Sierra-Cascade Intensive Forest Management Research Cooperative

Series Report No. 13

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ANNUAL REPORT 2012

TABLE OF CONTENTS

The year 2012 marked the thirteenth year as an organization for the Sierra Cascade Intensive Forest Management Research Cooperative.

Membership remained constant from 2011. The current membership consists of a mixture of landowners, forestry-related industries, State of California and federal agencies. There are currently fifteen member organizations in the Co-op.

Changes in member representatives and the steering committee occurred in 2012. Bill Stewart, University of California, Berkeley, replaced Gary Nakamura who retired in 2011. The steering committee consists of Bill as the university representative, Bob Powers as the research representative, and Mark Gray as the industry representative. With Jason Warshawer going to P.G. & E., Ken Scott became the Roseburg Resources representative.

Two presentations of results from research supported by the Cooperative were presented by members of the Co-op at the Forest Vegetation Management Conference in January. Vanelle Peterson reported on her research on two new pesticides, Milestone VM and Vista XRT (Proposals 10-01 and 10-02). The title of her presentation was "Milestone VM and Vista XRT; New Tools in Forestry Site Preparation". Ed Fredrickson reported on additional studies with Vista XRT (Proposal 10-02). His presentation was titled "Broadcast and Directed Release Treatments with Vista XRT and Accord". Both presentations were well received by the audience.

Working Group II met at the Forest Service office in Redding on February 21st (a summary of this meeting can be found in this Annual Report). Five new proposals were presented to the group by the authors. Following discussions on these proposals, all five were selected to be presented to the general membership at the 2012 business meeting scheduled for March. These included two herbicide-related proposals, a proposal to investigate the effects of the ripping done at the Co-op's study site on Fruit Growers' land (Proposal 00-05), a proposal to remeasure the Pondosa thinning and sub-soiling study, and a proposal to install Phase II of the Garden of Eden study.

The annual business meeting was held at the Forest Service office March 6, 2012 in Redding (a summary of the meeting can be found in this Annual Report). Thirteen Co-op members and guests attended. The first item of business was a review of membership status and the budget. The Co-op ended 2011 with a surplus of $6,966. As previously decided, dues for 2012 were returned to normal levels after three years of reduced rates.

Following the discussion on the budget, updates on six recently funded Co-op studies were presented – Proposal 11-01 Sunscald; Proposal 08-02 Cedar Stock Trials; Proposal 10-02 Vista; Proposal 10-01 Milestone; Proposal 11-02 GF9999; and Proposal 11-03 Mat 28 Site Prep. Executive Summaries of these studies are presented in this Annual Report.

The final item of business at the annual meeting was the presentation of six new proposals for possible Co-op funding. The

Co-op was able to finance three of these proposals (Proposal 12-01 Fruit Growers' Soil Pits; Proposal 12-02, Garden of Eden; and Proposal 12-03, Pindar GT).

Spring treatments for the Pindar herbicide study approved in 2012 (Proposal 12-03) were applied in April.

The soil pits for the 2012 approved Proposal 12-01 were installed on May 7-8th on the Fruit Growers' site.

Examinations of two study sites (Proposal 11-01, Sunscald and Proposal 08-02, Cedar Stock Trials) in May revealed heavy mortality in the planted conifer seedlings. The mortality was so excessive that the integrity of both studies was questionable. The decision was made to do an intensive survival examination at the Sunscald site immediately but wait until the end of the 2012 growing season to reevaluate the Cedar Stock Trial site. The examination at the Sunscald site was done on May 23rd and revealed the study was no longer viable (two of the four treatments had 10% or less survival, the highest survival of any of the treatments was 18%). All instrumentation was removed at this time and the study ended (the Executive Summary in this Annual Report describes these findings).

The Co-op field trip scheduled for August 22nd in the Shingletown area had to be cancelled due to the ongoing Ponderosa Fire. A couple of the planned stops for the field trip were burned by the fire.

Evaluations of results from the five ongoing herbicide proposals (Vista, Milestone, Mat 28, GF9999, and Pindar) were conducted in July and August.

The Agenda 2020 sites (Proposal 03-01) were visited in August in order to formulate future plans for this study.

The plots in two of the three Garden of Eden sites (Whitmore and Elk Horn) included in the 2012 approved Proposal 12-02 were felled by early November. All three sites had pre-harvest measurements taken and all plot corners were remonumented prior to falling.

The survival examination of the Cedar Stock Trial was conducted in November. As suspected after the May examination, mortality was extreme. Nine of the fifteen treatments had less than 10% survival (this included all living conifers in a treatment, not just measure trees). Five of the remaining treatments had less than 20% survival (results of these examinations are reported in an Executive Summary in this Annual Report). The fate of this study will be discussed at the 2013 annual meeting scheduled for March 5th.

The year 2013 should be another busy one for the Co-op. New proposals are currently being submitted to the Co-op for funding consideration. Several funded studies will have second year measurements made. The final Garden of Eden site included in Proposal 12-02 (Feather Falls) will be harvested. Site preparation for all three Garden of Eden sites will be completed in preparation for planting in 2014. Based on the interest shown for field trips featuring Co-op study sites, another trip will be planned for 2013.

20012 MEMBERSHIP

Land Manager Membership
- California Department of Forestry
- Fruit Growers Supply Co.
- Roseburg Resources Co.
- Sierra Pacific Industries, Inc.
- Soper-Wheeler Co.
- Timber Products Co.
- W.M. Beaty & Associates, Inc.

Associate Corporate Membership
- Cal Forest Nurseries & Mountain Gate Gardens

Affiliate Membership
- Dow AgroSciences
- Silver Butte Timber Co.
- Thunder Road Resources

Supporting Members
- California Forestry Association
- PSW Research Station
- University of California
- USDA Forest Service

Sierra Cascade Intensive Forest Management Research Cooperative

Annual Meeting March 6, 2012

The 2012 annual meeting was held at the Forest Service office in Redding, CA on March 6, 2012. Thirteen Co-op members and guests attended.

The 2011 Annual Report was the first item of business. Membership status was discussed. All members from 2011 have either paid 2012 dues or indicated that dues payments are on the way. A new member, Dow AgroScience, joined the Co-op in 2011. There are currently fifteen member organizations in the Co-op. The membership decided that an effort should be made to contact the following possible new members: Plum Creek (Eric Hipler); Crane Mills (Frank Barron); and Collins Pine (Eric O'Kelley). Mark Gray will take the lead in this effort.

The next item of business was a discussion on the budget. The Co-op ended 2011 with a surplus of $6,966. As previously decided, dues were returned to normal levels in 2012 after three years of reduced rates. Dues received for 2012 at the time of the annual meeting totaled $30,000. Another $28,000 has been promised. To supplement the summary of the 2011 budget found in the Annual Report, spread sheets of the proposed budget/workload for 2012-2016 and the Co-op manager's time/contract costs through the same period were presented to the membership. There will be at least $14,000 available for new proposal funding in 2012 according to budget projections.

A discussion of the desirability of a Co-op field trip for 2012 followed the budget discussion. The 2012 Weed Tour is going to be held July 11-12 and be conducted in the vicinity of Burney. As the Co-op has several study sites in this general location, the suggestion was made to combine the Co-op field trip with the Weed Tour. We could host a half day tour of our study sites either before or following the Weed Tour. After some discussion, the membership decided against combining the two field trips. Instead, the Co-op will host a field trip on August 22nd and will visit some Co-op study sites Ed Fredrickson has established around Shingletown. In addition, Mark Gray will contact Cajun James about including her study at Battle Creek with the Shingletown stops.

With the retirement of Gary Nakamura in August 2011, the Co-op no longer had an academic representative on the steering committee. Before he left, Gary recommended Bill Stewart (UC Berkeley) as his replacement with Richard Standiford (Cooperative Extension, Berkeley) as an alternate. Bill and Rick were invited to our annual meeting. Bill was able to attend (Rick was about to become a grandfather and couldn't make it). After a brief discussion of Bill's interests and research focuses, the Co-op membership offered him the position on the steering committee. Bill accepted and will join Bob Powers and Mark Gray on the committee (with Bob

Rynearson moving on to a new job, there will be one industry representative on the committee instead of the usual two). Bob Powers brought up the need for a Chair for the steering committee and recommended that the representative from industry fill this position. The membership agreed and Mark Gray accepted. New member recruiting will be one of the main responsibilities of the Chair.

The next item on the agenda was funded proposal updates. Prior to starting these updates, the membership was informed of the fate of one of the approved proposals from 2011 – the remeasurement of the Stock Type/Fertilization study (Proposal 00-04). Jianwei Zhang was going to remeasure the four sites included in this study and report the findings in a manuscript in an applied journal as well as in a summary report to the Co-op. Site visits to two of the four sites in the study, in order to remonument plot corners to facilitae the remeasurement process, revealed that the sites had been compromised (mortality in one site, inadvertent precommercial thinning at the other) to such an extent that they could no longer function as one of the replications in the study. Zhang decided to cancel the remeasurement and the funds ($4,500) approved for this study were returned to the Co-op account.

A discussion followed about how to protect study sites. Several ideas were discussed including sending a listing of all Co-op sites to the membership. This brought up the need for locating these sites on a base map with GPS coordinates. Suggestions on what type of base map to develop were discussed. A suggestion was brought forward to ask for proposals to address this situation. Jeff Webster indicated he would submit such a proposal.

Following the discussion on protecting study locations, updates on funded proposals were presented. Jason Warshawer presented results on Proposal 11-01 Sunscald and Proposal 08-02 Cedar Stock Trials; Ed Fredrickson presented results on Proposal 10-02 Vista, proposal 10-01 Milestone, Proposal 11-02 GF9999, and Proposal 11-03 Mat 28 Site Prep. Executive summaries of the first four proposals are found in the 2011 Annual Report. The last two proposals have no data to report as of yet.

Following the updates on funded proposals, Jason Warshawer reported on a stock type study he installed in 2007 in the Sacramento River canyon near Dunsmuir. Although not a Co-op funded study, the membership voted to help Jason take the fifth year growth measurements and survival counts at the 2011 annual meeting. This trial compared superior ponderosa pine seedlings to seedlings from the general collection. Also, plug-1 Douglas-fir were compared to Styro 8 Douglas-fir seedlings. As the study was replicated and well designed, the Co-op membership felt the knowledge gained from this study would be beneficial to the group. A full data package for this study is available at the Co-op manager's office in Redding.

After Jason's report on the stock type trial, six new proposals were presented to the membership for possible funding in 2012. Bob Powers presented a proposal for establishing a second rotation study at three of the Garden of Eden sites. Brent Roath proposed studying the effects of ripping/subsoiling on the site of an earlier Co-op study, Proposal 00-05 Timmer and Jopson. Ed Fredrickson presented three proposals for herbicide trials (Pindar GT, Mat 28 Black Oak, and Milestone/Velpar and Dimension EC combinations). Jeff Webster presented a proposal to remeasure a compaction study at Pondosa.

After these presentations were made, the meeting was opened for questions about the new proposals. After Bob Powers reviewed the history of the Garden of Eden study, Tom Jopson volunteered to donate $5,000 toward funding this proposal. This amount represented 50 percent of what was being requested to fund the proposal. Questions concerning funding for measurements needed after the first year resulted in the scheduling of a meeting with Zhang, Powers and the three land owners on whose lands the Garden of Eden sites are found (this is scheduled for April 19). The membership asked if Roath could enlarge his proposal by installing a second replication at another location (Brent was contacted later and agreed to add another replication). Much discussion centered around the Pondosa proposal. Since 2012 would represent the end of the 14th growing season after treatment, the suggestion was made to hold off until the end of the 15th season. Several co-op members volunteered to help get the plots ready for measurements in 2013 (if approved) by pulling tags, etc. this summer. After these and other questions/concerns were addressed, it was decided that the new proposals would be e-mailed to the voting membership for their decision as to which proposals would be funded. A quick turn around will be required in order to facilitate installation of some of the new proposals if they are selected for funding.

The meeting adjourned at this time.

Working Group II Meeting February 21, 2012

Working Group II met at the Forest Service office in Redding on February 21, 2012. In attendance were Tom Young, Mark Gray, Bob Amesbury, Scott Worden, Jianwei Zhang, Scott Carnegie, and Jason Warshawer (Chair).

If all current Co-op members renew their membership, the budget should have a surplus of at least $14,000 to be applied to new research proposals in 2012.

The meeting started with a discussion on freezer storage of seedlings – a takeoff on Darin McMichael's trial on Silver Butte lands out of Prospect, OR that was installed in April, 2010. This study tested viability of Douglas-fir seedlings stored in a freezer for varying lengths of time before out-planting. Damage from elk browsing so compromised the study that it was discontinued after the first growing season.

Following this discussion, Jason asked each attendee to list what issues they would like to see addressed with the available funds. **Mark:** developing an alternative to Velpar – DuPont is pricing it out of reach; amount of slash left after site preparation – how these amounts effect establishment and growth. Mark explained about his use of V-plows coupled with single-shank ripping to prepare planting spots on some of his brushier sites. **Tom:** alternative to Velpar; ripping – find out if this practice is really buying us anything; Douglas-fir frost study. **Bob:** ripping – is survival better and does this practice get a stand to the PCT stage quicker? Bob has some empirical data on ripped vs. non-ripped sites that are 10-15 years old; Velossa trials – seeing seedling damage mostly on east side sites (2011 fall spraying showing conifer damage in spring of 2012). **Scott Worden:** chemicals that can be used in a multi-species mix; amount of slash left following site preparation; ripping. **Scott Carnegie:** pre-emergent site prep Velpar alternative, glyphosate study follow-up (Mark's study) – would using less surfactant than the rates used in Mark's study allow users to go over the top of seedlings during dormancy?

The next item on the agenda was a discussion by the working group of the five new proposals that have been submitted to the Co-op for possible funding in 2012. **Soil Evaluation Proposal, Fruit Growers Test Site:** the working group was in favor of this proposal. The working group will ask Brent Roath to replicate the study at an additional site on Timber Products ground. Bob Amesbury can supply details about this new site. **Mat 28 Black Oak Hack and Squirt Trial:** Tom doesn't see much benefit from this study and was concerned abut the Co-op doing research that DuPont should be doing and paying for. Bob and Jason do see benefits in the study especially related to the issue of controlling live oak. Could lower rates than those proposed for the proposal be effective? Mark was worried about residual effects even with hack and squirt – was DuPont considering this material as a release treatment? Scott C. questioned if the trial would evaluate the effect on conifer tolerance through root uptake – similar to the effect of imazapyr on the tops of residual trees if used in a shaded fuelbreak. (Ed was contacted by telephone during the meeting and the questions raised by the group brought to his attention. He agreed to use lower rates than those proposed in his write-up = the 1.0 MLS rate will be replaced with a 0.25 MLS rate. There will be no change in the cost of the proposal. Ed said that Dupont was not proposing Mat 28 for use in release treatments). The working group was undecided about this proposal – but was leaning toward not recommending it.

Remeasuring the Pondosa Thinning and Sub-soiling Study: Jianwei explained that the end of the 2013 growing season would be the 10th year since the last measurement of this study and the 15th year since treatment. Many of the tree tags are overgrown and would need to be pulled before the remeasurements could be done. This would increase the cost of doing the proposal. The working group was concerned with the costs of the proposal. It was decided that Co-op members would pull/retag measure trees in 2012 through donated labor. The group recommended that the proposal be resubmitted to the Co-op in 2013 and if approved the 2013 measurements would then be taken 15 years after treatment. **Effects of First Rotation Silvicultural Treatments on Growth and Carbon Sequestration in the Second Rotation of a Ponderosa Pine Plantation:** There was much discussion on this proposal. Members were divided about taking on another complex study such as this one. The benefits of the study were well recognized but concerns were expressed about the need for supplemental outside funding, Co-op and landowner obligations if we voted to fund the start-up phase (in essence, this proposal), documentation/permits needed, whether this type of study complies with the goal of the Co-op, and the need to make this a comprehensive and complete study, etc. The final decision by the group was to hold off recommending this proposal until we could get more information about the study especially more precise future workloads, costs, and responsibilities. It was recommended that the landowners who have sites on their holdings meet with Bob Powers to flesh out this proposal.

