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The Southwest Oregon Forestry Intensified Research Program (FIR) is a cooperative effort between the College of Forestry at Oregon State University and the Pacific Northwest Forest and Range Experiment Station of the USDA Forest Service. It is designed to assist foresters and other resource management specialists in solving complex biological and management problems endemic to southwest Oregon. FIR specialists organize, coordinate, and conduct educational programs and research projects specifically tailored to meet the needs of this area.

Established in October 1978, the FIR Program is supported jointly by Oregon State University, the Bureau of Land Management, USDA Forest Service, O&C Counties, and the southwest Oregon forest products industry. It represents a determined effort by the southwest Oregon forestry community and county governments to find practical solutions to important forest management problems.

The "FIR REPORT" is one of the principal methods of reporting recent technological advances and research results pertinent to southwest Oregon, and alerts area natural resource managers to upcoming continuing education opportunities. Comments and suggestions concerning the content of "FIR REPORT" are welcome and encouraged. The report is prepared quarterly and is mailed free on request by contacting us at this address: FIR REPORT, 1301 Maple Grove Drive, Medford, OR 97501.

For the FIR Staff,

John W. Mann
Forest Engineering Specialist

Inside

OREGON STATE UNIVERSITY
EXTENSION SERVICE

FORESTRY INTENSIFIED RESEARCH

SERVING SOUTHWEST OREGON THROUGH RESEARCH AND EDUCATION

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Because of space limitations, results appear as extended abstracts. Readers who are interested in learning more about an individual study are encouraged to contact the principal investigator or wait for formal publication of more complete results.

Adaptive FIR

STUDY UPDATE: NON-CHEMICAL CONTROL OF BRUSH

In the Summer 1983 issue of the FIR Report (5(2):6), I briefly described a new study designed to explore the effectiveness of various slashing treatments as alternatives to the use of herbicides in the control of sprouting brush. When the original article was written, little had actually been accomplished but now, one year later, research is well underway.

The study has been divided into two phases. The first phase was started this winter and is designed to describe changes in the growth, phenology, and selected physiological characteristics (i.e., carbohydrate concentrations and xylem pressure potential) of Douglas-fir seedlings and sprouts of tanoak and greenleaf manzanita over a nine month period. This information will then be used to select slashing strategies that may slow sprout development that will be evaluated in the second phase of the study. The second phase will start during the winter of 1985 and will be a replicated experiment with up to six different treatments tested.

Data collection for phase one was started in March 1984. Originally I had intended to collect data in February but was unable to do so because of snow on the study site. Observations in late March revealed active root growth in Douglas-fir and greenleaf manzanita but not in tanoak which did not initiate root growth until early April. Budbreak, on the other hand, occurred in greenleaf manzanita a month before it did in either of the other species which both broke bud in mid-May. It is interesting to note that diameter growth started in late March for all three species but has been greatest in greenleaf manzanita through mid-June. Stem elongation and foliage development started during the second half of May for all three species, although the height growth rate was greatest in Douglas-fir until mid-June when it was exceeded by both brush species.

Soil moisture declined during May after remaining relatively constant through April. There were also corresponding increases in soil temperatures at both the 30 and 80 cm depths in May.

Predawn xylem pressure potentials were between -5 and -10 bars for all species in early April and late May, but on April 25th, predawn xylem pressure potential in Douglas-fir seedlings exceeded that of the other species by -10 bars. This can be attributed to below freezing air temperatures experienced during the predawn hours. Increased stress levels were measured in the brush species as well, but were not of the same magnitude as Douglas-fir. Measurement of xylem pressure potentials in all species over a 24-hour period on May 30-31 showed that Douglas-fir seedlings experienced significantly greater water stress than either of the brush species from about 9 a.m. until at least 5 p.m.

Carbohydrate samples from the foliage, stems, roots, and burls have been collected monthly since late March. These have been stored in Corvallis until laboratory measurements can be made of the starch and soluble sugar concentrations in the brush species. Data from these early samples should be available this summer. One hypothesis that I hope to examine is that there is a net drain of carbohydrate reserves from the roots and burls of the brush species during stem elongation and that these reserves are replenished after stem elongation has been completed. The implication is that interruption of the replenishment stage might reduce next year's growth.

S.H.

STUDY TO ASSESS SEEDLING RECOVERY FROM OVERSTORY REMOVAL DAMAGE

In the winter 1984 issue of the FIR Report I provided some information on the recovery of damaged seedlings three years after overstory removal. The results showed that seedlings could be very resilient; some seedlings severely damaged during logging recovered to the point that they could be classified as crop trees within three years. The implications for broad-scale recovery of damaged seedlings within a harvested unit are important. If recovery can be reliably predicted, some damaged seedlings may be included as crop trees in post-harvest stocking surveys and perhaps reduce the need to interplant or start over.

In order to provide reliable information on the probability of a seedling of a given size recovering from a given type of logging damage, John Mann and I are installing a series of permanent plots in areas logged this last winter. The plots will be located on at least five different harvest units representing a variety of site conditions, seedling sizes, and types of damage. Both damaged and undamaged trees will be observed for comparison of growth rates.

A report will summarize recovery after three years of observation. The publication will include a series of photographs to illustrate the damage immediately after harvesting and the level of recovery over the course of the study. Hopefully, longer-term monitoring of the plots will be possible after this initial publication.

The species of main interest is Douglas-fir, most commonly underplanted beneath shelterwoods and therefore the one where logging damage will be most critical during overstory removal operations in the future. We are aware of pathological considerations and intend to destructively sample some seedlings in the future to determine incidence of decay.

The results of this study will provide another important piece of information in the development of the comprehensive shelterwood management program which John and I will be working on for the next five years. We'd be happy to talk with any of you about our plans.

S.T.

Fundamental FIR

SEEDLING RESPONSES TO HEAT AND MOISTURE ENVIRONMENTS IN CLEARCUTS AND SHELTERWOODS

The Fundamental FIR reforestation microclimate group has been studying Douglas-fir seedlings in southwestern Oregon in an effort to assess environmental limitations present on reforestation sites. The summer of 1981 clearly demonstrated the harsh environmental conditions that occasionally occur on these sites. Our study was set up to monitor these conditions, the resulting soil temperature and moisture status, and seedling response with and without shade. A side by side clearcut-shelterwood pair was planted and instrumented during February 1981 at Cave Creek near Oregon Caves National Monument. Also, half of the seedlings on each site were protected by shadecards to the southwest. Environmental conditions were monitored continually on each site with a Penman weather station. Soil temperature profiles were measured over the growing season, soil water contents were determined, stomatal conductance was measured and seedling response and survival were visually assessed.

