata; windrow; broadcast burn; V-blade

Ref ID : 368
368. Everts, D. and Follet Ripping- a literature review on this site preparation technique. *NZFS Forest Research Institute Forest Establishment Internal Report No.* 91(Unpublished), 1977.
Keywords : ripping; reviews; site; Site preparation; techniques; literature review

Ref ID : 369
369. Filer, G. and Valentine, J. Site preparation alternatives for Canterbury Plains cutovers. *NZFS Forest Research Institute Forest Establishment Internal Report No.* 100(Unpublished), 1978.
Keywords : site; Site preparation; alternatives; cutover; Canterbury Plains

Ref ID : 370
370. Firth, J. Final report on the Esk Forest soil disturbance trial: measurement results to age 8 years. *NZ Forest Research Institute Project Record No.* 4460(Unpublished), 1995.
Keywords : Reports; Forests; forest soils; soil; soil disturbance; trials; measurement; age; forestry; Esk

Ref ID : 371
371. Firth, J. Final report on the Ngaumu Forest soil disturbance trial: measurement results to age 7 years. *NZ Forest Research Institute Project Record No.* 4615(Unpublished), 1995.
Keywords : Reports; Forests; forest soils; soil; soil disturbance; trials; measurement; age; forestry; Ngaumu

Ref ID : 372
372. Fitzgerald, R.E. and Skinner, M.F. Uniform establishment trials in the Wairau Valley, Blenheim District. Part 3, Trial NN534. *NZ Forest Research Institute Project Record No.* 393(Unpublished), 1983.
Keywords : establishment; trials; fertiliser; Pinus radiata; establishment trial; Wairau

Ref ID : 373
373. Gorman, P.J. Rooting patterns of Pinus radiata and Pinus muricata on a ploughed and fertilised gley podsol in westland. *NZFS, Forest Research Institute, Forest Establishment Report No.* 106(Unpublished), 1977.
Keywords : Pinus; Pinus radiata; Pinus muricata; podsol; ploughed; fertiliser; rooting pattern

Ref ID : 374
374. Hetherington, M.W. and Balneaves, J.B. Ripping in tussock country improves initial growth of radiata pine. *NZFS Forest Research Institute, Soils and Site Productivity Internal Report No.* 39(Unpublished), 1973.
Keywords : ripping; growth; radiata pine; pines; Site preparation

Ref ID : 375
375. Hunter, I.R. Five uniform establishment trials in North Auckland (AK578, AK580, AK581): results after four years. *NZFS Forest Research Institute, Soils and Site Productivity Report No.* 111(Unpublished), 1979.
Keywords : establishment; establishment trial; trials; forestry

Ref ID : 376
376. Hunter, I.R. Response of 4 year old P.radiata growing on a North Auckland podsolised sand to P, NP, and NPK fertiliser (A662 and A522). *NZFS Forest Research Institute, Soils and Site Productivity Internal Report No.* 95(Unpublished), 1980.

Keywords : responses; P; NP; NPK; fertiliser; growth response

Ref ID : 377
377. Hunter, I.R. The uniform establishment trial at Awahohonu Forest (WN203): results after four years. *NZFS Forest Research Institute, Soils and Site Productivity Report No.* 118(Unpublished), 1980.
Keywords : establishment; establishment trial; trials; Forests; forestry; Awahohonu Forest

Ref ID : 378
378. Hunter, I.R. and Thode, P.J. Growth of young radiata pine on podsolised soil greatly increased by cultivation and fertilisation. *NZFS Forest Research Institute, Soils and Site Productivity Report No.* 128(Unpublished), 1980.
Keywords : growth; radiata pine; pines; soil; Cultivation; fertiliser; Pinus radiata; podsol

Ref ID : 379
379. Jacks, H. Guide to current Soils and Nutrition trials in the province of Nelson. *NZFS Forest Research Institute, Soils and Site Productivity Report No.* 16(Unpublished), 1970.
Keywords : soils; nutrition; trials; soil; Pinus radiata; Nelson

Ref ID : 380
380. Jacks, H., Fitzgerald, R.E., Keizer, R., and Phibbs, S.B. Results of Soils and Nutrition experiments in Nelson for 1972. *NZFS Forest Research Institute, Soils and Site Productivity Report No.* 41(Unpublished), 1972.
Keywords : soils; nutrition; Nelson; Pinus radiata

Ref ID : 381
381. Jacks, H. and Keizer, R. Past Soils and Nutrition trials in the province of Nelson. *NZFS Forest Research Institute, Soils and Site Productivity Report No.* 25(Unpublished), 1971.
Keywords : soils; nutrition; trials; Nelson; Pinus radiata