Intolerant Conifer Site Preparation: This is the Pindar proposal. The group approved this proposal with a couple of reservations. Can more conifer species be added without substantially increasing the costs? Why was one of the treatments Milestone alone? Should other tank mixes be considered? These questions will be presented to Ed so he can make a clarification to the whole membership during our March 6th meeting.

The group then discussed the possibility of developing a new proposal to present to the full membership at the March meeting. This proposal would study the benefits of ripping. This study is different from the soil evaluation proposal submitted for 2012 by Brent Roath. It was decided that it is probably too late to get a study in this year, but the group will start setting aside study sites and submit a proposal in 2013. Soper Wheeler, Sierra Pacific Industries, and Roseburg Resource all volunteered to look for sites for the proposed study. Mark thought that Bob Powers may have already published on a study of this same nature. The Co-op will contact Bob about this.

Sierra Cascade Intensive Forest Management Research Cooperative Proposal 11-01
Sunscald and Frost Effects

Principal Investigator: Jason Warshawer

Title: Sunscald and Frost Effects on Douglas-fir Survival

Year Funded: 2011

Executive Summary:

In recent years, Douglas-fir has been increasing as a percentage of planted species in many of our plantations. Douglas-fir is one of the more difficult conifer species to get established. Minimizing the number of seedlings lost to mortality and the subsequent replanting costs represent the greatest opportunity for cost savings in establishing our plantations. The purpose of this study is to quantify the amount of mortality to planted Douglas-fir seedlings resulting from sunscald and/or frost. Imbedded in the study will be an investigation of the most cost effective ways to protect Douglas-fir seedlings from sunscald.

Planting sites on lands managed by Co-op member Roseburg Resources were proposed for the initial installations of the study.

Planting stock type will be Styro-8's. Planting spacing will be 8 feet by 12 feet. A replication will consist of 20 seedlings. Each treatment will be replicated four times for a total of 320 trees per study site. The four treatments include: sun protection with mesh screen/wire bracket, frost protection with plastic tubing, sun protection with calcium carbonate, and control.

Data collection will consist of survival exams conducted annually at the end of the growing season. These exams will be conducted for three consecutive years following initial planting.

A pre-harvest spray of 2% Chopper plus oil was applied in September of 2008. The study site was harvested in 2010. The site was single ripped in July and Velpar was applied in November of 2010.

2011: The study site was planted in May by Co-op members from Roseburg Resources and Thunder Road Resources. The treatments were applied immediately following planting by the same Co-op members.

This site was one of those visited during the Co-op field trip in June.

Instruments for collecting soil/weather data were installed in July. Sensors for collecting soil temperature were buried to a depth of 10 centimeters at five randomly located spots in the study site. Sensors to record air temperature were installed 12 inches above ground immediately adjacent to seedlings receiving the four treatments. There were nine of these sensors installed. The sensors located in the plastic tubing treatment were placed within the tube. Finally, two temperature-collecting stations equipped with radiation shields for the sensors were located at either side of the study site. The sensors at these stations were five feet above the

ground. All sensors have 2-hour recording intervals.

The calcium carbonate treatment had to be reapplied three times during the year due to rain washing the material off of the treated seedlings. Employees from Roseburg Resources did all of the reapplication work. Minor maintenance was required on the screen/wire bracket and plastic tubing treatments during the year.

Survival counts were done in late October/early November. First year survival ranged from 94 to 96 percent with no significant differences between treatments. There were numerous brown tips on seedlings in the plastic tubing treatment. Also, some terminal buds were clipped by wildlife in this treatment.

Second-year survival will be taken at the end of the growing season in 2012.

2012: In mid-May, a walk-through examination of the study site revealed extensive mortality in all treatment replications. Based on this finding, a systematic survival survey was conducted on May 23rd. Survival of the treatments (November 2, 2011 survival in parenthesis) was as follows: Control 7.5% (93.75%); Shade Screens 18.75% (93.75%); Plastic Tubing 10% (96.25%); and Calcium Carbonate 16.25% (95%).

Based on the timing of the two survival surveys, this mortality was obviously a winter event. Following the May survival survey, data were downloaded from the temperature sensors that were located throughout the study site (see above write-up for 2011 as to placement of the sensors). A sample of this data can be found at the end of this report. The data revealed that starting the last few days in October, 2011 and continuing through mid-April 2012, the site was subjected to low temperatures below 20 degrees for most of the period. There were two periods (each about a week long) of 0 degree weather in the last half of January and again in the first part of February. Soil temperatures during these times dropped to the mid-thirties. A lack of snow cover contributed to these low soil temperatures. There were tremendous swings between daytime/nighttime readings. Coldest temperatures were recorded in the plastic tubes.

A final survival survey was conducted on November 7th. Results of this survey revealed that survival continued to fall during the summer: Fall 2012 survival levels: Control 2.5%; Shade Screens 8.75%; Plastic Tubing 6.25%; and Calcium Carbonate 2.5%. The study was abandoned at this time.

Temperature Sensor Data Key:

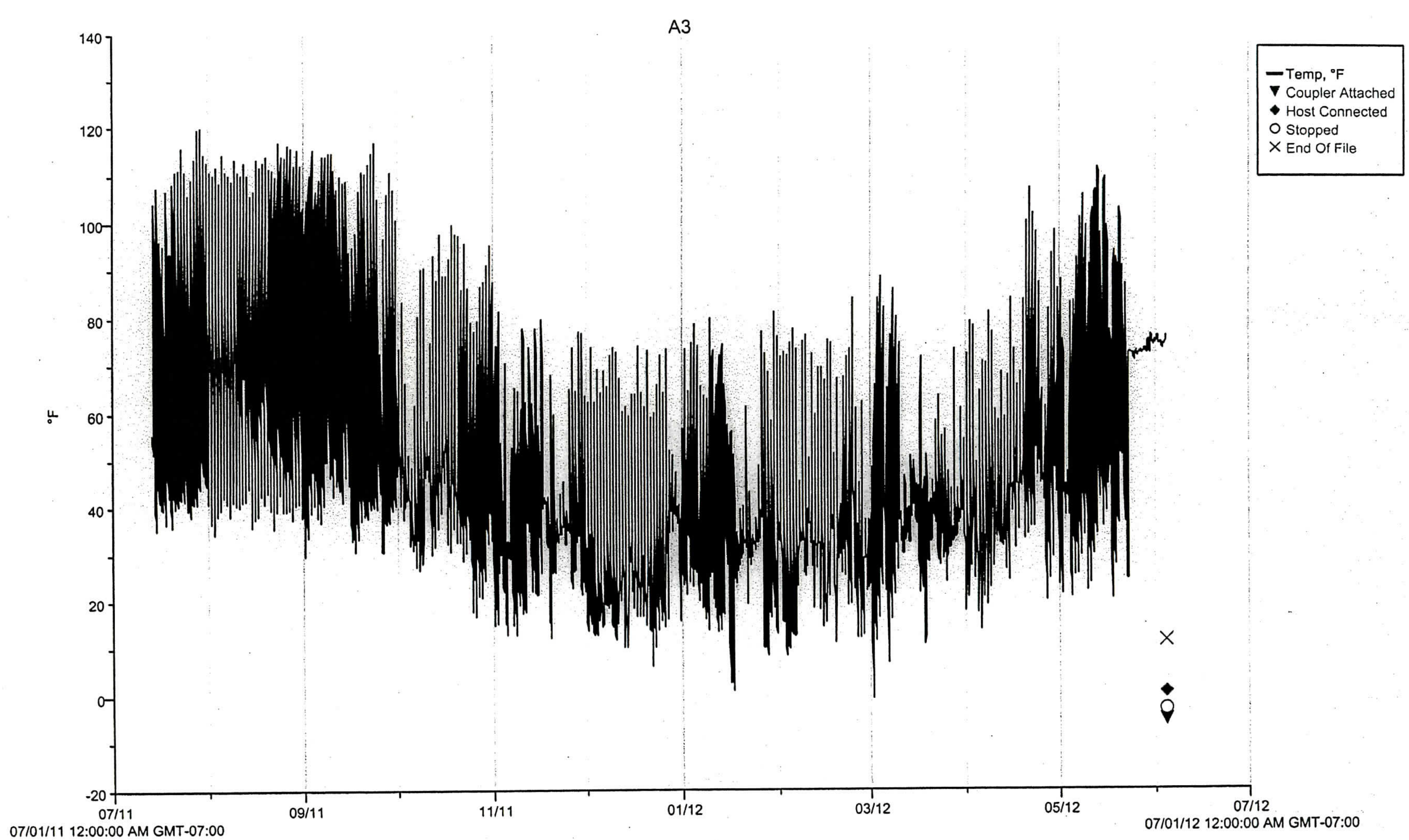
A3 (Control) - sensor installed 12 inches above ground immediately adjacent to a seedling

G5 (Ground) – sensor buried to a depth of 10 centimeters

R2 (Radiation Shield) – sensor installed at 5 feet above ground

S2 (Shade Screen) – sensor installed 12 inches above ground immediately adjacent to a seedling

T2 (Plastic Tube) – sensor installed 12 inches above ground inside the plastic tube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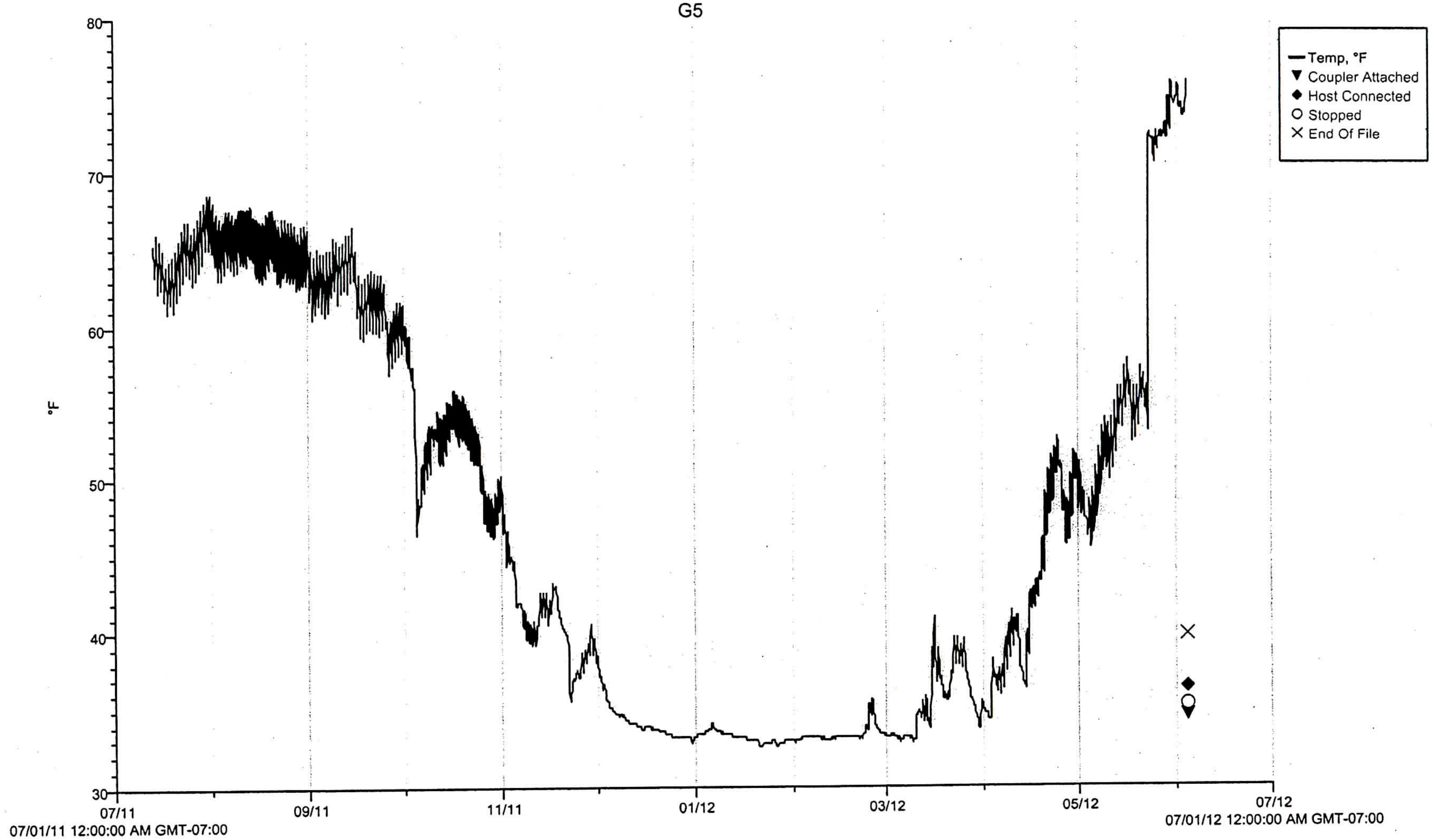
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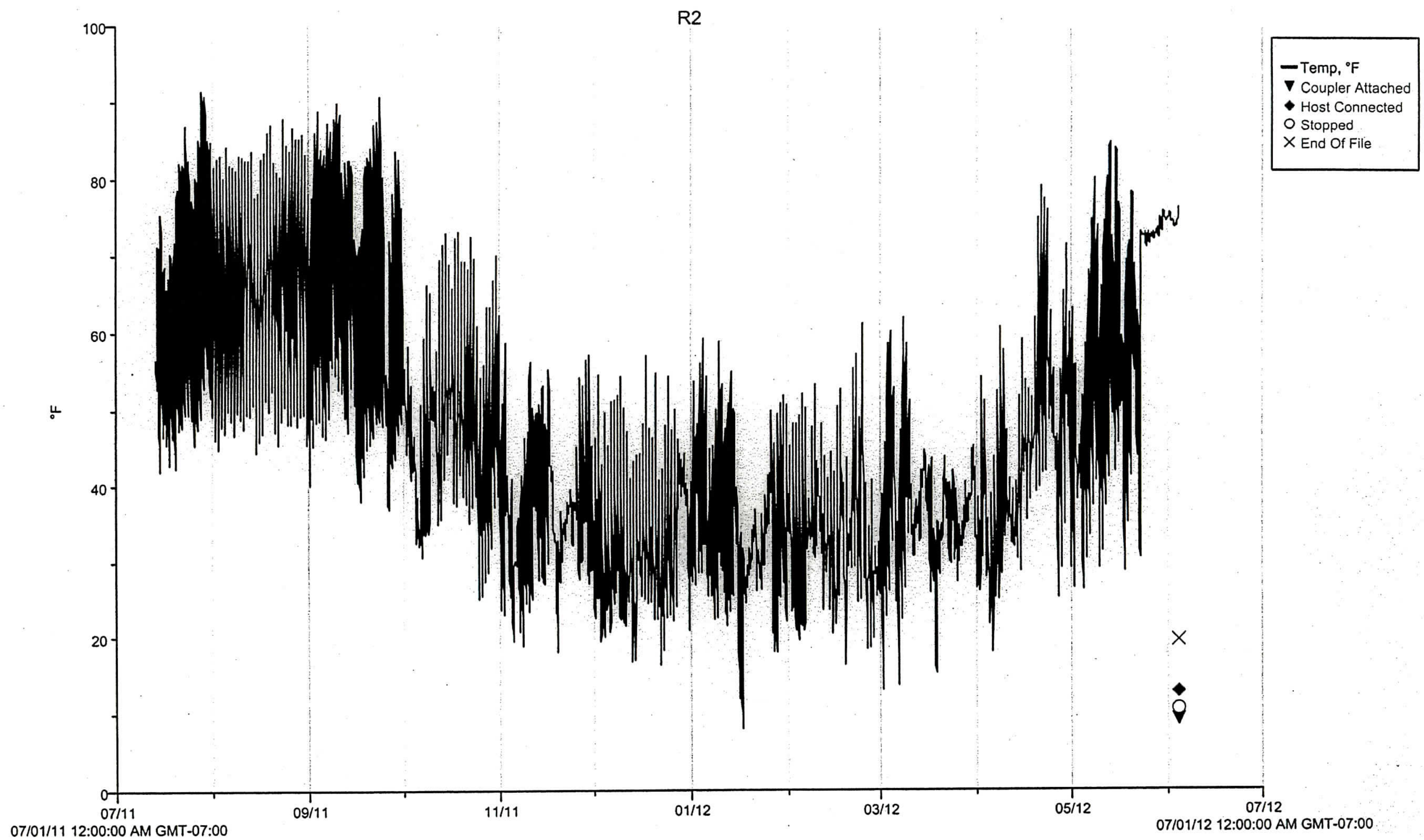
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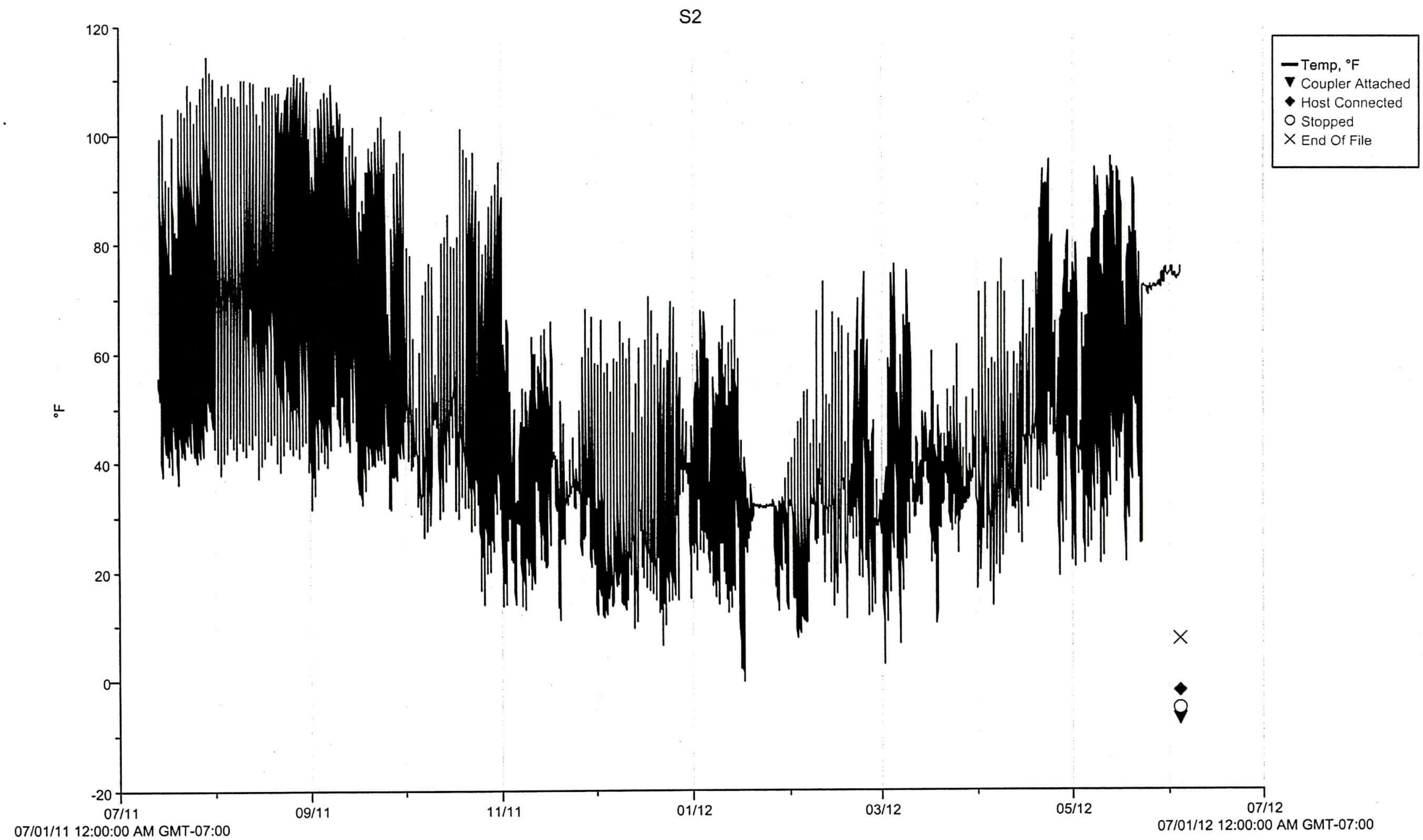