Soil temperature

Our data show that air temperatures on these adjacent sites were almost identical even though solar radiation was decreased substantially by the shelterwood canopy. The radiation difference resulted in much cooler average soil temperatures in the shelterwood when compared to the clearcut (Fig. 1). This effect was noticeable both at the soil surface and near the bottom of the seedling root zone. Shadecards led to no statistically significant differences in average soil temperature conditions.

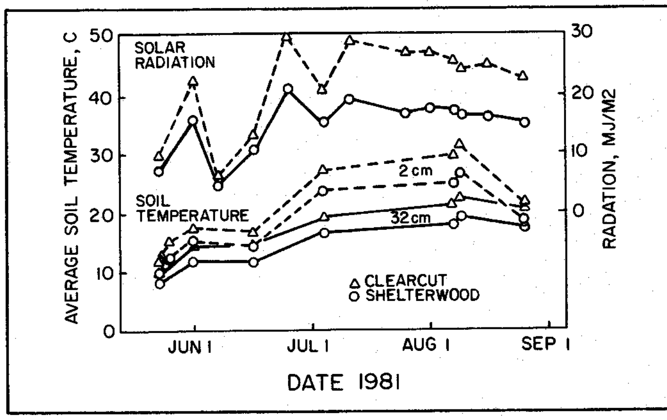

Figure 1. Shelterwood - clearcut comparison of soil temperature and radiation.

In August of that year we experienced a heat wave with five days of unusually high temperatures. (Average air temperature was greater than 78°F and the daily maxima were about 98°F). During that time maximum soil temperatures reached seasonal highs for all treatments and large treatment differences were measured. Shadecards substantially reduced the maximum soil temperatures in the clearcuts but not as much as the shelterwoods. Unprotected seedlings in the clearcut experienced soil temperatures greater than 113°F (45°C) for more than four hours each day. This heat stress showed up in our survival data (Table 1).

Table 1. Seedling survival (percent).

	Clearcut		Shelterwood	
Date	Shadecard	Control	Shadecard	Control
10/81	73	40	100	97
5/82	67	17	100	94

Both shadecard and shelterwood treatments improved seedling survival. We plotted our soil temperature data as "amount of time at high temperature" in order to demonstrate the utility of shadecards. Figure 1 shows that shelterwoods affect average soil temperature dramatically and, therefore, create a better environment for seedling growth. Shadecards don't change the average soil temperature but they do decrease the duration of high temperatures (Fig. 2) and enhance seedling survival in heat stress events.

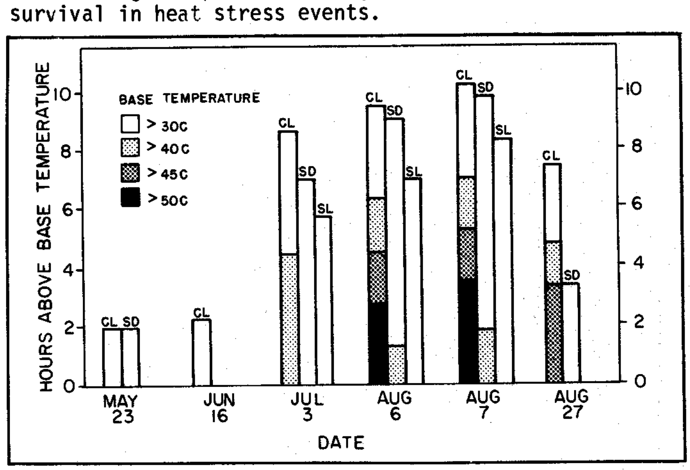

Figure 2. Duration of high soil temperatures at 2 cm. (CL = clearcut; SL = shelterwood; SD = shadecard).

Water use

Our shelterwood and shadecard treatments also affected soil water use. Total soil water use in the seedling root zone was the same on the clearcut and the shelterwood but the timing was different (Fig. 3).

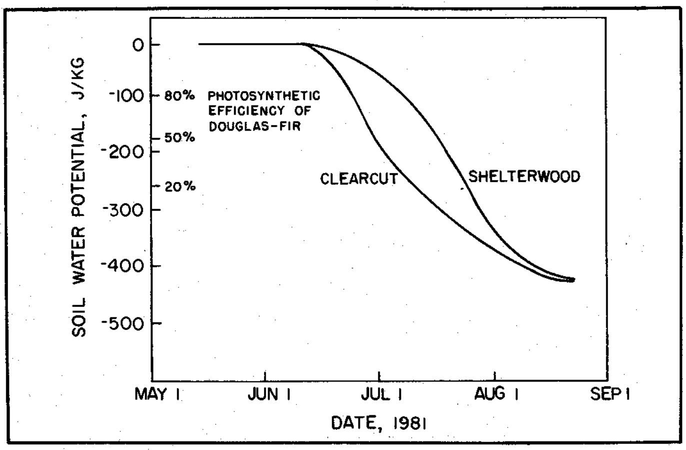

Figure 3. Seasonal trends in soil moisture and phenology.

Water use in the clearcut occurred earlier in the season, probably due to soil surface evaporation enhanced by warmer soil temperatures. This conclusion is reinforced by the stomatal resistance patterns which show seedling water loss decreases over each day and over the season (Figs. 4 and 5).

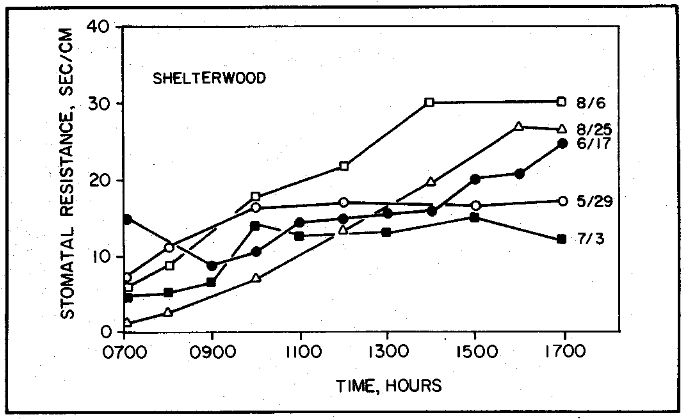

Figure 4. Stomatal resistance of Douglas-fir seedlings under a shelterwood canopy, summer 1981.