Ref ID : 382
382. Kimmins, J.P. and Dyck, W.J. Review of site preparation impacts on long-term site productivity in New Zealand. *NZ Forest Site Management Cooperative Report No.* 51(Unpublished), 1990.
Keywords : reviews; site; Site preparation; impact; site productivity; productivity; New; New Zealand; forestry; Pinus radiata

Ref ID : 383
383. Lowe, A.T. Annual foliage analysis results for Cooperative trial WD398. *NZ Forest Research Institute Project Record No.* 1662(Unpublished), 1987.
Keywords : foliage; analysis; trials; Pinus radiata; foliage sampling; Cultivation

Ref ID : 384
384. Lowe, A.T. Annual foliage analysis results for Cooperative trial WN261/1. *NZ Forest Research Institute Project Record No.* 1670(Unpublished), 1987.
Keywords : foliage; analysis; trials; Pinus radiata; Cultivation; high altitude

Ref ID : 385
385. Mason, E.G. The effect of ripping upper Taupo pumice on the growth of P.radiata - Cpt. 558. *NZ Forest Research Institute Project Record No.* 717(Unpublished), 1985.
Keywords : effects; ripping; growth; Pinus radiata; growth response; pumice; Taupo

Ref ID : 386
386. Mason, E.G. Results of some experiments involving cultivation, fertilisation and/or weed control as factors, examining the growth of young radiata pine. *NZ Forest Site Management Cooperative Report No.* 29(Unpublished), 1988.
Keywords : Cultivation; weed; weed control; control; growth; radiata pine; pines; fertiliser; Site preparation; forestry

Ref ID : 387
387. Mason, E.G. Decision-Support systems for establishing radiata pine plantations in the central North Island of New Zealand. *University of Canterbury* PhD Thesis, 1992.
Keywords : radiata pine; pines; plantations; New; New Zealand; Decision support system; establishment; plantation; Pinus radiata; Central North Island

Ref ID : 388
388. Mason, E.G. and Cullen, A.W.J. The effect of ripping a pastured clay site in Coromandel on the growth of Pinus radiata. *NZ Forest Research Institute Project Record No.* 686(Unpublished), 1984.

Keywords : effects; ripping; site; growth; Pinus; Pinus radiata; clay soil; Coromandel

Ref ID : 389
389. Mason, E.G. and Cullen, A.W.J. Growth of two stock types after a range of site preparation techniques. *NZ Forest Research Institute Project Record No.* 725(Unpublished), 1984.
Keywords : growth; types; site; Site preparation; techniques; Pinus radiata; growth response

Ref ID : 390
390. Mason, E.G. and Cullen, A.W.J. The effect of ripping upper Taupo pumice on the growth of P. radiata - Cpt. 243. *NZ Forest Research Institute Project Record No.* 780(Unpublished), 1985.
Keywords : effects; ripping; Taupo; pumice; growth; P; Pinus radiata

Ref ID : 391
391. Mason, E.G. and Cullen, A.W.J. Effects of site modification on the growth of radiata pine at Kaingaroa Forest - results after 6 years. *NZ Forest Research Institute Project Record No.* 1845(Unpublished), 1988.
Keywords : effects; site; modification; growth; radiata pine; pines; Forests; Kaingaroa; Pinus radiata; Cultivation

Ref ID : 392
392. Mason, E.G. and Cullen, A.W.J. Effects of site modification on the growth of radiata pine at Ohakuri forest - results after year 6. *NZ Forest Research Institute Project Record No.* 1850(Unpublished), 1988.
Keywords : effects; site; modification; growth; radiata pine; pines; Forests; Cultivation; forestry

Ref ID : 393
393. Mason, E.G. and Cullen, A.W.J. Effects of site modification on the growth of radiata pine at Cape Karikari - results after 4 years. *NZ Forest Research Institute Project Record No.* 1849(Unpublished), 1988.
Keywords : effects; site; modification; growth; radiata pine; pines; Site preparation; Pinus radiata; Northland

Ref ID : 394
394. Mason, E.G. and Cullen, A.W.J. Effects of site modification on the growth of radiata pine at Wainui Forest - results after 6 years. *NZ Forest Research Institute Project Record No.* 1844(Unpublished), 1988.
Keywords : effects; site; modification; growth; radiata pine; pines; Forests; Pinus radiata; Cultivation

Ref ID : 395
395. Mason, E.G., Cullen, A.W.J., and Rijkse, W.C. Effect of ripping and ripping/bedding on the growth of two P.radiata stock types at Kariori Forest. *NZ Forest Research Institute Project Record No.* 1598(Unpublished), 1987.
Keywords : effects; ripping; growth; types; Forests; bedding; growth response; Pinus radiata