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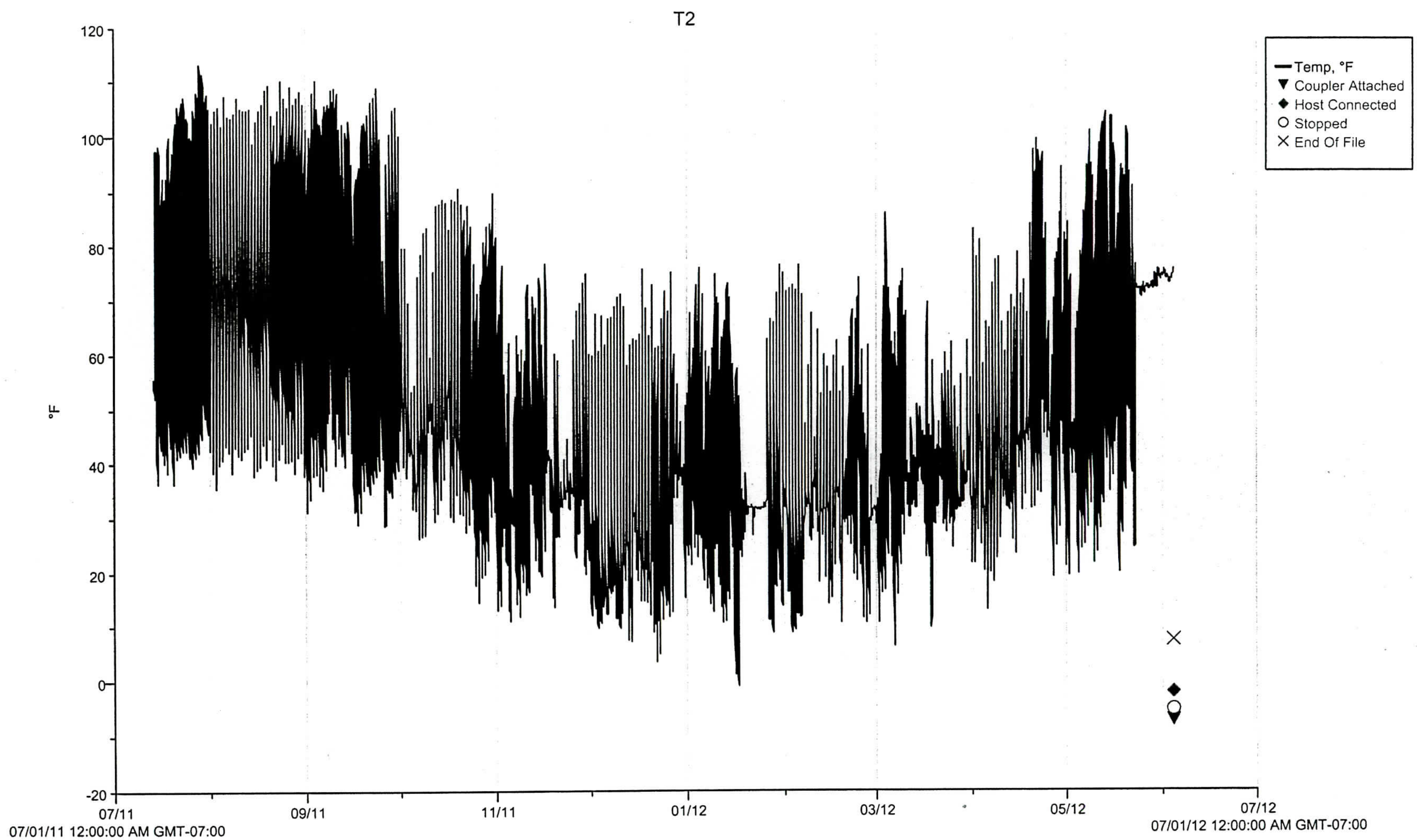
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Sierra Cascade Intensive Forest Management Research Cooperative Proposal 08-02
Incense Cedar Stock Type Trials

Principal Investigator: Jason Warshawer

Title: Improving the Establishment and Growth of Incense Cedar on Dry Sites Through Stock Type Trials

Year Approved: 2008

Executive Summary:
To help address a lack of knowledge concerning growing cedar - in nurseries as well as after out-planting - as a component species in conifer plantations, a study was proposed in 2008 to determine the principal contributions of stock type to incense cedar (*Libocedrus decurrens*) and sugar pine (*Pinus lambertiana*) survival, early growth, and total above-ground biomass on dry sites in the interior Sierra Cascade region of northern California and southern Oregon under vegetation free conditions. The study will also provide information on effects of time of sowing on seedling performance. Sugar pine was dropped from the trials for the time being at the annual meeting of the Co-op in March, 2008.

Planting sites on lands managed by Co-op members Sierra Pacific Industries, Roseburg Resources and possibly Silver Butte Timber Co. were proposed for the initial installations of the study.

The study will include stock types Styro 5, 8, 10D, and 15; bare root 1-0 and 1-1; and plug-1. The styro stock types will have three periods of sowing: April, May, and June. This results in 15 treatments which will have 4 replications at each site. Plot size is 72'x72' per replication with 60 plots per site. Planting spacing will be 8 feet x 8 feet resulting in 81 seedlings per plot. The center 25 seedlings will be measure trees with in-plot buffering of two rows of seedlings receiving the same treatment. Each site will require 7 – 8 acres for installation.

Caliper and height will be taken pre-planting and at the end of the fifth growing season. Survival will be monitored annually at the end of each growing season.

2009: The initial installation of the study will be on Roseburg Resources land. One thousand Stubby 4's were grown at Cal-Forest Nursery in Etna, California for the plug-1 stock type and will be transplanted in the spring of 2010 at IFA's nursery in Elkton, Oregon. Two thousand bare root seedlings were grown at the IFA nursery in Canby, Oregon for the 1-1 stock type and will be transplanted in the spring of 2010 at the IFA nursery in Elkton. The seedlings for the 1-0 stock type will be grown in Canby. Seed for the Styro 5, 8, 10D, and 15 stock types will be sown in April, May, and June of 2010 at Cal-Forest Nursery for the 2011 spring plant.

2010: Because of the wet spring, some changes were made in the nurseries that were to receive seedlings for transplanting. Instead of going from Cal-Forest (Etna, CA) to IFA at Elkton, Oregon as originally planned, the Stubby 4's were sent to the IFA nursery at Canby, Oregon for transplanting. Planting date was 4/26/10. The 1-1 stock type transplants from Canby were planted in Elkton on 6/16/10. The 1-0 stock type were grown at Canby and all Styro stock types were grown at Cal-Forest as originally planned.

Plot layout was completed in November. The study site is located near Pondosa on Roseburg Resources land in a new clearcut. The clearcut has been doubled ripped. Planting spots will be marked in early 2011 with planting to follow. Representative measurements for caliper and height for each stock type will be taken prior to out-planting.

Due to the wet spring, late planting dates, and less than ideal nursery practices, the 1-1's are poor representatives of this stock type. The 1-0's are small, averaging about 2 inches in height. Plug-1's look good. All stock will be frozen for the trial.

2011: Representative samples of all stock types were measured for seedling height and caliper in mid-May (Figure 1). These data are available at the Co-op manager's office in Redding. Out-planting was accomplished using contract crews during the week of May 23rd. The weather was ideal for planting with rain and snow showers occurring on all planting days. Planting spots were selected by Roseburg and Forest Service inspectors.

This study site was one of the stops on the Co-op field trip in June. At this time it was noted that all three bare-root stock types were having survival issues. The container stock types looked good regardless of time of sowing.

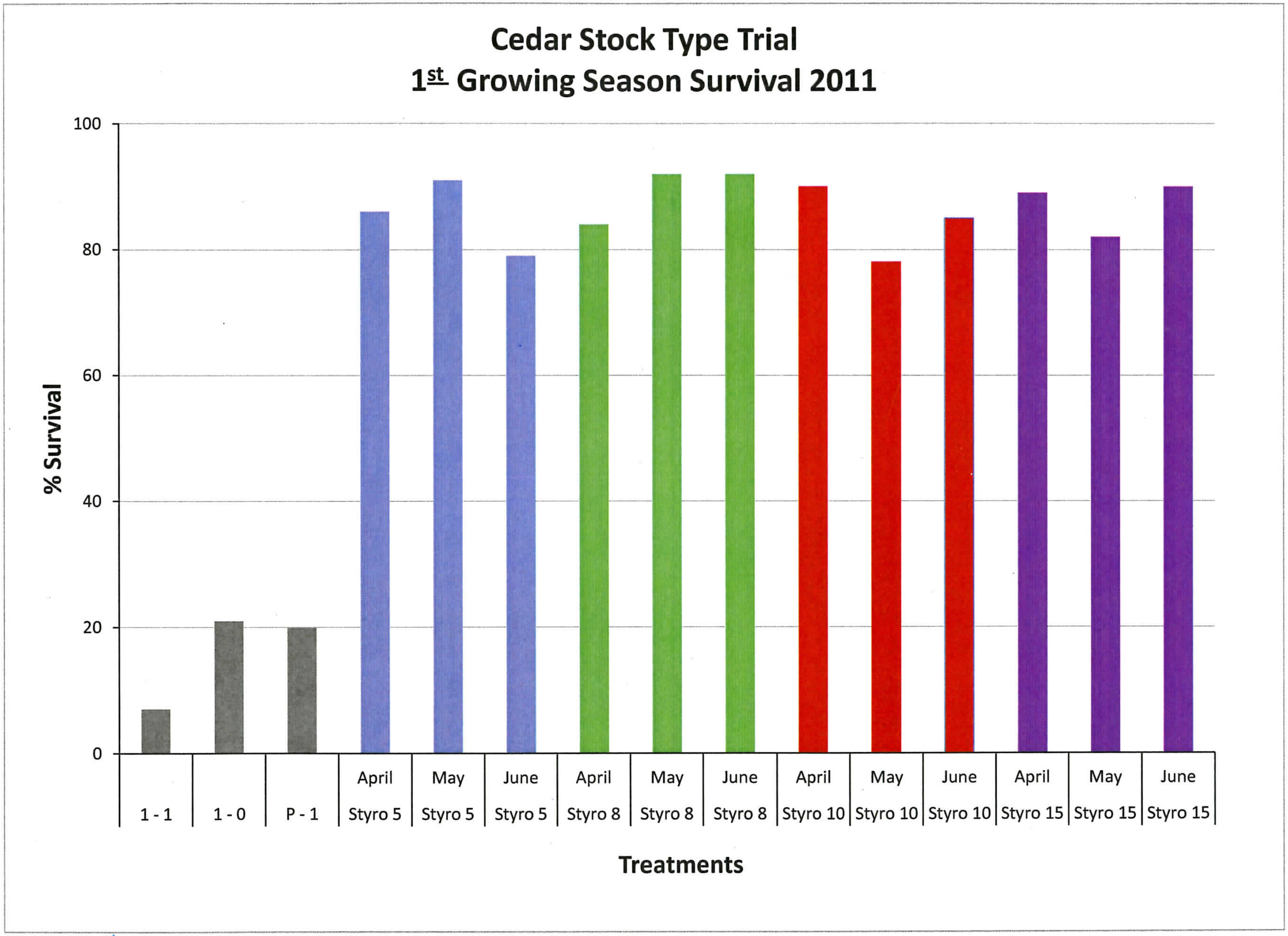
First year survival exams were done in late October/early November (Figure 2). Two of the bare-root stock types, 1-0 and plug-1, had survival rates of about 20 percent; the 1-1 seedlings had a survival rate of 7 percent. First year survival for the container stock ranged from 78 to 92 percent with no sowing date consistently producing bigger seedlings than the other dates.