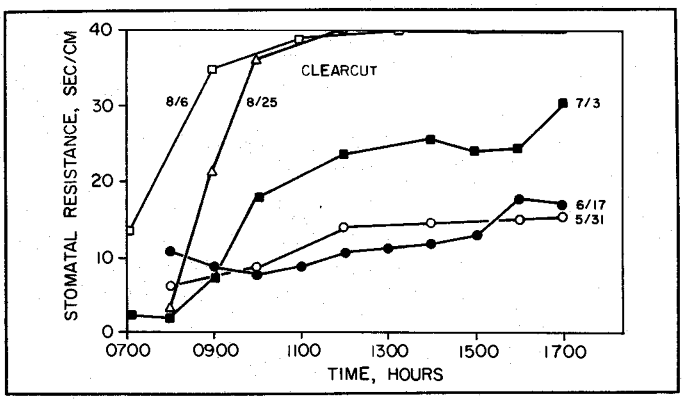

Figure 5. Stomatal resistance of Douglas-fir seedlings in a clearcut, summer 1981

This conservation of water by decreased transpiration can have harmful side effects. As stomatal resistance increases and water use decreases, photosynthesis and growth are reduced. The most notable difference in time of stomatal closure between our sites is shown as the seasonal change in mid-day resistance values. During August, within three hours after sunrise, clearcut stomatal resistance reached higher values than the maximum values ever recorded in the shelterwood. This indicated that these seedlings probably ceased transpiration and growth as early as 9 a.m. During the month of August, both unshaded and shaded seedlings in the clearcut were under heat and water stress. This stress affected survival. While shadecards substantially increased survival in the clearcut (Table 1), the shelterwood certainly offered the greatest protection. Overwinter survival was also influenced by treatment. Unshaded clearcut seedlings had the highest mortality, followed by shaded clearcut seedlings and finally unshaded shelterwood seedlings. It would seem from these data that while shelterwoods offer maximum protection during very severe heat events, shadecards do provide short term protection. We are now working to quantify shadecard effects to determine when they will provide adequate protection for transplanted seedlings. This will be a function of soil and site properties as well as the climate for a specific year.

Stuart Childs, OSU Soil Science
Lorrie Flint, OSU Soil Science

UPDATE ON REFORESTATION SYSTEMS STUDY

Fourth and fifth replicates of the reforestation systems study were planted this winter and spring on south- and north-facing slopes on the Jacksonville Resource Area of the BLM. Planting on two other replicates of the 12 that are planned was postponed, because weather conditions prevented burning. First-year survival of the initial three replicates was reported earlier (FIR Report 5(4):9).

This study compares alternative reforestation methods for Douglas-fir on hard-to-regenerate sites in the Siskiyou Mountains. Treatments include clearcut vs. shelterwood, burning vs. no burning, four different types of planting stock, and shading, bud-capping, or Vexar[R] tubing vs. no protection. The fourth and fifth replicate included 2+0 seedlings grown at only 15 per square foot, 4-cubic inch container seedlings, and 1+1 bareroot transplants. Fifty trees of each type were planted on each of 16 plots spread evenly over the four combinations of harvest system and site preparation method.

A crew of forestry technicians from the PNW Station in Corvallis premarked each planting spot, cleared heavy slash from the non-burn plots, and provided on-the-ground coordination of the planting operation. Planting was done by small crews under contract to the Jacksonville Resource Area.

Valerie Davis, PNW

GENETICS OF SHELTERWOOD REGENERATED STANDS

A study was initiated in 1980 to evaluate the impacts of the shelterwood regeneration system on the genetic composition of regenerated Douglas-fir stands. In an earlier FIR Report (Winter 1983), we reported that the levels of genetic diversity in the seedling regeneration of shelterwoods were not significantly less than levels of diversity in shelterwood leave trees or in uncut stands adjacent to shelterwoods. We also determined that there was only a slight increase in the amount of selfed-fertilized seed from shelterwood leave trees versus that from trees in uncut stands. We had expected that there might be a small loss of genetic diversity in the regeneration of shelterwoods or that the amount of selfed seed would be significantly greater due to the small number (15-35 trees hectare) and wide spacing of leave trees. Based on these preliminary findings, we concluded that shelterwood harvesting and regeneration of Douglas-fir could be employed without an appreciable loss in productivity due to narrowing of the genetic base or a change in genetic composition of stands. It may also be possible to use the shelterwood system for maintaining in situ genetic reserves. The selfing analysis indicated that inbreeding in shelterwood trees is no greater than in uncut stands. Therefore, it should be possible to collect open-pollinated seed from seed trees in thinned stands without appreciable inbreeding in seed progenies.

The objective of the final phase of the study was to investigate patterns of seed and pollen dispersal within shelterwoods and determine the relationship between dispersal patterns and the distribution of progenies in stands. We were interested to know if the natural regeneration in shelterwoods is made up of clusters of related seedlings, or if seedling progenies are randomly distributed in the understory. Likewise, we also wanted to investigate the genetic composition and distribution of pollen which pollinates cones of leave trees. A statistical procedure was developed to infer the most likely leave tree parent for any seedling in the regeneration or a pollen grain in the crown of a leave tree. From these analyses, we estimated that the minimum effective seed and pollen dispersal distances within shelterwoods were 63 m and 70 m, respectively. We were also able to assign most likely leave tree parents to a large number of seedlings in several groups in the understory and for many pollen grains from the crowns of several leave trees. These analyses indicated that although seed and pollen are dispersed relatively large distances within shelterwoods, there is some indication that seedlings and pollen are made up of loosely arranged groups of related individuals within shelterwoods. Further studies will be needed to determine if these patterns persist as stands develop and to assess the genetic consequences of grouping of related individuals.

David Neale, OSU, Forest Science
Tom Adams, OSU, Forest Science

FIELD TESTS OF CONTAINER VS. BAREROOT SEEDLINGS

In a region-wide study, ranger districts that had stock grown at the Beaver Creek greenhouse nursery of the USDA Forest Service were asked to install container vs. bareroot seedling comparisons. Fourteen sets of plots were installed in southwestern Oregon between 1973 and 1976. Some final exams, analyses, and reporting are being done as part of Fundamental FIR.

For six tests of Douglas-fir in the Cascades, average survival after 3 to 7 years was 55.3% for containers (mostly 39- to 65-cm³ plugs) and 55.7% for the bareroot seedlings (all 2+0s). The relatively low percentages are a reflection of the harsh sites on which the tests were placed. Considering the number of individual studies in which one or the other stock type performed better, the results were also fairly even: 2+0s survived more than 5% better than plugs in three tests, containers were more than 5% better in two, and there was less than 5% difference in the sixth one. For three tests of Shasta red fir on the Butte Falls Ranger District after three years, average survival was 56.7% for 65-cm³plugs and 57.3% for 2+0s. Container seedlings were better in one trial, 2+0s better in a second, and the two types survived within 5% of each other in the third. Average height at the final measurement was also very similar for both stock types within species: for Douglas-fir, 52 cm for plugs, 50 cm for bareroot seedlings; for Shasta red fir, 17 cm for plugs and 16 cm for 2+0s. None of the seedlings were protected from animal damage, which may have tended to equalize the growth.

For two trials of Douglas-fir on the Gold Beach Ranger District after five years, average survival and height for 65-cu. in. plugs were 82% and 85 cm, respectively. The 2+0s averaged 80% survival and 100 cm in height.