Ref ID : 396
396. Mason, E.G., Milne, P.G., and Cullen, A.W.J. Experimental cultivation rig trial at Balmoral. Results after year one. *NZ Forest Research Institute Project Record No.* 724(Unpublished), 1984.
Keywords : Cultivation; trials; Site preparation; Balmoral

Ref ID : 397
397. Mason, E.G., Milne, P.G., and Cullen, A.W.J. Experimental cultivation rig trial at Eyrewell - results after year one. *NZ Forest Research Institute Project Record No.* 718(Unpublished), 1984.
Keywords : Cultivation; trials; Site preparation; Eyrewell

Ref ID : 398
398. Mason, E.G., Milne, P.G., and Cullen, A.W.J. Experimental cultivation rig trial at Balmoral. *NZ Forest Research Institute Project Record No.* 1047(Unpublished), 1985.
Keywords : Cultivation; trials; Balmoral; forestry

Ref ID : 399
399. Mason, E.G., Milne, P.G., and Cullen, A.W.J. Experimental cultivation rig trial at Eyrewell - results after year 2. *NZ Forest Research Institute Project Record No.* 1030(Unpublished), 1985.
Keywords : Cultivation; trials; Eyrewell; forestry

Ref ID : 400
400. Mason, E.G., Milne, P.G., and Cullen, A.W.J. Experimental cultivation rig trial at Glendhu - results after 2 years. *NZ Forest Research Institute Project Record No.* 1137(Unpublished), 1986.
Keywords : Cultivation; trials; forestry; Glendhu

Ref ID : 401

401. Mason, E.G., Milne, P.G., and Cullen, A.W.J. Establishment regimes for radiata pine on yellow-brown earths in Southland. *NZ Forest Research Institute Project Record No.* 1508(Unpublished), 1987.
Keywords : establishment; radiata pine; pines; yellow brown earths; Pinus radiata; Southland

Ref ID : 402
402. Mason, E.G., Milne, P.G., and Cullen, A.W.J. Establishment regimes for radiata pine on yellow-brown earths in Southland - 4th year results. *NZ Forest Research Institute Project Record No.* 1846(Unpublished), 1988.
Keywords : establishment; radiata pine; pines; yellow brown earths; Southland; Pinus radiata

Ref ID : 403
403. Mason, E.G., Milne, P.G., and Cullen, A.W.J. Experimental cultivation rig trial at Eyrewell - results after year 4. *NZ Forest Research Institute Project Record No.* 1848(Unpublished), 1988.
Keywords : Cultivation; trials; Eyrewell; forestry

Ref ID : 404
404. Mason, E.G., Milne, P.G., and Cullen, A.W.J. Experimental cultivation rig trial at Balmoral - results after year 4. *NZ Forest Research Institute Project Record No.* 1847(Unpublished), 1988.
Keywords : Cultivation; trials; Balmoral; forestry

Ref ID : 405
405. Mead, D.J., Fitzgerald, R.E., Oliver, G.R., and Keizer, R. The responses of radiata pine to fertilisers and cultivation at Waiwhero, Nelson (N193 and N195). *NZFS Forest Research Institute, Soils and Site Productivity Report No.* 70(Unpublished), 1976.
Keywords : responses; radiata pine; pines; fertiliser; Cultivation; Nelson; Pinus radiata; Waiwhero

Ref ID : 406
406. Mees, C.A. and Dyck, W.J. Effect of slash and soil removal on the growth of 17 year old, second rotation radiata pine. *NZ Forest Research Institute Project Record No.* 1350(Unpublished), 1986.
Keywords : effects; Slash; soil; removal; growth; rotation; radiata pine; pines; soil removal; Pinus radiata; slash removal

Ref ID : 407
407. Mees, C.A., Dyck, W.J., and Balneaves, J.B. Evidence of site productivity decline in Canterbury forests. *NZ Forest Research Institute Project Record No.* 1821(Unpublished), 1988.
Keywords : site; site productivity; productivity; Forests; Pinus radiata; Canterbury

Ref ID : 408
408. Menzies, M.I. Pinus radiata: frosting experiments. *NZFS Forest Research Institute Tree Physiology Report No.* 20(Unpublished), 1976.
Keywords : Pinus; Pinus radiata; frost

Ref ID : 409
409. Murphy, G., Firth, J., and van Dijk, W.A.J. Soil disturbance trial: Cpt 128, Tairua Forest - Final report. *NZ Forest Research Institute Project Record No.* 1400(Unpublished), 1986.
Keywords : soil; soil disturbance; trials; Forests; Reports; forestry; Tairua; Coromandel

Ref ID : 410
410. Robertson, E.D. Soil bulk density using the "Ronly sub-surface density gauge": a preliminary study of three forest soils. *NZ Forest Research Institute Project Record No.* 897(Unpublished), 1985.
Keywords : soil; bulk density; density; Forests; forest soils; soils; forestry