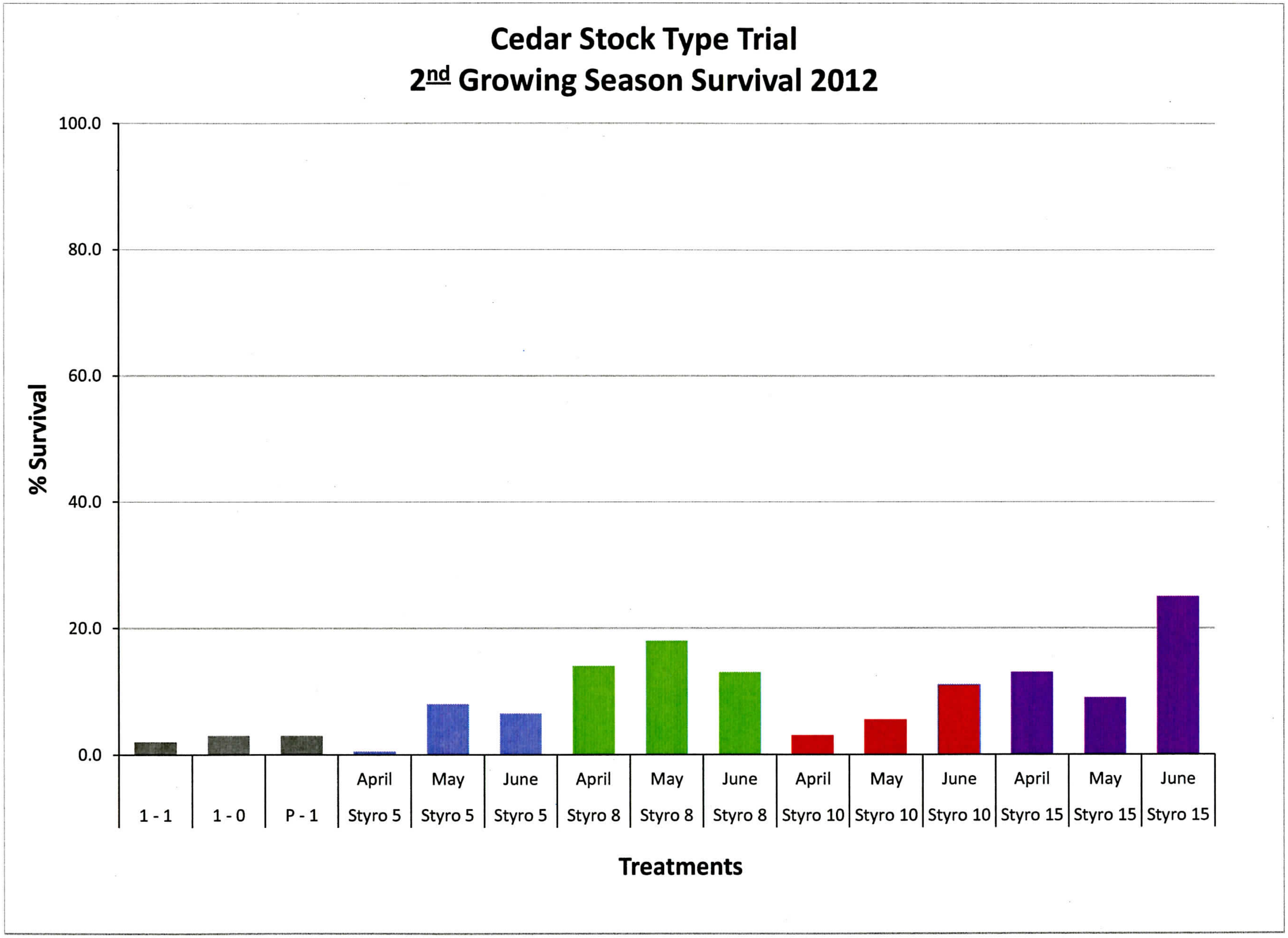
2012: A walk-through examination in May revealed survival problems with the cedar seedlings. Mortality was uniformly high in all fifteen treatments. The mortality was so excessive that the viability of the study was in question. A decision was made to wait until the end of the 2012 growing season to evaluate the trial.

This evaluation was conducted on November 13th. Figure 3 shows survival percentages by treatment. When Figure 3 is compared to Figure 2, the extent of the second year mortality is apparent. Nine of the fifteen treatments had survival rates of less than 10%. Five of the remaining treatments had less than 20% survival (this included all living seedlings in a treatment, not just measure trees). The Cedar Stock Trial is located very close to the Sunscald Study site. The extremely cold conditions recorded at the Sunscald site affected the cedar site as well (see Sunscald Executive Summary in this Annual Report).

The status of this study will be discussed at the 2013 annual meeting and a decision made as how to proceed with the study.


Cedar Stock Type Trial
Stock Types At Time Of Planting May 2011
Styro 5 8 10 15
April Sowing
5 8 10 15
May Sowing
5 8 10 15
June Sowing
1-1 1-0 P-1


Cedar Stock Type Trial
1st Growing Season Survival 2011
100
80
60
40
20
0
% Survival
1 - 1
1 - 0
P - 1
April Styro 5
May Styro 5
June Styro 5
April Styro 8
May Styro 8
June Styro 8
April Styro 10
May Styro 10
June Styro 10
April Styro 15
May Styro 15
June Styro 15
Treatments


Cedar Stock Type Trial
2nd Growing Season Survival 2012
% Survival
100.0
80.0
60.0
40.0
20.0
0.0
1 - 1
1 - 0
P - 1
April Styro 5
May Styro 5
June Styro 5
April Styro 8
May Styro 8
June Styro 8
April Styro 10
May Styro 10
June Styro 10
April Styro 15
May Styro 15
June Styro 15
Treatments

Sierra Cascade Intensive Forest Management Research Cooperative Proposal 10-01 Milestone VM

Principal Investigator: Ed Fredrickson

Title: Aminopyralid Site Preparation and Conifer Tolerance

Year Approved: 2010

Executive Summary:

Milestone VM (aminopyralid) is a relatively new product in California. It was registered for use in 2008 for non-crop sites. Currently Dow AgroScience is compiling data in the hope of obtaining a forestry label. Milestone VM is a pre and post emergent herbicide that controls a wide variety of broadleaf weeds (including legumes) and brush. It is an auxin and has both foliar and soil activity. The residual control is proving to be quite good and the product is an excellent inhibitor of seed germination. It is also showing some unique properties for brush control when tank mixed with other products. It has very low use rates, with maximum label rates at seven ounces per acre (0.1 lb ae/ac).

Previous testing has indicated no conifer tolerance for "over the top" applications, but directed applications around trees appears to be feasible. There is also a strong potential to broaden the spectrum of control when tank mixed with Velpar DF. The major questions surrounding Milestone VM and forestry at this point are regarding conifer tolerance as a site preparation spray and the duration of control by season. Milestone VM might have a fit as a site preparation treatment for some of the chemically intolerant conifers such as sugar pine, cedar, and redwood, although testing has yet to be done.

The stated objective of this study is to evaluate the effect of aminopyralid rate and timing on vegetation control and conifer tolerance of ponderosa pine and Douglas-fir when applied as a pre-plant site preparation treatment with Milestone VM alone and in combination with Velpar DF compared to Velpar DF as the operational standard.

The study will have two sites, one east side Cascade site and a low elevation west side Cascade site. Each site should be a fresh clear-cut or wildfire that has not had any chemical treatment prior to the trials. The plan will be to spray the east side site in the fall of 2010 and the low elevation site in the spring of 2011. Both sites will be planted in the spring of 2011. The study design will be a completely randomized block design with four replications. Stock type and seed lot will be the same for all trees of each species in the study. The stock type will be similar to what is operationally planted on the site.

Treatments to be studied include: Milestone VM alone at 0.0625, 0.11, and 0.22 lbs. a.i./acre; Milestone VM at 0.11 lbs. a.i./acre plus Velpar DF at 1.0 a.i./acre, and Velpar

DF alone at 2.5 lbs. a.i./acre. All applications will be applied at 10 gallons per acre at 30 psi. Base line data for conifer height and caliper will be taken at time of planting. End of season evaluations will take place at the end of the first and second growing seasons after treatment and will consist of ocular estimates of vegetation percent cover by species for the weeds and brush, ocular rating of conifer damage, and measurement of conifer seedling height and caliper.

2010: The fall site is located on property owned and managed by Sierra Pacific Industries approximately 10 miles west of Dana, California. Elevation is approximately 4000 feet. Slope is between 0 and 10 percent. The site is a sub-soiled clear-cut that was planted three years ago and has never received any herbicide treatment. As a result, the site is dominated by herbaceous vegetation with relatively poor stocking. Study plots were established in areas with no conifer stocking. Plot size is 12 feet by 36.3 feet (0.01 acre).

The study site was installed and sprayed on October 6, 2010. All treatments were applied with a 12 foot backpack boom sprayer and all plots were sprayed with one timed pass. Sprayer was calibrated prior to application.

2011: The spring site is also located on property owned and managed by Sierra Pacific Industries approximately ten miles south of Dunsmuir, California in the Sacramento Canyon. Elevation of the site is approximately 3000 feet on a west aspect. The site was pre-harvest sprayed with Chopper prior to logging. After logging, no further chemical or mechanical treatments were conducted.

The spring trial was installed and sprayed on March 11th, 2011. Treatments and application procedures were similar to those used on the fall site.

Plots were planted on both sites in the spring of 2011. Ten ponderosa pine and ten Douglas-fir were planted in each of two rows in every plot. All ponderosa pine were styro 6's and Douglas-fir were styro 8's. The spring site was planted on March 17, 2011 and the fall site was planted on May 6, 2011. All seedlings were initially measured for caliper and height at planting.

The spring and fall sites were evaluated on August 31, 2011. Percent cover for competing vegetation was visually estimated by species as was percent bare ground. Caliper and height were measured for all surviving trees and percent survival was calculated along with stem volume. Terminal bud damage and needle damage were assessed on a scale from 0 to 10 with 0=No Damage and 10=Most Severe.

Data were analyzed using SAS statistical software and analysis of variance with Tukeys HSD procedure for multiple comparisons. Data were analyzed as a completely randomized block design with four replications.

First year results indicated that Milestone VM by itself has extremely good tolerance on both Douglas-fir and ponderosa pine at all rates tested in these trials at either timing. Vegetation control with Milestone VM by itself was poor. Control improved dramatically with the addition of Velpar DF at 1.33 lbs product per acre. See Tables 1 and 2 for efficacy data.

Percent bare ground was significantly greater for both the Velpar DF treatment at 3.33 lbs product per acre and the 1.33 lbs Velpar DF plus 7 oz of Milestone VM treatment compared to all other treatments and the control in the fall trial. The spring site had very little vegetation occupy the site in the first season after planting. At the end of the first season, percent bare ground in the controls averaged 87.5 percent. As a result, no significant differences were found between treatments regarding percent bare ground.

Annual grasses were controlled very well with the operational standard of 3.33 lbs Velpar DF in the fall having a percent cover of 1.5 percent compared to 52.5 percent in the controls. The result was significantly different from the controls and the lowest rate of Milestone VM by itself ($p<0.05$). The tank mix of Velpar DF at 1.33 lbs plus Milestone VM at 7 oz did very well having an annual grass percent cover of 16.25 percent, however the result was not significantly different from the control. No significant differences were found on the spring site for annual grass control, but this was due to virtually no annual grass occupying the site.

The main effect of treatment was also significant for prickly lettuce control in the fall, however multiple comparisons between treatments failed to yield any treatments significantly different from each other. The Velpar treatment at 3.33 lbs, Velpar at 1.33 lbs plus 7 oz of Milestone VM and the 14 oz Milestone VM treatment gave good to excellent control (0%, 3.25% & 5.75% cover respectively) compared to 18.75% cover in the controls.

While treatment was determined to be significant regarding snowberry and deerbrush control in the spring, the results appear to be an artifact due to the overall lack of cover for either species. Therefore, the results are not deemed to be real. Similar results were found for yellow nutsedge in the fall trial but also are most likely the result of high variability between replications. No other individual species were significantly affected by treatment.

The ponderosa pine seedlings planted in the spring trial, appeared to suffer from some type of nursery issue, as seedlings suffered an abnormal amount of mortality even in the control plots.

Douglas-fir and ponderosa pine survival, height or stem volume was not significantly affected by treatment in either the spring or the fall trial ($p<0.05$). Douglas-fir caliper was significantly larger in the treatment with Velpar DF at 3.33 lbs compared to the control trees in the fall. Caliper was not significantly different for Douglas-fir seedlings among any of the chemical treatments. Calipers were significantly larger for ponderosa pine seedlings treated in the fall with either the Velpar DF alone at 3.33 lbs or 1.33 lbs Velpar DF plus 7 oz of Milestone VM compared to all other treatments with the exception of the 14 oz Milestone VM treatment. Caliper was not significantly affected by treatment in the spring trial. See Tables 3 through 6 for conifer tolerance data.

Stem volume in the fall timing for both Douglas-fir and ponderosa pine was largest with either the 7 oz Milestone VM plus 1.33 lb Velpar DF combination or the Velpar DF by itself at 3.33 lbs. The results were not statistically significant at the $p<0.05$ level, but the values were very close and the trend is probably real.

Overall, Milestone VM appears to provide insufficient vegetation control by itself. However, in combination with low rates of Velpar DF, control is increased significantly. Ponderosa pine and Douglas-fir both appear to be very tolerant to Milestone VM in either the spring or fall, even up to twice the maximum label rate. No terminal bud or needle damage was noted in either species. The fact that no significant differences existed for seedling caliper, height, stem volume or survival for either Douglas-fir or ponderosa pine between the operational standard of Velpar DF alone at 3.33 lbs compared to the tank mix of 7 oz Milestone VM plus 1.33 lbs Velpar DF suggest that this may be a suitable alternative to straight Velpar, especially when intolerant conifers are involved. The tank mix also provided similar vegetation control. These data compare well with the analogous trials conducted in the FSC Research Group. Final data will be collected in the fall of 2012 for both timings.

2012: The spring and fall sites were evaluated on August 28, 2012. Percent cover for competing vegetation was visually estimated by species as was percent bare ground cover. Caliper and height were measured for all surviving trees and percent survival was calculated along with stem volume. Terminal bud damage and needle damage were assessed on a scale from 0 to 10 with 0=no damage and 10=most severe.

Data were analyzed using SAS statistical software. Analysis of variance was used to determine significance of the main effects of treatments and orthogonal contrasts were used to make specific comparisons among treatments. Analysis of variance was used to determine if there were any differences in initial seedling size among treatments. If initial seedling size was found to be significantly different among treatments, analysis of co-variance was used to adjust for initial seedling size difference with initial tree size as the co-variant. Vegetation data were analyzed using analysis of variance for the main effects, and multiple comparisons of means were done using Student Neuman Kewls least significant difference procedure. Orthogonal contrasts were used to make specific comparisons among treatments.

Because of the low cover values in the spring trial, only total percent cover and percent bare ground were analyzed. Main effects of treatment were not significantly different between treatments for either total cover or percent bare ground at the end of the second growing season for the spring trial (P<=0.05). Although not significant, percent bare ground did differ by over 40 percent for the Velpar treatments and the control (Table 8). Percent bare ground in the control ranged from 10 to 80 percent, and this high variability resulted in the treatments not being significant. The Velpar DF alone and Velpar DF plus 7 ounces of Milestone had the highest percent bare ground cover and the lowest percent total cover. The treatments did not significantly differ for percent bare ground or total cover.