In the interior Siskiyous, survival in a ponderosa pine test was less than 21% for all stock types after two years--this included both 65- and 164-cm³ plugs. The site had heavy grass cover and was infested with pocket gophers. For sugar pine near Galice, survival of containers after three years was 97% compared to 33% for 1+1s. The latter stock was of visibly poor quality at time of planting, however. After six years, the seedlings were so decimated by blister rust that meaningful data could not be collected. A test of Shasta red fir in a shelterwood unit yielded survival and height results of 66% and 25 cm for 165-cm³ plugs, 56% and 22 cm for 39-cm³ plugs, and 48% and 28 cm for 2+0 seedlings after six years. The tallest seedlings on the unit, however, were naturals--many of which were one-year-old at the time of planting.

I excavated a small sample of root systems during field examinations and found just as many apparent root-form problems with bareroot as with container seedlings. I did not, however, find any with problems so severe that tipping or failure had occurred or seemed imminent.

Grouping all plug vs. bareroot tests together yields the following summary: container seedlings survived at least 5% better than bareroot seedlings in five sets of plots; the difference in survival was less than 5% in four sets; and the bareroots survived best on five sites. For tests where height data are available, plugs averaged more than 5 cm taller than 2+0s in two trials; height difference between stock types was less than 5 cm in six sets; and bareroot seedlings were taller in four sets.

The results indicate that, although stock type can affect survival, the influence is often overridden by site factors such as drought, competition, and animal damage. In terms of growth, the smaller container seedlings can often catch up to but seldom grow taller than 2+0s in southwestern Oregon. The fact that plug seedlings are one year younger than 2+0s at time of planting is academic, because that can be controlled administratively when planning stock types to use.

These data will be presented and discussed in more detail in a manuscript that is currently being prepared.

Pete Owston, PNW

SITE PREPARATION AND SEEDLING GROWTH IN SOUTHWEST OREGON PROGENY TEST

Private, state, and federal land owners are cooperating in tree improvement programs throughout southwestern Oregon. These programs involve replicated family tests in carefully selected and intensively managed progeny plantations on many sites. Growth will be measured at 5-year intervals in these plantations, and the resulting data will be used in choosing superior parents for subsequent breeding programs.

Site preparation methods used on the progeny test plantations are diverse. They vary from cable logging followed by a broadcast burn to tractor logging followed by mechanical slash disposal, stump removal, and tilling. Many of these preparation methods benefit survival and make planting easier. Their effects on subsequent seedling growth are unknown, however, and the influence of various site preparation techniques on soil quality and microsite variation has not been measured.

The Pacific Northwest Forest and Range Experiment Station is now conducting a study to determine the effects of site preparation on progeny test plantations in southwestern Oregon. There are three objectives:

(1) Measurement of the effects of site preparation on five-year seedling growth

(2) Measurement of microsite variability within plantations

(3) Measurement of plantation site quality

The first data were collected in 1983, on 16 plantations in Coos and Curry Counties. Soil density in the plantations and in adjacent undisturbed stands was measured with a proving ring penetrometer. Soil organic matter also was measured in both the plantations and in adjacent stands. Five-year height measurements and the site preparation techniques used on each plantation were obtained from office records. Douglas-fir site index, slope, aspect azimuth, rockiness, soil texture, and soil depth were measured in the field.

The resulting data were analyzed in two ways: regression analysis was used to determine the relationships between seedling height and other variables from the individual plantations, then average values from each plantation were used in seedling height-site quality regressions.

The regression analyses of separate plantations indicated that variations in soil density and seedling growth among sample areas within a plantation were equaled or exceeded by variations within those sample areas. Relationships between trees and soil at individual microsites may have been obscured by that within-sample variation, because the analyses were based on average seedling height and average penetrometer, organic matter, slope, and aspect measurements.

The expected negative correlation of seedling height with soil compaction did not occur in most of the separate plantation regressions. In fact, average sample-area growth was not significantly related to average sample-area compaction within 13 of the 16 plantations. Variation within the sample areas probably was responsible for the lack of correlation. A soil density measurement at one point may have shown the potential for seedling growth at that point, but the average of 12 to 16 density measurements was not correlated with the average of a hundred or more seedling heights on the same sample area.

The progeny test plantations were designed to test genetic differences, and Douglas-fir families were expected to grow at different rates. Nevertheless, the within-plantation variation associated with families with the same genetic constitution was statistically significant for 7 of the 16 plantations. Within those 7 plantations, genetic differences seem to have been more important than the soil differences associated with compaction. The plantations given the most intensive site preparation showed height differences among family sets more often than those with minimal site preparation. They also tended to have the least variation in soil density measurements.

When average values from each plantation were used in seedling height-site quality regressions, Douglas-fir site index was significantly correlated with seedling height, but the correlation was poor. An expression which included elevation, slope, and soil rockiness provided a much better correlation with seedling height. Unfortunately, environmental factors are indirect indicators of site quality that vary with locality. Correlations of environmental factors with seeding height growth also tend to be abstract and hard to apply. Direct measures of early growth will be used in 1984-1986 sampling.

The measurements obtained in 1983 provided useful indications of the difficulties involved in separating the effects of site preparation from the effects of site quality, but they did not accomplish the objectives of this site preparation study. Many more plantations must be sampled to make sense of the extreme variation encountered. Beginning in 1984, most of those plantations will be located in the interior of southwestern Oregon.

Don Minore - PNW

SHADE PROTECTION AFTER THREE GROWING SEASONS

Douglas-fir 2-0 seedlings planted in Spring 1981 on a southwest exposure at 4,000 feet near Butte Falls, Oregon were treated with shadecards or Reemay sleeves versus no radiation protection (control). The shadecards were 12-inch square paper board supported by lathe stakes. The Reemay sleeves, which have shown promise on many sites as deer browse protectors, were spun polyester sleeves (2" diameter x 30" length). The sleeves had not been evaluated for seedling impact on sites experiencing high radiation loads. Therefore, it was of interest to determine whether or not they would have a negative effect on seedling vigor. The summer of 1981 turned out to be an excellent, although atypical, time for the test due to a prolonged heat spell in August.

The first year results showed 8%, 3%, and 38% mortality for control, shadecards and Reemay sleeves, respectively. During the second growing season mortality increased to 28% for controls and 58% for Reemay sleeves. Seedlngs with the shadecard treatment incurred no mortality during the second growing season. The third growing season revealed no significant difference among treatments; the increase in mortality being only 5% for controls, 7% for shadecards and none for Reemay sleeves. Either the seedlings were sufficiently established by this time or the stresses encountered were not severe enough to cause mortality, which may have been the case, since the 1983 summer was relatively mild (moist and cooler than normal).