Ref ID : 411
411. Robertson, E.D. and Skinner, M.F. The effect of cultivation on soil properties in relation to radiata pine establishment. Part 1. RO1835 Southern Kaingaroa. *NZ Forest Research Institute Project Record No.* 1372(Unpublished), 1985.
Keywords : effects; Cultivation; soil; soil properties; radiata pine; pines; establishment; Kaingaroa

Ref ID : 412
412. Skinner, M.F. The response of radiata pine seedlings on hard sites of different site preparations and fertiliser. Trial WN261/2: low altitude Kariori. *NZ Forest Research Institute Project Record No.* 805(Unpublished), 1984.
Keywords : responses; radiata pine; pines; Seedlings; site; Site preparation; fertiliser; trials; altitude; Pinus radiata; Kariori

Ref ID : 413
413. Skinner, M.F. The response of radiata pine seedlings on hard sites to different site preparations and fertilisers: Trial

WN261/1 - high altitude Kariori. *NZ Forest Research Institute Project Record No.* 793(Unpublished), 1985.
Keywords : responses; radiata pine; pines; Seedlings; site; Site preparation; fertiliser; trials; high altitude; altitude; Kariori; Pinus radiata

Ref ID : 414
414. Skinner, M.F., Thorn, A.J., Graham, J.D., and Hunter, I.R. The effect of site preparation and fertiliser on the growth of P.radiata on the pumice plateau. An assessment at age 2 years. *NZ Forest Research Institute Project Record No.* 141(Unpublished), 1983.
Keywords : effects; site; Site preparation; fertiliser; growth; pumice; assessment; age; Pinus radiata

Ref ID : 415
415. Skinner, M.F., Thorn, A.J., Graham, J.D., and Hunter, I.R. The effect of site preparation and fertiliser on the growth of P.radiata on the pumice plateau. An assessment at age 4. *NZ Forest Research Institute Project Record No.* 334(Unpublished), 1983.
Keywords : effects; site; Site preparation; fertiliser; growth; pumice; assessment; age; Pinus radiata

Ref ID : 416
416. Skinner, M.F., Thorn, A.J., Graham, J.D., and Hunter, I.R. The effect of cultivation and fertilisation on the growth of Pinus radiata on a podsolised sand in Northland. An assessment at age 2. *NZ Forest Research Institute Project Record No.* 140(Unpublished), 1983.
Keywords : effects; Cultivation; growth; Pinus; Pinus radiata; Northland; assessment; age; podsol; fertiliser

Ref ID : 417
417. Skinner, M.F., Thorn, A.J., Graham, J.D., and Hunter, I.R. The effect of cultivation and fertiliser on the growth of P.radiata in Northland. An assessment at age 2. *NZ Forest Research Institute Project Record No.* 142(Unpublished), 1983.
Keywords : effects; Cultivation; fertiliser; growth; Northland; assessment; age; Pinus radiata

Ref ID : 418
418. Skinner, M.F., Thorn, A.J., Hunter, I.R., and Graham, J.D. The effect of site preparation and fertiliser on the growth of P.radiata on the pumice plateau. Assessments at ages 2 and 4 years. *NZ Forest Research Institute Project Record No.* 204(Unpublished), 1983.
Keywords : effects; site; Site preparation; fertiliser; growth; pumice; assessment; age; Pinus radiata

Ref ID : 419
419. Skinner, M.F., Thorn, A.J., Hunter, I.R., and Graham, J.D. The effect of cultivation and fertilisation on the growth of radiata pine on a northern podsol. Trial AK739/1. Results to age 4. *NZ Forest Research Institute Project Record No.* 550(Unpublished), 1984.
Keywords : effects; Cultivation; growth; radiata pine; pines; podsol; trials; age; Pinus radiata; fertiliser

Ref ID : 420
420. Skinner, M.F., Thorn, A.J., Hunter, I.R., and Graham, J.D. The effect of cultivation and fertilisation on the growth of radiata pine on a northern podsol. Trial AK739/2. Results to age 4. *NZ Forest Research Institute Project Record No.* 551(Unpublished), 1984.
Keywords : effects; Cultivation; growth; radiata pine; pines; podsol; trials; age; Pinus radiata; fertiliser

Ref ID : 421
421. Thorn, A.J. The effects of cultivation and fertiliser on the early growth of Pinus radiata Kaingaroa Forest. *NZ Forest Research Institute Project Record No.* 85(Unpublished), 1982.
Keywords : effects; Cultivation; fertiliser; growth; Pinus; Pinus radiata; Kaingaroa; Forests