The fall treatments analyzed total percent cover, percent bare ground, and downy brome cover (Table 7). Treatment effects were significant for downy brome in the fall (P<=0.05). Milestone only treatments had significantly more downy brome cover than the operational standard of Velpar DF alone, and the control also had greater downy brome cover than the Velpar DF standard. Treatment effects were not significantly different for total cover. Effect of treatment was significant for percent bare ground. Percent bare ground was highest in the Velpar DF alone treatment and lowest in the Milestone only treatments. The addition of 1.33 pounds Velpar DF to 7 ounces of Milestone significantly increased percent bare ground. The Velpar DF alone had similar percent total cover to the Velpar DF plus Milestone treatment, but the Velpar DF alone a higher percent bare ground. This is primarily due to more downy brome present in the Velpar DF plus Milestone treatment. The two treatments did not differ significantly in percent bare ground or total cover, but the Velpar DF alone treatment had significantly less downy brome cover than the Velpar DF plus Milestone treatment.

Initial seedling size was significant for ponderosa pine in both the spring and fall trials. Therefore, seedling data had to be adjusted for initial size. Ponderosa pine survival was not affected by treatment in the spring or fall timings (P<=0.05). The main effect of treatment on height was not significant in the spring, nor were the multiple comparisons (Tables 11 and 12). Treatment differences did occur in the spring for caliper and stem volume, with the highest rate of Milestone and the Velpar DF alone having larger seedlings than the control. In the fall trial, all herbicide treatments resulted in significantly taller seedlings than the controls (P<=0.05). Contrasts indicated that seedlings were taller in the Velpar DF alone treatment compared to the other herbicide treatments, but differences were small. For both caliper and volume in the fall, all herbicide treatments were significantly larger than the controls. Velpar DF alone had significantly larger seedlings than the Milestone only treatments. Ponderosa pine seedlings were largest in both the spring and fall trials with Velpar DF alone. Ponderosa pine in the spring or fall did not significantly differ in caliper, height, stem volume, or survival for Velpar DF alone compared to the Velpar DF plus Milestone treatment.

Douglas-fir initial seedling size was also significant for both spring and fall trials (Tables 9 and 10). Seedling data again had to be adjusted for initial size. Douglas-fir survival was not significantly affected by treatment for either the spring or fall trial ($P<=0.05$). Survival was best on the spring site (Dunsmuir) and fairly poor on the fall site (Dana). There were large differences in survival by treatment in the fall trial, but due to high variability, the results were not significant. Velpar DF alone had the highest survival on the fall site (75%), differences in survival on the spring site were minimal. Douglas-fir caliper, height, and volume were greater in the Milestone only treatments and the Velpar DF alone compared to the controls. Multiple comparisons indicated this effect with the Milestone only treatments was primarily due to the 7 and 14 ounce per acre treatments having larger seedlings. No treatment effects were significant on Douglas-fir caliper, height, or stem volume in the fall trial. Seedlings were largest in the Velpar DF alone treatment but closely followed by the Velpar DF plus Milestone treatment. The lack of significance is most likely due to high variability and heavy mortality. Comparing Velpar DF alone to the Velpar DF plus Milestone treatment yielded no significant differences in survival in either the spring or fall. However, Velpar DF alone in the spring produced significantly larger and taller seedlings.

Overall, Milestone by itself is not a suitable alternative to Velpar DF for forest site preparation. However, comparable control can be achieved by adding 7 ounces of Milestone to a very low rate of Velpar DF (1.33 pounds product). This is cheaper, but residual carryover into the second year may be less than with Velpar DF alone. Douglas-fir survival was slightly less with this tank mix compared to Velpar DF alone in both the spring and fall treatments. This can mostly be attributed to less competition with the Velpar DF only treatment, especially in the fall trial. Analogous trials in the Forest Stewardship Council Research Group (FSCRG) had higher Douglas-fir survival for the tank mix. Competition was not as variable between treatments and the results are more likely a result of phytotoxicity. The Velpar DF plus Milestone tank mix did provide larger seedlings in the fall compared to controls and Milestone treatments alone.

All field work and evaluations are completed for this proposal. The complete report and all supporting data are available at the Co-op's office in Redding.

TREATMENT	%Bare Ground	% Cov Annual Grass	% Cov Prickly Lettuce	% Cov Deer Brush	% Cov Willow Herb	% Cov Yellow Nutsedge
4 oz/ac MVM	16.25	60.0	12.0	4.25	2.25	3.25
7 oz/ac MVM	26.25	42.5	15.0	1.25	0.75	4.5
14 oz/ac MVM	40.0	33.75	5.75	1.25	0.5	3.75
7 oz MVM + 1.33 lbs Velp DF/ac	73.75	16.25	3.25	1.0	0.25	1.25
3.33 lbs/ac Velp DF	93.75	1.5	0.0	0.0	0.5	0.0
Control	18.75	52.5	18.75	2.25	1.0	2.5

Table 1. Percent bareground and percent cover by species ten months after treatment for the Fall Milestone VM site preparation trial . MVM=Milestone VM, Velp DF=Velpar DF. All rates amount product per acre.

TREATMENT	%Bare Ground	% Cov Ann. Grass	% Cov Prickly Lettuce	% Cov Deer Brush	% Cov Bull Thistle	% Cov Snow Berry	% Cov Brack. Fern	% Cov Yellow Nutsedge
4 oz/ac MVM	92.75	2.5	0.0	0.25	0.0	0.5	2.25	0.75
7 oz/ac MVM	95.75	0.0	0.0	0.0	0.0	1.0	5.0	1.0
14 oz/ac MVM	95.0	0.0	0.0	0.25	0.0	0.0	4.25	1.0
7 oz MVM + 1.33 lbs Velp DF/ac	95.5	0.0	0.25	0.0	0.25	0.0	3.75	0.5
3.33 lbs/ac Velp DF	97.75	0.0	0.0	0.0	0.0	0.25	0.5	0.0
Control	87.5	0.0	0.5	1.5	0.0	0.25	7.5	1.25

Table 2. Percent bareground and percent cover by species five months after treatment for the Spring Milestone VM site preparation trial . MVM=Milestone VM, Velp DF=Velpar DF. All rates amount product per acre.

TREATMENT	Cal mm	Ht cm	Stem Vol cm^3	Percent Survival	Terminal Bud Rating	Needle Rating
4 oz/ac MVM	3.64	25.04	3.74	92.5	0.0	0.0
7 oz/ac MVM	4.01	27.51	4.69	75.0	0.0	0.0
14 oz/ac MVM	4.06	25.45	4.69	95.0	0.0	0.0
7 oz MVM + 1.33 lbs Velp DF/ac	4.44	26.12	5.59	87.5	0.0	0.0
3.33 lbs/ac Velp DF	4.58	25.14	5.69	92.5	0.0	0.0
Control	3.41	22.82	2.88	90.0	0.0	0.0

Table 3. Douglas-fir measurements ten months after treatment for the Fall Milestone VM site preparation trial . MVM=Milestone VM, Velp DF=Velpar DF. All rates amount product per acre.

TREATMENT	Cal mm	Ht cm	Stem Vol cm^3	Percent Survival	Terminal Bud Rating	Needle Rating
4 oz/ac MVM	5.55	33.23	11.49	97.5	0.0	0.0
7 oz/ac MVM	5.61	34.38	12.16	100.0	0.0	0.0
14 oz/ac MVM	5.85	34.22	12.41	92.5	0.0	0.0
7 oz MVM + 1.33 lbs Velp DF/ac	5.36	31.7	9.65	100.0	0.0	0.0
3.33 lbs/ac Velp DF	5.48	32.58	11.31	100.0	0.0	0.0
Control	5.37	32.18	10.36	95.0	0.0	0.0

Table 4. Douglas-fir measurements five months after treatment for the Spring Milestone VM site preparation trial . MVM=Milestone VM, Velp DF=Velpar DF. All rates amount product per acre.

TREATMENT	Cal mm	Ht cm	Stem Vol cm^3	Percent Survival	Terminal Bud Rating	Needle Rating
4 oz/ac MVM	4.69	16.92	4.03	97.5	0.0	0.0
7 oz/ac MVM	4.68	18.44	4.21	92.5	0.0	0.0
14 oz/ac MVM	5.10	16.41	4.62	95.0	0.0	0.3
7 oz MVM + 1.33 lbs Velp DF/ac	5.57	20.43	6.65	95.0	0.0	0.0
3.33 lbs/ac Velp DF	5.61	17.53	5.77	97.5	0.0	0.0
Control	4.59	20.45	4.65	92.5	0.0	0.0

Table 5. Ponderosa pine measurements ten months after treatment for the Fall Milestone VM site preparation trial . MVM=Milestone VM, Velp DF=Velpar DF. All rates amount product per acre.

TREATMENT	Cal mm	Ht cm	Stem Vol cm^3	Percent Survival	Terminal Bud Rating	Needle Rating
4 oz/ac MVM	5.79	20.29	7.04	72.50	0.0	0.0
7 oz/ac MVM	6.29	24.01	9.99	52.50	0.0	0.0
14 oz/ac MVM	5.83	18.7	6.79	72.5	0.0	0.0
7 oz MVM + 1.33 lbs Velp DF/ac	5.7	19.92	6.83	70.0	0.0	0.0
3.33 lbs/ac Velp DF	6.07	21.38	8.33	70.0	0.0	0.0
Control	5.68	21.38	7.59	62.5	0.0	0.0

Table 6. Ponderosa pine measurements five months after treatment for the Spring Milestone VM site preparation trial . MVM=Milestone VM, Velp DF=Velpar DF. All rates amount product per acre.

TREATMENT	% Bare Ground	% Total Cover	% Cov Annual Grass	% Cov Prickly Lettuce	% Cov Deer Brush	% Cov Willow Herb	% Cov Yellow Nutsedge
4 oz/ac MVM	9.0	93.2	15.5	6.8	2.0	1.8	4.0
7 oz/ac MVM	8.8	90.5	16.0	13.2	1.2	1.2	4.5
14 oz/ac MVM	12.5	94.5	7.5	10.8	1.8	0.8	3.0
7 oz MVM + 1.33 lbs Velp DF/ac	28.8	66.0	2.5	12.5	0.0	1.0	1.2
3.33 lbs/ac Velp DF	43.8	62.2	0.8	29.5	0.0	1.0	0.0
Control	19.0	80.2	15.0	8.8	4.8	0.8	1.5

Table 7. Percent bareground and percent cover by species 22 months after treatment for the Fall Milestone site preparation trial . MVM=Milestone, Velp DF=Velpar DF. All rates amount product per acre.

TREATMENT	% Bare Ground	% Total Cover	% Cov Ann. Grass	% Cov Prickly Lettuce	% Cov Deer Brush	% Cov Bull Thistle	% Cov Snow Berry	% Cov Brack. Fern	% Cov Yellow Nutsedge
4 oz/ac MVM	47.5	46.2	8.0	7.8	0.2	0.5	0.2	10.2	2.2
7 oz/ac MVM	61.2	30.2	2.5	6.0	1.0	0.8	0.8	14.8	2.2
14 oz/ac MVM	66.2	31.2	3.2	4.5	0.8	0.5	0.0	17.2	3.2
7 oz MVM + 1.33 lbs Velp DF/ac	83.0	17.5	1.8	3.0	0.8	0.5	1.2	8.5	1.8
3.33 lbs/ac Velp DF	85.0	14.2	2.0	4.0	0.5	0.2	0.0	6.0	0.8
Control	48.8	47.8	8.8	15.8	2.0	0.8	0.5	16.8	3.2

Table 8. Percent bareground and percent cover by species 17 months after treatment for the Spring Milestone site preparation trial . MVM=Milestone, Velp DF=Velpar DF. All rates amount product per acre.

TREATMENT	Cal mm	Ht cm	Stem Vol cm^3	Percent Survival	Terminal Bud Rating	Needle Rating
4 oz/ac MVM	5.0	28.7	7.6	52.5	0.0	0.0
7 oz/ac MVM	5.3	28.9	8.7	25.0	0.0	0.0
14 oz/ac MVM	5.7	27.5	10.8	30.0	0.0	0.0
7 oz MVM + 1.33 lbs Velp DF/ac	5.5	28.5	10.5	57.5	0.0	0.0
3.33 lbs/ac Velp DF	6.2	25.1	11.5	75.0	0.0	0.0
Control	4.1	25.0	5.0	50.0	0.0	0.0

Table 9. Douglas-fir measurements 22 months after treatment for the Fall Milestone site preparation trial . MVM=Milestone, Velp DF=Velpar DF. All rates amount product per acre.

TREATMENT	Cal mm	Ht cm	Stem Vol cm^3	Percent Survival	Terminal Bud Rating	Needle Rating
4 oz/ac MVM	10.6	46.7	59.1	95.0	0.0	0.0
7 oz/ac MVM	11.8	52.3	88.2	80.0	0.0	0.0
14 oz/ac MVM	11.4	48.8	72.1	82.5	0.0	0.3
7 oz MVM + 1.33 lbs Velp DF/ac	10.5	45.3	54.0	87.5	0.0	0.0
3.33 lbs/ac Velp DF	11.9	50.8	89.2	92.5	0.0	0.0
Control	8.8	42.6	39.5	85.0	0.0	0.0

Table 10. Douglas-fir measurements 17 months after treatment for the Spring Milestone site preparation trial . MVM=Milestone, Velp DF=Velpar DF. All rates amount product per acre.

TREATMENT	Cal mm	Ht cm	Stem Vol cm^3	Percent Survival	Terminal Bud Rating	Needle Rating
4 oz/ac MVM	7.5	26.5	19.7	85.0	0.0	0.0
7 oz/ac MVM	7.0	26.1	14.4	85.0	0.0	0.0
14 oz/ac MVM	8.0	26.6	20.9	90.0	0.0	0.0
7 oz MVM + 1.33 lbs Velp DF/ac	9.5	31.5	32.1	92.5	0.0	0.5
3.33 lbs/ac Velp DF	9.9	31.3	35.8	97.5	0.0	0.0
Control	6.1	24.8	11.2	87.5	0.0	0.0

Table 11. Ponderosa pine measurements 22 months after treatment for the Fall Milestone site preparation trial . MVM=Milestone, Velp DF=Velpar DF. All rates amount product per acre.

TREATMENT	Cal mm	Ht cm	Stem Vol cm^3	Percent Survival	Terminal Bud Rating	Needle Rating
4 oz/ac MVM	13.6	40.7	87.0	70.0	0.0	0.0
7 oz/ac MVM	14.5	45.2	104.5	52.5	0.0	0.0
14 oz/ac MVM	14.7	40.6	94.3	72.5	0.0	0.0
7 oz MVM + 1.33 lbs Velp DF/ac	14.1	38.1	85.2	67.5	0.0	0.0
3.33 lbs/ac Velp DF	15.6	42.0	110.5	70.0	0.0	0.0
Control	11.4	37.0	57.5	60.0	0.0	0.0

Table 12. Ponderosa pine measurements 17 months after treatment for the Spring Milestone site preparation trial . MVM=Milestone, Velp DF=Velpar DF. All rates amount product per acre.

Sierra Cascade Intensive Forest Management Research Cooperative Proposal 10-02
Fluroxypyr (Vista XRM)

Principal Investigator: Ed Fredrickson

Title: Vista XRT Conifer Tolerance and Manzanita Control

Year Approved: 2010

Executive Summary:
Vista XRT (fluroxypyr) is a newly registered chemical to California and forestry. The active ingredient fluroxypyr has been around since the late 1908's. It is a growth regulator herbicide similar in action to triclopyr with several unique characteristics. The main one being fluroxypyr having a greater conifer tolerance compared to triclopyr. The second is that fluroxypyr is very effective in controlling manzanita.

A limited amount of development work was done in the late 1980's and early 1990's with fluroxypyr in forestry. The results showed a potential for conifer release "over the top" applications. Conifer tolerance was good overall, but varied with geographic location. All of the early conifer tolerance and efficacy work on manzanita was with application in either April or June, timings not typical for usual conifer release. Further tests need to be done in a more typical timing for aerial release applications, such as late August or early September. The other concern is that since its conception, the formulation of fluroxypyr has changed significantly. This change in formulation may increase conifer tolerance but could decrease efficacy on a waxy-leaf species such as manzanita.