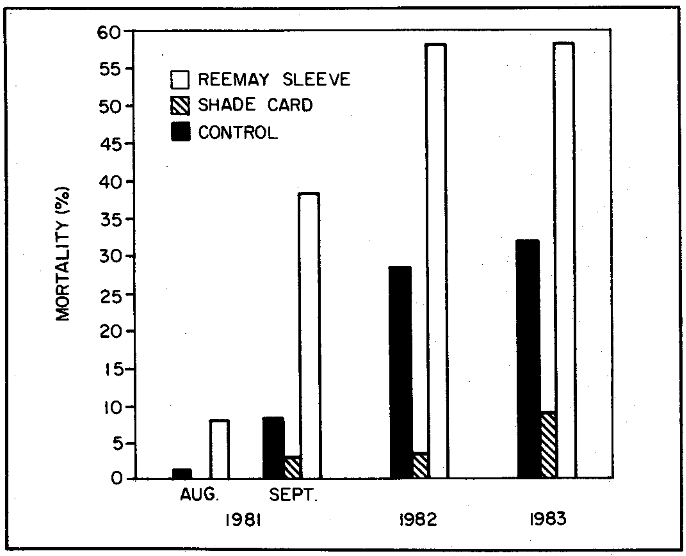

Figure 1. Seedling mortality by shade treatment and growing season.

Height growth, which had been significantly greater for shadecard treated seedlings during the second growing season, did not differ among treatments in the third growing season.

The data for this site suggest that shading is important to seedling survival on sites subjected to high radiation loading during the first two growing seasons. During the third growing season shading may not be as important. Because of mortality caused by Reemay sleeves during the first two growing seasons, their use is not recommended on harsh, southwest exposures in southern Oregon. Concurrent studies using Reemay sleeves for deer control in other areas of Oregon (west of the Cascades) did not show similar mortality. If shading had been needed during a third growing season, maintenance of shadecards would have been important, as 50% of the cards in this study were down. Although height growth was improved slightly by shading (second growing season and by only 1.5 cm), it was probably a low priority to the seedling compared to root growth, particularly for this harsh site at high elevation.

Dave DeYoe, OSU Forest Science

Of Interest

BLOCK WEIGHT REDUCTION IN SKYLINE LOGGING

If you have ever hefted a 13-inch diameter steel haulback block that is used as a tailhold for a running skyline, you have some appreciation for the difficulty involved in moving an object of this weight around in the woods. If you've actually carried one of these blocks, along with straps, chainsaw, climbing gear, and your lunch, out to the tailhold location, you have an even better idea of the rigging crew's job. A 13-inch block normally weighs about 65 pounds. It would be very desirable to have some way to reduce the weight of this equipment.

At present, the only way to achieve any rigging weight reduction is to use a smaller block, but we know that bending stresses imposed on wire rope by small diameter sheaves is highly undesirable (FIR REPORT, Fall 83, 5(3):5). Shorter rope life and losses in strength efficiency make this an impractical solution to the problem.

Recent research has been undertaken by Dr. John Miles at the University of California-Davis to determine if conventional steel sheaves can be replaced with lighter nylon sheaves. In tests performed so far, nylon sheaves were mounted onto a standard block housing and then assessed under operation for physical durability and thermal stability. Heat buildup is a difficult problem with this plastic-like material which takes much longer to dissipate heat and is prone to deform if significant temperatures are generated during operation. The recommended maximum continuous service temperature for nylon sheaves is 100°C.

The nylon sheaves were tested using a sheave load simulator that can be programmed to duplicate static wire rope tensions and speeds typical of cable logging operations. Four sheaves have been tested consecutively, each incorporating modifications indicated by tests on the previous design. The fourth design was also tested operationally in the field as the tailblock of a running skyline.

Throughout testing and modification, heat dissipation appeared to be a major problem. The final design tested had a special steel hub pressed into the center of the nylon sheave. During an hour of continuous running on the load simulator, temperatures of the nylon adjacent to this steel hub remained below 70°C and there was no material deformation. In field testing which involved nine hours of actual operating time, temperature of the nylon reached only 38°C. Again, there were no physical deformation problems.

This most recent design, using an 18-inch diameter nylon sheave, weighed 97 pounds, about 10 pounds less than a comparable all steel block. The next step is to make design modifications to the heavy housing apparatus, which promises additional weight savings.

J.M.

FOREST VEGETATION MANAGEMENT TEXT UNDERWAY

A number of forest scientists across the U.S. are collaborating on a textbook about forest vegetation management. The project is centered at Oregon State University, but involves specialists from Auburn University, Virginia Polytechnic Institute and State University, the University of Maine, the University of California at Davis, and the USDA Forest Service. Dr. Jack Walstad is the project director, and Drs. Doug Brodie, Mike Newton, John Tappeiner, and Steven Radosevich of OSU are contributing key chapters. The project is supported financially by the Environmental Protection Agency, which plans to use the document in future risk/benefit analyses of forestry herbicides. Work on the text is about half done, with target completion date of 1986.

The textbook will cover the general principles of forest vegetation management, with emphasis on the Southern Pine Region, the Pacific Northwest, and the Northeast. Specific chapters will cover: 1) ecological principles of plant competition, 2) origin of current forest vegetation problems, 3) analysis of forest vegetation management alternatives, 4) survival, growth, and yield benefits associated with forest vegetation management, 5) economic analysis of forest vegetation management options, and 6) procedures for developing forest vegetation management prescriptions.

Jack Walstad
FIR Program

SOIL COMPACTION UNDER A WIDE-TIRE EQUIPPED SKIDDER

Rubber-tired log skidders equipped with extra-wide tires have recently been introduced into ground-based logging operations, particularly in the southeastern U.S. and eastern Canada. The wide tires are primarily designed to improve skidding in swampy areas, and to extend the logging season into wet periods. An additional proposed advantage to wide tires is reduced soil compaction because of lower ground pressure. Little work has been done, however, to quantitatively determine the effect of wide-tire equipped skidders on soil compaction.

We had the opportunity to briefly examine this effect when John Deere and Co. provided the Oregon State University College of Forestry with a JD-640 skidder equipped with wide tires to be used for demonstration purposes. These tires were the Goodyear Terra-grip type which are 73 inches in diameter and 44 inches wide. During testing the tires were inflated to 30 psi. Under the direction of Marvin L. Rowley, OSU Forest Properties Manager, the skidder was used in the commercial thinning of a 50-year-old stand of Douglas-fir during November and December, 1983. The soil was of the Price series, with a surface horizon of silty clay loam, and a subsoil of silty clay. We determined soil compaction by comparing the bulk density before skidding to the bulk density after skidding. Four designated skidtrails were monitored, which received 2, 12, 20 and 40 round trips, respectively. We established three transects across each trail, and took four bulk density measurements along each transect. We permanently marked the transect locations so that bulk density measurements could be made at the same point before and after skidding. Bulk density was measured with a single-probe nuclear densimeter, with the probe set at a 12-inch depth. We collected soil samples at each point for gravimetric moisture content determination.