The significance of a herbicide that could be applied over the top of conifers to release seedlings from evergreen brush cannot be overstated. The potential cost savings of being able to release plantations with aerial applications rather than ground directed treatments is dramatic. Fluroxypyr is currently labeled for aerial release in pine plantations. Applications at a more typical time for release should provide an even greater degree of tolerance than previous studies have shown. Based on previous data, there may be the potential for an early season release window.

The stated objective of this study is to evaluate the effect of Vista XRT rate and timing on manzanita control and tolerance of ponderosa pine and Douglas-Fir with "over the top" broadcast applications. The study is a trial that will look at several application rates and timing of application to define the conifer tolerance of Vista XRT.

The study site should be a two or three year old conifer plantation with a manzanita brush component. Plans are to look at ponderosa pine and Douglas-fir tolerance to the herbicide treatments; however, plot size is limited and it may be hard to find a plantation with enough of each species for a

Sierra Cascade Intensive Forest Management Research Cooperative Proposal 10-02
Fluroxypyr (Vista XRM)

Principal Investigator: Ed Fredrickson

Title: Vista XRT Conifer Tolerance and Manzanita Control

Year Approved: 2010

Executive Summary:
Vista XRT (fluroxypyr) is a newly registered chemical to California and forestry. The active ingredient fluroxypyr has been around since the late 1908's. It is a growth regulator herbicide similar in action to triclopyr with several unique characteristics. The main one being fluroxypyr having a greater conifer tolerance compared to triclopyr. The second is that fluroxypyr is very effective in controlling manzanita.

A limited amount of development work was done in the late 1980's and early 1990's with fluroxypyr in forestry. The results showed a potential for conifer release "over the top" applications. Conifer tolerance was good overall, but varied with geographic location. All of the early conifer tolerance and efficacy work on manzanita was with application in either April or June, timings not typical for usual conifer release. Further tests need to be done in a more typical timing for aerial release applications, such as late August or early September. The other concern is that since its conception, the formulation of fluroxypyr has changed significantly. This change in formulation may increase conifer tolerance but could decrease efficacy on a waxy-leaf species such as manzanita.

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good sample size. The study site should be chosen and laid out by August 2010. The study design will be a completely randomized block design with four replications. At least four seedlings of each species must be present in each plot to provide a valid sample size if both ponderosa pine and Douglas-fir are included. For a pine only trial, 8 seedlings per plot would be a minimum.

Two spray timings will be utilized in this study (late August 2010 and April 2011 – or as soon as the site opens in the spring prior to bud-break). Treatments will include: Vista XRT alone at 0.25, 0.5, and 1.0 lbs. a.i./acre; Vista XRT at 0.25 and 0.5 lbs. a.i./acre plus Garlon 3A at 0.5 lbs. a.i./acre; and a control. No surfactants will be added to the treatments. All applications will be applied at 10 gallons per acre. At treatment, conifer caliper and height will be measured on all conifers as well as initial manzanita percent cover. Post-treatment evaluations will take place at the end of the season in 2011 and 2012. Percent crown and stem reduction will be evaluated for manzanita; conifer evaluations will consist of caliper and height measurements and an ocular rating of damage.

2010: The fall study site is located on property owned and managed by Sierra Pacific Industries approximately 5 miles southwest of Burney, California. Elevation is approximately 4500 feet. Slope is between 0 and 10 percent. The site was clearcut and planted to a mix of ponderosa pine, Douglas-fir, and white fir. The site was initially treated with Velpar DF as a site preparation treatment. Seedlings were two years old at the time of treatment. Study plot size is 12 feet by 72.6 feet (0.02 acre). A minimum of three ponderosa pine and Douglas-fir were in each plot.

The plots were sprayed on September 3, 2010. All treatments were applied with a 12 foot backpack boom sprayer and all plots were sprayed with one timed pass. The sprayer was calibrated prior to application. Initial measurements of caliper and height for all conifers within the plots were recorded at the time of treatment.

The trial was evaluated on October 21, 2010. No conifer growth had occurred since treatment, therefore only ocular evaluations were conducted. Percent foliar brownout was evaluated for greenleaf manzanita, gooseberry, ponderosa pine, Douglas-fir, and white fir where it was present. White fir was not a part of the study but it did occur in the majority of the plots. Tolerance was evaluated for white fir, but the results are anecdotal and any statistical analysis would be invalid. Terminal and lateral bud damage was assessed for all conifers on a scale of 0 to 10 with 0 being no damage and 10 being dead. Results were taken only seven weeks after treatment and are preliminary. Full treatment effects will not develop until the end of the 2011 growing season. See 2010 Annual Report pages 18-22 for these results.

2011: The spring study site is on property owned and managed by Roseburg Resources Company approximately ten miles west of Burney. Elevation is approximately 2500 feet. Slope is between 0 and 10 percent.

therefore all information is anecdotal. Gooseberry that was initially controlled very well at the time of the 2010 evaluation with Vista XRT alone had re-sprouted significantly by the 2011 evaluation. Control was unacceptable at this evaluation. Adding Garlon 3A improved control but still probably not up to acceptable standards.

No treatments were significantly different from the controls regarding foliar brownout of ponderosa pine or Douglas-fir in the spring, and Douglas-fir showed no differences between any treatments in the fall compared to the controls. Fall treatments showed significantly higher damage of ponderosa pine at 1 lb a.i./ac of Vista XRT by itself compared to all other treatments including the controls ($p<.05$). This brownout data is somewhat deceiving in that terminal bud damage was severe for both ponderosa pine and Douglas-fir when Garlon 3A was added to Vista XRT at either the 0.25 or 0.5 lb a.i./ac rates. Survival was excellent for all treatments with the spring or fall timing. No significant differences in survival existed for ponderosa pine or Douglas-fir between treatments, including the controls.

Caliper, height or stem volume were not significantly affected by any treatment in the spring trial for either ponderosa pine or Douglas-fir. Caliper and stem volume were not significantly affected by any treatment in the fall trial for ponderosa pine or Douglas-fir. Douglas-fir height was significantly influenced by treatment in the fall. Douglas-fir treated with Vista XRT at the 1 lb a.i./ac rate were significantly shorter than all other treatments. No differences existed between any of the other treatments. Ponderosa pine trees were shortest with both treatments containing Garlon 3A, however, the results were not significantly different from any of the other treatments.

The most obvious data that showed the damage associated with the addition of Garlon 3A was the terminal and lateral bud rating scale. Due to the low numbers associated with the scale, statistical analysis was not practical, however the effects are obvious. The spring and fall treatments produced very little if any terminal or lateral bud damage to either ponderosa pine or Douglas-fir with Vista XRT alone. Significant increases were noted when Garlon 3A was added to either rate of Vista XRT, especially with the 0.5 lb a.i./acre rate of Vista XRT. Ponderosa pine was affected more than Douglas-fir. Virtually total terminal bud kill was seen in pine with the higher rate of Vista XRT in combination with Garlon 3A in the fall. Damage was somewhat less pronounced in spring treatments.

In summary, greenleaf manzanita and whitethorn were not adequately controlled with any treatment tested in either the spring or fall timing at labeled use rates. Both ponderosa pine and Douglas-fir show remarkable tolerance to Vista XRT by itself up to the maximum label rate of 0.5 lb a.i./ac with no surfactant. The addition of Garlon 3A at 0.5 lb a.i./ac did not improve control of manzanita or whitethorn and severely increased terminal bud damage to both ponderosa pine and Douglas-fir. The lack of brush control is most likely due to a lack of adjuvant in the spray treatments coupled with less coverage provided by broadcast treatments. Other data have unequivocally shown excellent control of manzanita species with directed hand spray treatments with an oil based or non-ionic surfactant added. Dow AgroSciences is currently testing several adjuvants to be used over conifers on manzanita with Vista XRT and Rodeo.

2012: Data were collected for the final spring treatment evaluation in July. Previously injured conifers and vegetation had completely recovered from any initial damage by the treatments. Variation between treatments was so minimal (almost zero percent control and no conifer damage) that statistical analysis would have yielded no statistical differences between treatments. That being the case, no analysis was done and raw data is presented in the tables.

Manzanita percent control was virtually zero for all treatments with the exception of the one pound a.i. per acre treatment, which was only 7 percent at the end of the second year (Table 7). Whitethorn percent control was even worse. All treatments had zero percent control by the end of the second growing season.

Ponderosa pine survival was not affected by treatment. Survival was 100 percent for all treatments except the lowest rate of Vista XRT alone and even it was 94 percent (Table 7). Douglas-fir had poor survival in general but treatments were similar to the control. The lowest rate of Vista XRT in combination with Garlon 3A did have the lowest survival, although differences were slight.

Trees had recovered enough that there was no difference in percent brownout for either ponderosa pine or Douglas-fir. All treatments had zero percent brownout for either species. Lateral and terminal bud damage ratings were also zero for all treatments except for the terminal bud rating for Douglas-fir with the lowest rate of Vista XRT alone, but this bud damage appeared to be insect related (Table 8).

Caliper, height, and stem volume didn't appear to be affected by treatment. Even with the combinations of Vista XRT and Garlon 3A that initially produced a significant amount of leader dieback, trees treated with the highest rate of Vista XRT and Garlon 3A had recovered enough that they were the largest trees on average (Table 9).

Overall, it does not appear that Vista XRT is a suitable treatment at maximum label rates for control of manzanita or whitethorn with broadcast applications. Other data show it is highly effective as a directed spray treatment with the addition of a surfactant. This is mainly due to coverage and volume applied. All broadcast applications contained no surfactant due to conifer tolerance issues. Both Douglas-fir and ponderosa pine are tolerant to even twice the maximum label rate of Vista XRT alone with no surfactant.

All field work and evaluations are completed for this proposal. The complete report and all supporting data are available at the Co-op's office in Redding.

Treatment	Manzanita	Gooseberry	Pine	Doug F	W. Fir
Lbs a.i./acre	**% Brownout**	**% Brownout**	**% Brownout**	**% Brownout**	**% Brownout**
Vista 0.25	28.8	10.0	0.0	2.5	0.0
Vista 0.5	46.3	17.5	2.5	1.3	0.0
Vista 0.25 + 0.5 Gar 3A	13.8	80.0	8.8	3.8	1.3
Vista 0.5 + 0.5 Gar 3A	51.3	63.3	26.3	17.5	0.0
Vista 1.0	87.5	10.0	2.5	16.3	5.0
Control	0.0	1.3	0.0	0.0	0.0

Table 1. Fall percent brownout data one year after treatment.

Treatment	PP Term	PP Lateral	DF Term	DF Lateral	WF Term	WF Lateral
Lbs a.i./acre	**Bud Dam.**	**Bud Dam.**	**Bud Dam.**	**Bud Dam.**	**Bud Dam.**	**Bud Dam.**
Vista 0.25	0.0	0.0	0.3	0.0	0.0	0.0
Vista 0.5	0.5	0.5	0.0	0.0	0.0	0.0
Vista 0.25 + 0.5 Gar 3A	2.3	1.8	0.0	0.0	0.0	0.0
Vista 0.5 + 0.5 Gar 3A	7.8	6.8	2.3	1.5	0.0	0.0
Vista 1.0	0.8	0.0	2.5	2.3	0.7	0.7
Control	0.0	0.0	0.0	0.0	0.0	0.0

Table 2. Fall terminal and lateral bud damage by species. 0 = no damage 10 = dead bud.

Treatment			PP Stem			DF Stem
Lbs a.i./acre	**PP Cal. mm**	**PP HT cm**	**Vol cm^3**	**DF Cal. mm**	**DF HT cm**	**Vol cm^3**
Vista 0.25	41.3	113.9	2306.1	22.4	95.4	664.0
Vista 0.5	36.2	99.3	1548.5	21.4	81.0	418.3
Vista 0.25 + 0.5 Gar 3A	35.1	86.1	1183.4	19.8	80.9	564.7
Vista 0.5 + 0.5 Gar 3A	43.4	75.1	1850.3	22.7	76.0	494.6
Vista 1.0	37.0	100.0	1680.8	17.0	49.1	180.8
Control	31.6	88.1	1095.4	21.0	87.7	527.8

Table 3. Fall caliper, height & stem volume one year after treatement.

Treatment	Manzanita	Whitethorn	Pine	Doug F	
Lbs a.i./acre	**% Brownout**	**% Brownout**	**% Brownout**	**% Brownout**	
Vista 0.25	1.3	0.0	1.3	2.5	
Vista 0.5	32.5	7.5	2.5	7.5	
Vista 0.25 + 0.5 Gar 3A	7.5	1.3	0.0	1.3	
Vista 0.5 + 0.5 Gar 3A	30	17.5	7.5	5.0	
Vista 1.0	67.5	12.5	6.3	7.5	
Control	2.5	0.0	0.0	0.0	

Table 4. Spring percent brownout data four months after treatment.

Treatment	PP Term	PP Lateral	DF Term	DF Lateral		
Lbs a.i./acre	**Bud Dam.**	**Bud Dam.**	**Bud Dam.**	**Bud Dam.**		
Vista 0.25	0.0	0.0	2.5	0.0		
Vista 0.5	0.5	0.0	1.8	0.0		
Vista 0.25 + 0.5 Gar 3A	1.0	0.5	0.0	0.0		
Vista 0.5 + 0.5 Gar 3A	2.5	2.3	0.5	0.0		
Vista 1.0	1.0	0.8	0.8	0.3		
Control	0.0	0.0	0.0	0.0		

Table 5. Spring terminal and lateral bud damage by species. 0=no damage 10=dead bud.

Treatment			PP Stem			DF Stem
Lbs a.i./acre	**PP Cal. mm**	**PP HT cm**	**Vol cm^3**	**DF Cal. mm**	**DF HT cm**	**Vol cm^3**
Vista 0.25	19.5	60.0	271.0	9.8	40.9	43.1
Vista 0.5	24.2	75.7	515.4	9.8	49.1	56.0
Vista 0.25 + 0.5 Gar 3A	22.2	65.1	400.7	8.5	37.4	28.6
Vista 0.5 + 0.5 Gar 3A	24.8	71.7	503.1	10.6	47.7	61.67
Vista 1.0	24.7	71.6	478.4	12.6	48.8	80.7
Control	21.9	69.0	399.2	12.1	49.7	88.4

Table 6. Spring caliper, height & stem volume four months after treatement.

Treatment	Manzanita % Brownout	Whitethorn % Brownout	Pine % Brownout	Doug F % Brownout	P. Pine % Survival	Doug Fir % Survival
Vista 0.25	0.0	0.0	0.0	0.0	93.8	66.5
Vista 0.5	1.3	0.0	0.0	0.0	100.0	77.0
Vista 0.25 + 0.5 Gar 3A	0.0	0.0	0.0	0.0	100.0	49.8
Vista 0.5 + 0.5 Gar 3A	0.0	0.0	0.0	0.0	100.0	58.0
Vista 1.0	7.5	0.0	0.0	0.0	100.0	77.0
Control	0.0	0.0	0.0	0.0	100.0	66.3

Table 7. Spring Vista XRT percent brownout data 15 months after treatment.

Treatment	PP Term Bud Dam.	PP Lateral Bud Dam.	DF Term Bud Dam.	DF Lateral Bud Dam.
Vista 0.25	0.0	0.0	1.3	0.0
Vista 0.5	0.0	0.0	0.0	0.0
Vista 0.25 + 0.5 Gar 3A	0.0	0.0	0.0	0.0
Vista 0.5 + 0.5 Gar 3A	0.0	0.8	0.0	0.0
Vista 1.0	0.0	0.0	0.0	0.0
Control	0.0	0.0	0.0	0.0

Table 8. Spring Vista XRT terminal and lateral bud damage by species 15 months after treatment 0 = no damage 10 = dead bud.