Measured slopes, soil moisture contents (just before skidding), and bulk densities are presented in Table 1. Changes in bulk density with skidding were highly significant for all trails (=0.01, paired t-test). Skidtrails created by the wide-tire equipped skidder averaged 13-14 feet wide, and rutting was minor, except on the 40-trip, adverse slope trail, where some soil displacement occurred. This soil displacement may have slightly exaggerated the increase in bulk density for the 40-trip trail, because with the soil surface lowered, the 12-inch probe would have gone deeper into the soil profile, into the more dense, stony subsoil.

TABLE 1. WIDE-TIRE EQUIPPED SKIDDER SKIDTRAIL CONDITIONS, AND SOIL BULK DENSITY DATA.

NUMBER OF TRIPS	SLOPE*	SOIL MOISTURE CONTENT	BULK DENSITY BEFORE LOGGING	BULK DENSITY AFTER LOGGING	CHANGE IN BULK DENSITY
	%	%	G/CM^3	G/CM^3	%
2	3 A	53	0.975	1.069	9.6
12	4 A	47	0.965	1.062	10.0
20	14 F	51	0.983	1.108	12.8
40	13 A	49	0.907	1.156	27.5

* A = ADVERSE (SKIDDING UPHILL WHEN LOADED)
F = FAVORABLE (SKIDDING WHEN LOADED)

We did not have the opportunity to directly compare these data from the wide-tire equipped skidder with effects from a skidder equipped with conventional tires. The wide-tire equipped skidder did cause statistically significant soil compaction. It was, however, able to skid on very wet soils on which it would have been difficult for a conventionally equipped skidder to operate without extensive slipping, rutting, and compaction.

Donald Miles, OSU, Forest Engineering
Hank Froehlich, OSU, Forest Engineering

MEASURING SOIL WATER AVAILABILITY IN THE FIELD

Every year we get a number of questions from foresters and soil scientists regarding the best method to collect available soil water data. We wrote this note to answer some of those questions.

The first question usually asked is "should I collect site specific information or can I use general information?" We feel that managers should match data quality with the intended use of the information. In situations where specific site preparation or harvest scheduling decisions will be made using available soil water data, information should be collected for specific management units. If there is insufficient planning time, funds, or expertise, or if the data are required for non site specific management decisions, then generalized soils information can be used. We are currently cooperating with Dick Miller (USFS PNW Experiment Station) and the Adaptive FIR Program to provide a summary of most of the available soil water data which has been collected in Southwest Oregon. We hope to present the results of that project in an upcoming FIR Report.

For managers working on specific units, it is appropriate to collect data on the site. Three factors should be considered in evaluating soil water availability: total quantity of water, the soil water potential, and the timing of water loss over the growing season. A good working definition for the quantity of available soil water is "that water stored in the root zone when fully recharged, minus any water which remains in the soil root zone at the driest part of the year." The precipitation maps of Southwest Oregon (Froehlich et al., 1982; McNabb et al, 1982) can be used to get the amount of precipitation that can be included in the total amount which will be available to plants.

Although many soils can have the same quantity of available soil water, they may have differing seasonal patterns of water loss. Figure 1 shows soil water potential vs time for one soil over a two year period. The total available water capacity was nearly the same in the two years but the seasonal timing of water use was quite different. This effect is due to environmental rather than soil conditions and is of considerable importance in determining the timing of activities such as logging, reforestation, and vegetation management. Another example of the differences in timing of water use due to shelterwoods and clearcuts is shown in the FIR Report article "Seedling Responses to Heat and Moisture Environments in Clearcuts and Shelterwoods" in this issue.

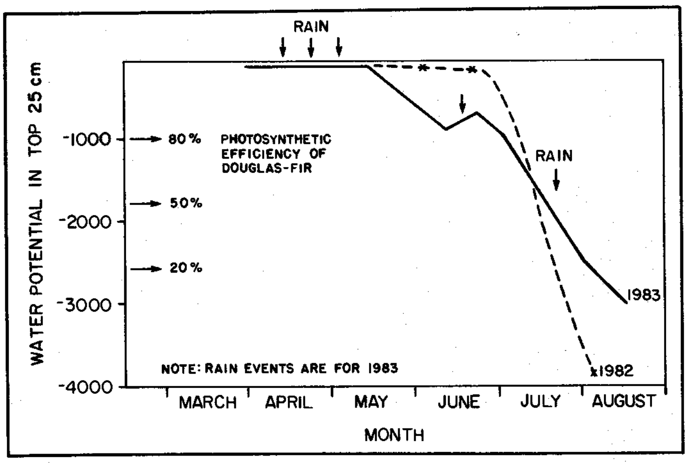

Figure 1. Soil water potential versus time for Wolf Creek clearcut.

Measurement of available soil water can be done in the laboratory or in the field. Using laboratory data, available water capacity can be estimated from soil water and release curves. First, estimate water potentials at field capacity and seasonal low water contents. Available soil water is the difference in the water content values at the two points. The laboratory determined available water capacity is often performed on disturbed soil samples and should be converted to field basis by inclusion of field bulk density and rock fragment content.

An alternative approach is to measure available water capacity in the field. Field capacity can be measured in early spring (March-April), within 1 or 2 days after a soaking rain. The seasonal low water content can be collected in late summer (late August-early September). The difference between these two measurements is available soil water. An advantage of making this determination in the field is that the measurements include the influence of local field conditions such as soil density, soil structure, rock fragment content and soil layering, all of which affect soil water holding characteristics.

It is often desirable to know the timing of water use as shown in Figure 1. This information can be collected by periodic sampling for volumetric soil water content through a season. When water content samples are taken, water potential measurements should also be made. Tensiometers can be used in the field when the soil is quite wet: between 0 and -0.8 bar. For drier conditions, samples should be taken to the laboratory. The OSU soil physics laboratory has the equipment to make soil water potential measurements for those who can't make the measurement themselves. We would also be glad to discuss your measurement plans with you.

From your field data you can produce a site specific soil water release curve. Once established for your site, a measurement of either water content or water potential can be used to predict the other. This can be particularly useful in estimating volumetric water content during the planting season by using a quick draw tensiometer and the field soil water release curve. An added benefit of the field technique is the information on water content vs time (to determine seasonal water supply) and water potential vs time (to determine seasonal water stress).

Stuart Childs, OSU Soil Science
Alan L. Flint, OSU Soil Science

HERBICIDE CONCENTRATION STUDY NEEDS VOLUNTEERS

A study entitled "Baseline concentration measurements of herbicides in air in southwest Oregon" is in the development stage at OSU. This study is designed to quantify the ambient regional concentrations (if any) of picloram, triclopyr, and 2,4-D in air.