Treatment	PP Cal. mm	PP HT cm	PP Stem Vol cm^3	DF Cal. mm	DF HT cm	DF Stem Vol cm^3
Vista 0.25	25.3	87.5	637.7	12.0	51.1	79.3
Vista 0.5	34.4	118.8	1603.1	11.7	48.8	104.7
Vista 0.25 + 0.5 Gar 3A	31.1	99.3	1131.4	9.4	42.0	40.6
Vista 0.5 + 0.5 Gar 3A	33.8	112.4	1468.4	15.2	62.6	185.5
Vista 1.0	32.8	109.8	1298.7	14.7	54.3	139.6
Control	29.4	101.0	1148.0	14.4	58.6	163.3

Table 9. Spring Vista XRT caliper, height & stem volume 15 months after treatement.

Sierra Cascade Intensive Forest Management Research Cooperative Proposal 12-01

Fruit Growers Soil Pits

Principal Investigator: Brent Roath

Title: Fruit Growers Stock Type Soil Investigation

Year Approved: 2012

Executive Summary:
In February 2002 this plantation was established as one of three replications for the Sierra Cascade Intensive Forest Management Research Cooperative Proposal 00-05, Timmer/Jopson Study. This proposal was titled "Improving Seedling Nutrition in the Nursery to Increase Seedling Performance in the Field". The original stock trial was located in the July 2000 Bark Fire. The stock trial area was subsoiled using a winged subsoiler in two directions. The spacing between the tines was 8 feet, leaving an effective 4 X 4 rip spacing considering the cross ripping. Following the subsoiling operation, the plantation was planted with white fir, Douglas-fir, and ponderosa pine. The white fir seed source was slightly off-site, but the Douglas-fir and the ponderosa pine seed sources were within the same seed zone as the plantation. The plantation received atrazine treatments in 2002 and 2003. The general aspect for the trial area is 225 degrees or southwest and the slope is about 15 percent.

In July 2011 the California Forest Soils Council held their annual summer meeting and visited the site as one of the stops on their field trip. Everyone was impressed with the exceptional growth of all the conifers, but the good survival and growth of the white fir on such an exposed site was amazing. One of the participants of the field trip wondered if the subsoiling led to this improved survival and growth.

Brent Roath volunteered to examine and describe the soils on the site to help answer the question: "What influence did the subsoiling have on seedling survival and growth?" Brent submitted a proposal for funding to the Co-op membership at their annual meeting on March 6, 2012. This proposal proposed addressing the question by digging at least two backhoe pits in subsoiled plots in the study area and one pit in an adjacent undisturbed (not subsoiled) area. One pit would be dug at right angles to a single subsoil channel to determine how much one pass loosens the soil and to determine density or pattern of root growth associated with the subsoiling. A second backhoe pit would be dug at a 45 degree angle at a point where cross subsoiling had occurred. At each backhoe pit: basic soil profile characteristics would be described; visual assessments would be made to determine how much soil was loosened between rip channels; undisturbed soil core samples from each horizon would be

collected to determine bulk density and to develop soil moisture retention curves; and soil samples from each horizon would be collected in case further analysis is desired at a later date.

2012: The soil pits were put in on May 7th and 8th. The Forest Service GIS geology layer of the project area was examined. This layer showed inclusions of ultramafic bodies within a larger metasedimentary rock zone. This mixing of rock types created variability in the soil profiles found in Pit 1 (Douglas-fir) and Pit 2 (ponderosa pine). Surface cobbles and stones uplifted during subsoiling revealed the widespread presence of the ultramafic rock types. Upon examination of the soils in the trenches, inclusions of talc were mixed in the soil and bedrock. Prior to subsoiling, the presence of this ultramafic rock could have given the general impression that the whole area had low site potential.

General soil productivity in the stock trial was calculated using a standardized Region 5 Forest Service guide for estimating soil productivity from soil and site properties. This estimation indicated that the soil productivity was moderate (Forest Service Site Class FSSC 3-4) for **Pits 1** and **2** and low for **Pit 3**. Soil water holding capacity (plant available water) calculated from estimated soil textures and rock fragments indicated that **Pit 1** holds 6.9 inches of water, **Pit 2** 7.9 inches of water, and **Pit 3** 2.6 inches of water. The high soil water holding capacity for **Pits 1** and **2** within the stock trial would have given seedlings good survival potential and the first 10 years of tree growth. Tree growth after this first 10 year period will be controlled by the seasonal precipitation levels, which are estimated to be 25-30 inches per year (Forest Service GIS precipitation layer) and the evapotranspiration demand on the southwestern aspect.

Pit 1: Soil parent material was a mixture of ultramafic and metasedimentary rocks. A fractured stone layer which will slow root penetration to greater depth was found in this pit. The depth to the stone layer varied across the pit face because it was not parallel with the soil surface. The stone layer thickness was about 6 to 8 inches across the pit face. Since it was fractured, fine roots did exist below this stone layer.

The soil in the surface has a cobbly loam to cobbly light clay loam texture, which has good water holding capacity and would be very favorable for seedling survival. The soil below the stone layer has a very cobbly clay loam texture and a high water holding capacity. Once roots are able to move through the stone layer this additional soil water will promote good tree growth.

As mentioned the stone layer was not parallel with the slope or soil surface. Due to the angle of the slope of the stone layer compared to the general gradient of the soil surface, the stone layer appeared to daylight at the lower end (down slope) of the soil pit and on the uphill side angled downward into the slope. Therefore further upslope the depth to the stone layer will increase and more soil will be available for early tree root growth.

In regard to the depth of effective subsoiling, it was difficult to discern the depth of mixing due to the darker color of the upper soil found in **Pit 1**.

Pit 2: Soil parent material was metasedimentary rock. There was no stone layer.

The surface texture in the upper 13 inches was a loam texture changing to a light clay loam at 27 inches and at greater depth a clay loam.

The mixing from the subsoiling was quite evident in **Pit 2** and an 18 foot transact across the pit face between 3 trees was examined. Approximately 85% of the transect showed signs of mixing of the dark organic rich A horizon with the redder colored subsoil. Due to the cross ripping, soil mixing was both actual subsoil penetration and mixing and also deposition or mounding occurring along the subsoiler path. The depth of the mixing across the transect was measured to determine the overall effective depth that the tines of the subsoiler penetrated. Depth of mixed soil ranged from 10 to 18 inches and averaged about 14 inches based upon eleven sample points across the transect. Due to the fact that the soil surface was uneven due to the subsoiling, the subsoiler tines were not able to penetrate to their full depth, which probably exceeded 20 inches.

The soils in **Pit 1** and **2** were 42 and 54+ inches deep, which would classify them as deep and very deep, respectively. A few fine tree roots were observed within the fractured bedrock below the soil at 60 inches deep.

Pit 3: This pit was outside the stock trial area and below the road. This area had not been subsoiled. The soil was only 19 inches deep to a highly fractured, but massive and continuous bedrock, which generally hinders root penetration. Therefore the trees below the road will not have as much available soil water during the normal summer drought period. The shorter intermodal growth rate observed around **Pit 3** seemed to confirm this, at least for the trees near the pit.

Summary: Knowing the good waterholding capacity of the surface soil and subsoil and the deep soil depth at both **Pits 1** and **2**, along with the two atrazine treatments in the trial area, good seedling survival and growth for at least 10 years could have been expected even without the subsoiling.

Since the salvage operations were done in August, no appreciable increase in soil bulk density, above natural conditions, due to the skidding operation would be expected.

In attempting to take soil core bulk density samples, the sampler tip was damaged due to the high content of gravels especially in the case of the A horizon at **Pit 1**. The values for the limited number of samples collected are given in the Appendix of the Final Report which can be found at the Co-op manager's office in Redding.

The amount of roots observed in the soil pits seemed small in both quantity and size considering the size of the trees. But the soil pits only exposed about one-half of the root crown. The size and location of the roots that were within 3 feet of either side of one tree that bordered the soil pit were diagramed. The diagrams are in the Appendix.

Photos

Site 1 – Douglas-fir - Back hoe begins digging

Soil Profile at Douglas-fir pit. Note limited quantity of roots visible. Less than might have been expected due to good tree growth. However, the pit face only represents about one-half of the root crown.

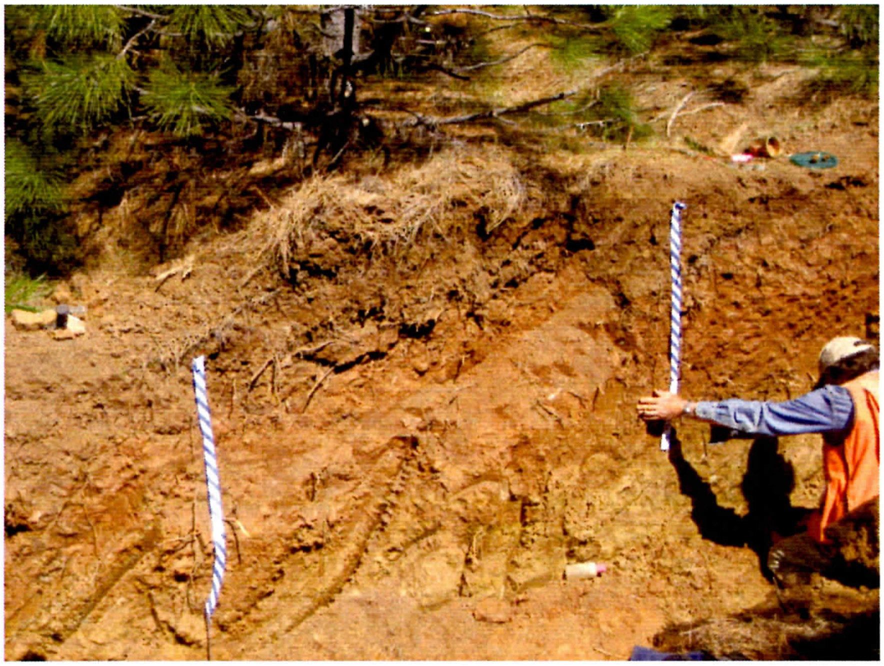
Douglas-fir pit. Soil knife on roots for scale. Large roots appear to be growing horizontal (layering out) just above fractured, but continuous stone layer.

Closeup of stone layer. Note it is fractured but still in original orientation.

Flags were placed at top of stone layer to show depth and direction. Despite stone layer, note overall soil depth is deep to very deep.

Site 2 – Ponderosa pine

Soil depth was deep, no stone layer present here. Blue/white ribbon indicates general area of root description which was 3 feet on each side of tree bole. Note number and size of roots present. An attempt was made to diagram root locations and sizes and is given in the Appendix. Also note undulating soil surface due to cross ripping with final pass on slope contour.



Soil horizons revealed here by color changes. Soil texture was loam in A horizon increasing to clay loam in B and deeper.

Boundary marked by nails shows mixing of A (darker) and B (redder) horizons due to subsoiling.

Broader view showing undulating and mixing of A and B horizons from subsoiling.

Depth of mixing ranged from 10 to 18 inches, but averaged about 14 inches. The uneven soil surface probably limited tine penetration.

Interesting observation - new root following burned out root channel. Note blackened area of charcoal from burned root.

Site 3 – Outside stock trial area, no subsoiling done. Soil depth to a highly fractured, but massive bedrock is limited and ranged from 17 to 35 inches within the pit.

Closeup of highly fractured, but massive and continuous bedrock that will severely retard root growth. Knife blade for scale.

Photo displays typical internodal growth here. Much less than in stock trial area.
Area was treated one time with Velpar.

Sierra Cascade Intensive Forest Management Research Cooperative Proposal 11-03
Mat 28 Site Preparation and Conifer Tolerance

Principal Investigator: Ed Fredrickson

Title: Aminocyclopyrochlor Site Preparation and Conifer Tolerance

Year Funded: 2011

Executive Summary:
Aminocyclopyrochlor is a new product to the vegetation management market. It will be registered for use in 2011 for non-crop sites. Currently Dupont is compiling data to expand the registration to other uses, including forestry. Aminocyclopyrochlor is a pre and post emergent herbicide that controls a wide variety of broadleaf weeds and brush. It is a synthetic auxin and has both foliar and soil activity. The residual control is proving to be quite strong and the product is an excellent inhibitor of seed germination. It is also showing some unique properties for brush control when tank mixed with other products. It has very low use rates, with maximum proposed label rates of 9 ounces product per acre. The product is very safe to mammals with oral and dermal LD 50 values greater than 5000 mg/kg body weight. Half life ranges from 37 to 128 days depending on soil type and weather conditions. There is no bio-accumulation or magnification. It is also extremely safe to aquatic organisms including daphnia.

Previous testing has indicated no conifer tolerance for "over the top" applications, but directed applications around trees may be feasible. There is also a strong potential to broaden the spectrum of control when tank mixed with Velpar DF. The major questions surrounding this herbicide in forestry regard conifer tolerance as a site preparation spray, efficacy on forest weeds, and the duration of control by season. Aminocyclopyrochlor may potentially have a fit as a site preparation treatment for some of the chemically intolerant conifers such as sugar pine, cedar, and redwood, although testing has yet to be done.

The stated objective of this study is to evaluate the effect of aminocyclopyrochlor rate and timing on vegetation control and conifer tolerance of ponderosa and Douglas-fir when applied as a pre-plant site preparation spray. This proposal is for a trial that would look at the effect of site, rate, and timing on vegetation control and conifer tolerance of ponderosa pine and Douglas-fir for site preparation treatments with aminocyclopyrochlor alone and in combination with Velpar DF and Accord XRT II compared to Velpar DF as the operational standard. Specific questions to be answered are: Does Mat 28 rate effect vegetation control or conifer tolerance? Can tank mixes of Mat 28 and a low rate of Velpar DF achieve similar vegetation control and coniference tolerance to the operational standard of Velpar DF alone? How does Mat 28 alone compare to the operational standard of Velpar Df regarding vegetation control and conifer tolerance? Does the addition of Accord XRT II to Mat 28 improve vegetation control?

The study will have two sites, one high elevation or east side Cascade site and a low elevation west side Cascade site (only one site was funded in 2011). Each site should be a fresh clear-cut or wildfire that has not had any chemical treatment prior to the trial. All plots will be laid out in the spring or fall of 2011. The plan will be to spray the high elevation site in the fall of 2011 and the low elevation site in the spring of 2012. Both sites will be planted in the spring of 2012.

The study design will be a completely randomized block design with three replications. Plot size will be 12' x 36' (0.01 acre). Plots will be planted with 10 trees each of ponderosa and Douglas-fir in the same plot (two rows of each species). Stock type will be similar to what is operationally planted on the site. Seedlings are to be provided by the cooperator as well as one or two planters to plant the plots. Planting will be supervised by Thunder Road Resources.

Two spray timings will be utilized in this study (October 2011 – high elevation and March of 2012 – low elevation). Treatments will include Mat 28 at 1.125, 2.25, and 4.5 ounces a.i. per acre; Mat 28 at 2.25 ounces a.i. per acre combined with Velpar DF at 1.0 pound a.i. per acre; Mat 28 at 2.25 ounces a.i. per acre combined with Velpar DF at 2.0 pounds a.i. per acre; Velpar DF at 2.5 pounds a.i. per acre; Mat 28 at 2.25 ounces a.i. per acre combined with Accord XRT II at 2.6 pounds a.i. per acre; and a control. Plots will be sprayed with a twelve foot boom sprayer at ten gallons per acre. All plots will be sprayed with one timed pass. The boom will be set with 4-9503 nozzles which provide a similar drop size spectrum to a helicopter set up with D-8 nozzles at a 45 degree angle. All chemical will be provided by Dow AgroSciences.

Seedling caliper and height will be measured initially at time of planting. End of season evaluations, which will take place at the end of the first and second growing seasons after treatment, consist of ocular estimation of vegetation percent cover by species for the weeds and brush, measurement of conifer seedling caliper and height, and an ocular rating of conifer damage. Stem volume will be calculated for analysis. Analysis of variance and multiple procedures for a completely randomized block design will be utilized to analyze data.

2011: The study site was established in October on ground owned and managed by Sierra Pacific Industries near Shingletown, CA. Elevation is approximately 4200 feet. Slope is 0 to 5 percent and of relatively negligible aspect. The site was pre-harvest sprayed with four percent Accord XRT II and two percent MSO, logged, and ripped. No further site preparation activities have been conducted.