This note is a request for information about air sampling station sites from people who live and work in southwest Oregon. Three stations are desired near Winston, in the Applegate Valley, and the Illinois Valley on the interior side of the Siskiyous. Three other stations are desired near Brookings, Gold Beach, and Powers on the coastal side. Station sites must meet the following conditions:

1. 110 V AC electrical power available within 100 yards;
2. site must be located a mile or more from agricultural fields, railroad and utility right-of-ways, or other areas of herbicide use;
3. the site should be a knoll situated within a larger valley that is between managed forest lands and populated areas;
4. for security purposes, it is necessary that each site be either near to where people are usually present, or that the site be fenced against people entering.

Local volunteers (individuals, companies or public agencies) are also needed to periodically check the sampling station's conditions at each of these areas.

The check would be to ensure that flow rates through the sampler are correct and that the vacuum pump is operating properly. Once a week the sample filter cartridge will be exchanged for a new one. Altogether, this will require no more than one-half hour twice per week plus travel time to reach the site.

If you think you may know of a site that fits the above criteria, or you would like to volunteer yourself or your group to assist in this study, please write or phone:

USDA Forest Service RWU-1653
3200 Jefferson Way
Corvallis, OR 97331
Attn: Ken Bentson
Telephone: (503)757-4385

WORKSHOP NOTEBOOKS AVAILABLE

Extra copies of the notebooks that were provided to participants of the Reforestation Research Advances in Southwest Oregon, and the Resource Issues in Timber Harvesting workshops held this past spring are available. These notebooks contain outlines, abstracts or complete papers of speakers' presentations and often include lists of pertinent references and valuable figures and tables. The papers are unedited, but provide a good reference for those unable to attend the workshops. There is a $10 charge for the Resource Issues in Timber Harvesting notebooks (251 pages) and a $6 charge for the Reforestation Research Advances in Southwest Oregon notebooks (100 pages) to cover the cost of reproduction and mailing. Please send a check or purchase order payable to:

OSU College of Forestry
Forestry Accounting
Oregon State University
Corvallis, OR 97331

Continuing Education

CALIFORNIA FOREST SOILS COUNCIL

September 7-8, 1984. Crescent City, CA. Soils Council summer field trip will visit Gasquet Mountain, the Cal Nickel Mine operation and will also look at watershed rehabilitation work in Redwood National Park. For details and registration, contact Gary Nakamura (916)365-7631.

SKYLINE LOGGING OPERATIONS

September 20, 1984. Medford, OR. Sponsored by Adaptive FIR. Intended for timber sale layout foresters, contract administrators and other resource specialists that have not attended the Forest Engineering Institute. The workshop will provide information on the functions of the logging crew during timber harvesting and the interrelationships between sale preparation, contract administration and logging. Registration limited to 30 participants. CONTACT: Elaine Morse or John Mann, Adaptive FIR (503)776-7116.

TRACTOR LOGGING OPERATIONS

September 28, 1984. Medford, OR. Sponsored by Adaptive FIR. Intended for timber sale layout foresters, contract administrators and other resource specialists that have not attended the Forest Engineering Institute. Topics to be covered will include skidtrail and landing spacing considerations, equipment types, equipment capabilities and limitations, equipment performance calculations, skidtrail layout, and post harvest treatments. Registration limited to 30 participants. CONTACT: Elaine Morse or John Mann, Adaptive FIR (503)776-7116.

EVALUATING SEEDLING QUALITY

October 16-18, 1984. Corvallis. This two and one-half day workshop will present state-of-the-art information on the various tests used to evaluate seedling quality. It will review the principles, procedures, and predictive abilities of tests for frost hardiness, carbohydrates, and root growth capacity. Presentations will be incorporated into a proceedings to be published immediately following the workshop. The registration fee will be $125 per person. Registration will be limited to 280 participants. For further program information contact: Mary Duryea, Department of Forest Science (503)754-2244, or Conference Assistant (503)754-2004, Oregon State University, Corvallis, OR 97331.

HERBICIDE AND NON-HERBICIDE FOREST WEED CONTROL FOR SOUTHWEST OREGON

November 7, 1984 - Medford OR; November 8, 1984 - Roseburg, OR. Sponsored by Adaptive FIR. The workshop will address the roles of grazing animals, fire, mechanical control and ground-based herbicide application for controlling forest weeds. Registration will be limited to 100 each day. Detailed program announcements will be mailed this summer. CONTACT: Elaine Morse, Ole Helgerson or Steve Hobbs, Adaptive FIR (503)776-7116.

Recent Publications

For copies of these publications, mail your request to the indicated address:

Publications
Pacific Northwest Forest and
Range Experiment Station
P.O. Box 3141
Portland, OR 97208 (1)

Education Committee
Northern California SAF
P.O. Box 93
Arcata, CA 95521 (2)

Laurentian Forest Research Center
Canadian Forestry Service
1080 Route du Vallon
Sainte-Foy, Quebec
CANADA G1V 4C7 (3)

Publications
Intermountain Forest and
Range Experiment Station
Ogden, UT 84401 (4)

Publications
F.E.R.I.C.
143 Place Frontenac
Pointe Claire, Quebec
CANADA H9R 4Z7 (5)

Forestry Business Office
College of Forestry
Oregon State University
Corvallis, OR 97331 (6)

American Society of
Agricultural Engineers
P.O. Box 410
St. Joseph, MI 49085 (7)

Watershed Systems Dev. Group
USDA Forest Service
3825 East Mulberry Street
Fort Collins, CO 80524 (8)

Pacific Southwest Forest and
Range Experiment Station
P.O. Box 245
Berkeley, CA 94701 (9)

Extension Bulletin Mailing
Industrial Building
Oregon State University
Corvallis, OR 97331 (10)

GROWTH OF PONDEROSA PINE POLES THINNED TO DIFFERENT STOCKING LEVELS IN CENTRAL OREGON, by James W. Barrett. 1983. USDA For. Serv. Pac. N.W. Forest and Range Experiment Station, Portland, OR. After 15 years growth was related to growing stock level in a 65 year old pole stand on an above average site. Annual diameter growth during the five years after initial thinning ranged from an average of about 0.28 inch at the lowest GSL to 0.10 at the highest. These rates increased slightly during the following decade but differences between GSL's remained about the same. These growth relationships resulted in much larger trees at the lower GSL's 15 years after the initial thinning. Gross basal-area increment was positively correlated with stand density during each of the three growth periods. Annual growth ranged from 1.4 square feet per acre at the lowest GSL to 3.9 at one of the higher densities. Cubic volume growth was related to GSL. Higher GSL's produced more wood, but were accompanied by mortality from the mountain pine beetle; growth was also distributed on many trees that may never reach merchantable size. Timber stands in mid-range levels (GSL 80, 100 square feet) grew reasonable amounts of wood without serious beetle attack.

(1)

MANAGEMENT OF THE EASTSIDE PINE TYPE IN NORTHEASTERN CALIFORNIA - PROCEEDINGS OF A SYMPOSIUM, by T. F. Robson and R. B. Standiford (eds.). 1983. Northern California Society of American Foresters, Arcata, California. 139 p. This publication compiles 19 papers describing the latest eastside pine management information. Individual paper topics include descriptions of climate and soils, discussions of management strategies, and technical information on site quality, fertilization, vegetation management, diseases, regeneration practices, site preparation, and thinning. The goal of the Northern California SAF chapter in preparing this publication was to provide the most accurate, pertinent information a forester would need to properly manage an eastside forest property, regardless of ownership or management objectives. (Cost - $10.)

(2)

IMPLICATIONS OF FULL-TREE HARVESTING FOR BIOMASS RECOVERY, by J. G. Routheir. 1982. Canadian Forestry Service, ENFOR Project P-54. 132 p. This report provides a fairly comprehensive look at the harvest and transport of entire trees, limbs and all, so that the biomass normally left as residue in the woods can be used as fuel at a processing facility. Conditions and harvesting methods analyzed are endemic to eastern Canada, but the methodology of the study would apply anywhere. Economic analysis of various alternatives are provided, but one noticeably lacking component is any consideration for degradation of long term site productivity due to complete above ground biomass removal.

(3)

CONSTRUCTION COST AND EROSION CONTROL EFFECTIVENESS OF FILTER WINDROWS ON FILL SLOPES, by M. J. Cook and J. G. King. 1983. USDA Forest Service Res. Note INT-335. Intermountain For. and Range Expt. Sta., Ogden, Utah. 5 p. Sediment barriers of filter windrows were designed and constructed on fill slopes in the vicinity of stream crossings on newly constructed roads. Windrows consisted of logs anchored at the bottom of the fill slope with slash embedded in the soil above the log. Windrows were constructed simultaneously with road construction at the rate of 170 feet/hour. A tracked, hydraulic pull shovel was used to place the slash. After three years, windrows retained at least 75 to 85 percent of the sediment moving down the fill slope as a result of either rill and gully erosion or slumping. Filter windrows were relatively inexpensive to construct and very effective at proventing eroded material from entering adjacent streams.

(4)

THE USE OF HIGH FLOTATION TIRES FOR SKIDDING IN WET AND/OR STEEP TERRAIN, by P. G. Mellgren and E. Heidersdorf. 1984. Forest Engineering Research Institute of Canada, Tech. Rep. No. TR-57. This report describes FERIC's four year program to evaluate the use of high-flotation logging tires as a means of extending the range and capabilities of conventional skidders. It contains a discussion of tire theory, results of performance tests under a variety of conditions, skidder tire options currently available and some usage considerations for planning wide tire operations.

(5)

GLYPHOSATE AND HEXAZINONE MIXTURES: EFFECTS ON WEEDS AND DOUGLAS-FIR TRANSPLANTS, by D. E. White and M. Newton. 1984. Forest Research Laboratory Research Note 76, Oregon State University, Corvallis. 5 p. This report describes a study designed to examine the effects of liquid and solid formulations of hexazinone with and without glyphosate on herbaceous weeds and Douglas-fir transplants. It was found that Douglas-fir survival was increased by herbaceous weed control and that hexazinone application rates of 1.1 - 2.2 kg/ha improved Douglas-fir height growth through the fourth year. Control of herbaceous weeds lasted longer with liquid hexazinone than with the dry product.

(6)

FOREST SERVICE SPRAY DRIFT MODELING, by John W. Barry and Robert B. Ekblad. 1983. American Society of Agricultural Engineers, Paper No. 83-1006. This paper reviews the development by USDA Forest Service of a computer base mathematical model for forest spraying. The first application of the model to a forest spray problem was in 1971 to predict the quantity of insecticide necessary to achieve spruce budworm mortality. Subsequent uses of the model have involved estimates of spray drift for Maine Forest Service, specifications for aerial treatment of southern pine seed orchards, and calculations of canopy penetration and spray drift for several forestry projects in the West. Model development has included the addition of codes for canopy penetration, droplet evaporation, and aircraft wake.

(7)

REGIMA4: A DETERMINISTIC SOIL WATER BALANCE MODEL, by Gordon E. Warrington and James D. Weatherbed. 1983. USDA Watershed Systems Development Group, WSDG-AD-00008. A computer program, REGIMA4, has been developed for forecasting average monthly conditions and trends of plant-available soil water for use in scheduling management practices. Conceptual descriptions of environmental processes related to the operation of REGIMA4, user instructions describing the kind of data needed, how they are input, and directions for executing this program are provided. Supporting information about computational procedures, physical processes, program validation, and data sensitivities are also included. The model produces tables and graphs that can be used to plan the kind, location, and timing of forest practices to coincide with appropriate soil water conditions. The computational procedures used in this model make it adaptable to a wide variety of climatic, soil, and site conditions that are likely to be found on National Forest lands. Analytical procedures were chosen for their use of data that could be obtained under forest management conditions, as well as their capability to provide accurate estimates of soil water content.

(8)

SITE INDEX CURVES FOR YOUNG-GROWTH INCENSE-CEDAR OF THE WESTSIDE SIERRA NEVADA, by K. Leroy Dolph. 1983. USDA Forest Service. Res. Note PSW-363. Pacific Southwest Forest and Range Experiment Station, Berkeley, CA. 8. p. Site index curves were developed for use in stands between 10 and 80 years old. Stem analysis data were collected from 56 trees growing in mixed-conifer stands of the westside Sierra Nevada of California. Reference age is 50 years at breast height. Site index curves at 10-feet intervals are presented for approximate field estimates and regression coefficients and the equation are provided for more precise estimates. Within the mixed conifer forest, Dolph recommends selection of dominant or codominant trees located within even-aged groups for consistent site estimates. Site trees must be defect-free and an increment core taken at breast height should show no fire scars, mechanical damage, or any period of suppression followed by release. Site indexes calculated from trees with b.h. ages greater than 75 years should be used with caution because such estimates are made with extrapolations of the basic data.

(9)

Correction

Last month we announced the availability of the publication, DESIGNING DOUBLE-TREE INTERMEDIATE SUPPORTS FOR MULTISPAN SKYLINE LOGGING, by John W. Mann. 1984. OSU Extension Service Publication EC-1165, but mistakenly gave the price as 75¢. In order to cover mailing and handling costs, this publication is available for $1.00 each.

(10)

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