The trial was staked and sprayed on October 20th.

2012: The trial was planted on March 24th. The trial was planted with Styro 6 ponderosa pine and Styro 8 Douglas-fir from Cal Forest Nursery of Etna, CA. Ten trees of each species were planted in rows in each plot.

The trial was evaluated on August 12th. Visual assessments of vegetation control and conifer damage were recorded at the time. Initially this trial was slated to have conifer measurements taken at the end of the first and second growing seasons. The trial site was confounded by severe frost damage to the Douglas-fir. It was decided to not measure conifer seedlings in 2012, but to take visual assessments only. The measurements that were to be taken in 2012 will be put off until 2014. The 2013 measurements will occur as planned.

Data were analyzed using SAS statistical software. Analysis of variance was used to determine significance of the main effects of treatment and orthogonal contrasts were used to make specific comparisons among treatments. Analysis of variance was used to determine if there were any differences in initial seedling size among treatments. If initial seedling size was found to be significantly different among treatments, analysis of co-variance was used to adjust for initial seedling size difference with initial tree size as the co-variate. Vegetation data was analyzed using analysis of variance for the main effects, and multiple comparisons of means were done using Student Neuman Kewls least significant difference procedure. Orthogonal contrasts were used to make specific comparisons among treatments.

The herbicide treatments had significantly less total cover and more bare ground than the controls (P<=0.05). The treatments with Mat 28 alone at any rate had significantly more cover than the operational standard of 2.66 pounds of Velpar DF alone (Table 1). The addition of 4.5 ounces of Mat 28 to 2.66 pounds of Velpar DF did not significantly improve vegetation control. The two treatments with a combination of Mat 28 plus Velpar DF and the Mat 28 plus Accord XRT II treatment were not significantly different than Velpar DF alone for either percent bare ground or percent total cover.

Although this site was not pre-treated with imazapyr prior to logging, total cover on the site was generally low and consisted mainly of bull thistle. All herbicide treatments greatly reduced the bull thistle cover compared to the controls.

Ponderosa pine survival was not significantly affected by treatment (R<=0.05). Douglas-fir survival was affected by treatment (Table 2). The treatments with Mat 28 alone (except 4.5 ounces/acre Mat 28) and all three of the tank mix treatments with Mat 28 had higher survival than the operational standard of Velpar DF alone. The same treatments were also higher than the control, but were not significant.

The damage ratings for ponderosa pine significantly varied by treatment (P<=0.05). The Velpar DF alone treatment and the controls had significantly less damage than any treatment containing Mat 28. Damage in general was severe with Mat 28. Bud swelling, terminal dieback, shortened needles, and twisting were some of the most common symptoms. Douglas-fir damage was severe for all treatments and did significantly differ by treatment. This was a direct result of severe frost damage.

Regardless of the frost damage on the Douglas-fir, it does not appear that Mat 28 will be a suitable pre-plant site preparation chemical due to the severe seedling damage it causes. Analogous trials with the Forest Stewardship

Council Research Group demonstrated the same trends in the spring or fall and across three different conifer species. Like Milestone alone, treatments with Mat 28 alone also provided little vegetation control. Due to its efficacy on brush, Mat 28 may still have a fit as a pre-harvest site preparation treatment. Several trials are underway to test this hypothesis.

Product and Rate	% Bare Ground	% Total Cover	% Cover Bull Thist	% Cover Grass	% Cover Squaw Carp	% Cover Snow Berry	% Cover G.L. Manz
2.25 oz MAT 28	95.0	5.7	1.0	1.3	0.3	0.3	1.0
4.5 oz MAT 28	95.7	5.3	2.7	0.3	0.3	0.3	0.3
9.0 oz MAT 28	93.3	7.0	1.0	0.3	0.0	0.7	0.3
4.5 oz MAT 28 + 1.33 lbs Velp DF	95.7	4.7	1.0	0.0	0.0	1.0	0.0
4.5 oz MAT 28 + 2.66 lbs Velp DF	98.7	1.3	0.0	0.0	0.0	0.3	0.0
2.66 lbs Velp DF	98.0	2.0	2.0	0.0	0.0	0.0	0.0
4.5 oz MAT 28 + 2 qts Acc XRT II	98.0	2.7	1.0	0.3	0.0	0.0	0.0
Control	81.0	21.0	16.7	0.3	0.7	0.7	0.3

Table 1. Total percent cover, percent bare ground and percent cover by species for MAT 28 site prep trial 10 months after treatment. All rates are pounds product per acre. Acc = Accord XRT II, Velp = Velpar DF

Product and Rate	P. Pine % Survival	Doug Fir % Survival	P. Pine Dam Code	Doug Fir Dam Code
2.25 oz MAT 28	100.0	70.0	6.7	8.3
4.5 oz MAT 28	96.7	50.0	7.3	8.7
9.0 oz MAT 28	93.3	60.0	7.3	8.3
4.5 oz MAT 28 + 1.33 lbs Velp DF	93.3	60.0	7.3	8.3
4.5 oz MAT 28 + 2.66 lbs Velp DF	93.3	63.3	7.0	8.3
2.66 lbs Velp DF	96.7	50.0	1.0	8.7
4.5 oz MAT 28 + 2 qts Acc XRT II	96.7	56.7	7.3	8.8
Control	100.0	50.0	1.7	8.7

Table 2. Ponderosa pine and Douglas-fir percent survival and damage ratings for MAT 28 site prep trial 10 months after treatment. Damage codes: 0 = No Damage, 10 = Dead.

Sierra Cascade Intensive Forest Management Research Cooperative Proposal 11-02
GF 9999 Site Preparation

Principal Investigator: Ed Fredrickson

Title: GF 9999 Site Preparation and Conifer Tolerance

Year Funded: 2011

Executive Summary:

GF 9999 is a foliar and soil active herbicide which has been in development for nearly six years. Due to the proprietary nature of this product, this trial must be done under a secrecy agreement and the actual active ingredient cannot be divulged at this time. GF 9999 is similar to other residual herbicides used in forestry. It has a broad spectrum of weed control and can be used at much lower rates than other residual herbicides used in forestry and is of low hazard to the environment. It also has extremely low toxicity to aquatic organisms and fish. It can be applied as either a pre or post emergent herbicide. It controls both grasses and broadleaved weeds.

This product has not been tested on forestry sites and conifer tolerance has not been established. It is also unclear how vegetation control will be influenced by forest soils, climate, and timing of application. There is however a strong potential that this will be an effective tool for forestry site preparation, especially on annual grasses and broadleaved weeds.

The stated objective of this study is to evaluate the effect of GF 9999 rate and timing on vegetation control and conifer tolerance of ponderosa pine and Douglas-fir when applied as a pre-plant site preparation spray. This proposal is for a trial that would look at the effect of site, rate, and timing on vegetation control and conifer tolerance of ponderosa pine and Douglas-fir for site preparation treatments with GF 9999 alone and in combination with Velpar DF and Accord XRT II compared to Velpar DF as the operational standard. Specific questions to be answered are: Does GF 9999 rate effect vegetation control or conifer tolerance? Can tank mixes of GF 9999 and a low rate of Velpar DF achieve similar vegetation control and conifer tolerance compared to the operational standard of Velpar DF alone? How does GF 9999 alone compare to the operational standard of Velpar DF regarding vegetation control and conifer tolerance? Does the addition of Accord XRT II to GF 9999 improve vegetation control?

The study will have two sites, one high elevation or east side Cascade site and a low elevation west side Cascade site (only one site was funded in 2011). Each site should be a fresh clear-cut or wildfire that has not had any chemical treatment prior to the trials. All plots will be laid out in the spring or fall of 2011. The plan will be to spray the high elevation site in the fall of 2011 and the low elevation site in the spring of 2012. Both sites will be planted in the spring of 2012.

The study design will be completely randomized block design with three replications. Plot size will be 12’ x 36’ (0.01 acre). Plots will be planted with

10 trees each of ponderosa pine and Douglas-fir in the same plot (two rows of each species). Stock type and seed-lot will be the same for all trees of each species in the study. The stock type will be similar to what is operationally planted on the site. Seedlings are to be provided by the cooperator as well as one or two planters to plant the plots. Planting will be supervised by Thunder Road Resources.

Two spray timings will be utilized in this study (October 2011 – high elevation and March 2012 – low elevation). Treatments will include GF 9999 at 2.1, 4.2, 6.3, and 8.4 ounces a.i. per acre; GF 9999 at 6.3 ounces a.i. per acre combined with Velpar DF at 1.0 pound a.i. per acre; GF 9999 at 6.3 ounces a.i. per acre combined with Accord XRT II at 2.6 pounds a.i. per acre; Velpar DF at 2.5 pounds a.i. per acre; and a control. Plots will be sprayed with a twelve foot boom sprayer at ten gallons per acre. All plots will be sprayed with one timed pass. The boom will be set with 4-9503 nozzles which provide a similar drop size spectrum to a helicopter set up with D-8 nozzles at a 45 degree angle. All chemical will be provided by Dow AgroSciences.

Seedling caliper and height will be measured initially at time of planting. End of season evaluations, which will take place at the end of the first and second growing seasons after treatment, consist of ocular estimation of vegetation percent cover by species for the weeds and brush, measurement of conifer seedling caliper and height, and an ocular rating of conifer damage. Stem volumes will be calculated for analysis. Analysis of variance and multiple comparison procedures for a completely randomized block design will be utilized to analyze data.

2011: The study site was established in October on ground owned and managed by Sierra Pacific Industries near Shingletown, CA. Elevation is approximately 4200 feet. Slope is 0 to 5 percent and of relatively negligible aspect. The site was pre-harvest sprayed with four percent Accord XRT and two percent MSO, logged, and ripped. No further site preparation activities have been conducted.

The trial was staked and sprayed on October 20th.

2012: The trial was planted on March 24th. The trial was planted with Styro 8 Douglas-fir and white fir and Styro 6 ponderosa pine. Seedlings were from Cal Forest Nursery. Ten trees of each species were planted in rows in each plot.

The trial was evaluated on August 12th. Visual assessments of vegetation control and conifer damage were recorded at the time. Initially this trial was slated to have conifer measurements taken at the end of the first and second growing seasons. The trial site was confounded by severe frost damage to the two fir species. It was decided to not measure conifer seedlings in 2012, but to take visual assessments only. The measurements that were to be taken in 2012 will be put off until 2014. The 2013 measurements will occur as planned.

Data were analyzed using SAS statistical software. Analysis of variance was used to determine significance of the main effects of treatment and orthogonal contrasts were used to make specific comparisons among treatments. Analysis of variance was used to determine if there were any differences in initial seedling size among treatments. If initial seedling size was found to be significantly different among treatments, analysis of co-variance was used to adjust for initial seedling size difference with initial tree size as the co-variate. Vegetation data was analyzed using analysis of variance for the main effects, and multiple comparisons of means were done using Student Neuman Kewls least significant difference procedure. Orthogonal contrasts were used to make specific comparisons among treatments.

The trial site had relatively low vegetative cover (Table 1). Treatment main effects were not significant for percent bare ground ($P<=0.05$), however, they were for percent total cover. The treatments with GF 9999 alone at any rate had greater total cover than the control or operational standard of 3.33 pounds Velpar DF. GF 9999 did not appear to have any effect on bull thistle whatsoever, which was the predominant species present. The best treatment overall was the Velpar DF alone.

While vegetation control appeared to be poor with GF 9999, conifer tolerance was excellent, even though all fir seedlings were seriously injured by frost. Neither survival or damage rating was affected by treatment for any species in the trial (Table 2). Survival was poor for Douglas-fir in general. The damage seen on the Douglas-fir and white fir did not significantly differ from that seen in the control or the operational standard of Velpar DF alone.

It was difficult to gauge the ability of GF 9999 to control competing vegetation due to the inherent low cover on the site. Annual grasses did appear to be reduced although the total presence of grass on the site was low. Conifer tolerance however, appears to be excellent for all species tested. Normally, phytotoxicity from herbicides is enhanced when there is some environmental stress added. There did not appear to be any associated with these treatments. Follow up evaluations should provide a clearer picture.

Product and Rate	% Bare Ground	% Total Cover	% Cover Bull Thist	% Cover Grass	% Cover Squaw Carp	% Cover Snow Berry	% Cover G.L. Manz
3 oz GF 9999	88.3	12.0	10.0	0.7	0.0	0.3	0.0
6 oz GF 9999	86.7	13.3	8.3	1.0	1.3	1.0	0.7
9 oz GF 9999	90.7	10.3	7.0	0.7	0.3	1.7	0.0
12 oz GF 9999	88.3	11.7	4.3	3.3	0.3	3.0	0.3
9 oz GF 9999 + 1.33 lbs Velp DF	90.0	10.0	10.0	0.0	0.0	0.0	0.0
9 oz GF 9999 + 2 qts Acc XRT II	96.7	3.7	0.7	0.0	0.3	1.0	0.7
3.33 lbs Velp DF	97.7	2.3	1.0	0.0	0.0	0.3	0.3
Control	93.3	7.0	1.3	2.3	0.3	1.7	0.3

Table 1. Total percent cover, percent bare ground and percent cover by species for GF 9999 site prep trial 10 months after treatment. All rates are pounds product per acre. Acc = Accord XRT II, Velp = Velpar DF

Product and Rate	White Fir % Survival	P. Pine % Survival	Doug Fir % Survival	White Fir Dam Code	P. Pine Dam Code	Doug Fir Dam Code
3 oz GF 9999	96.7	96.7	60.0	7.0	3.0	8.0
6 oz GF 9999	86.7	100.0	80.0	7.3	2.7	7.7
9 oz GF 9999	90.0	93.3	53.3	7.0	2.7	8.3
12 oz GF 9999	70.0	100.0	60.0	7.7	4.3	8.0
9 oz GF 9999 + 1.33 lbs Velp DF	73.3	96.7	63.3	8.0	4.3	8.0
9 oz GF 9999 + 2 qts Acc XRT II	73.3	100.0	76.7	7.3	2.7	7.3
3.33 lbs Velp DF	90.0	100.0	86.7	7.0	2.7	7.7
Control	80.0	90.0	93.3	7.7	4.3	7.7

Table 2. White fir, ponderosa pine and Douglas-fir percent survival and damage ratings 10 months after treatment. Damage codes: 0 = No Damage, 10 = Dead.

Sierra Cascade Intensive Forest Management Research Cooperative Proposal 12-03
Pindar GT Site Preparation

Principal Investigator: Ed Fredrickson

Title: Intolerant Conifer Site Preparation with Pindar GT (Penoxsulam + Oxyflourfen), Dimension EC (Dithiopyr), Goaltender (Oxyflourfen), and Milestone (Aminopyralid)

Year Funded: 2012

Executive Summary:

Mixed conifer plantations are becoming more and more popular in industrial forestry due to better seedling stock and the desire to diversify plantations. Unfortunately, conifer species such as Douglas-fir, white and red fir, incense cedar, and sugar pine have a lower tolerance to the operational standard chemical site preparation herbicide, hexazinone. This poses a significant challenge to foresters who wish to establish a diverse mix of conifer species in their plantations, and often leads to vegetation management treatments that are inferior in control and at a higher cost. With the potential loss of atrazine, foresters currently have no available chemical tool that exhibits a high degree of tolerance to these species of conifers. It is the goal of this trial to evaluate several new herbicides that may provide effective residual control of herbaceous vegetation and conifer safety.

Pindar GT, Dimension EC, Goaltender, and Milestone are four residual herbicides manufactured by Dow AgroSciences. Pindar GT is a liquid formulation that contains 0.083 pounds per gallon of the active ingredient penoxsulam plus 3.93 pounds per gallon of the active ingredient oxyflourfen; Dimension EC is a liquid formulation that contains 4 pounds per gallon of the active ingredient dithiopyr; Goaltender is a liquid formulation containing 4 pounds per gallon of the active ingredient oxyflourfen; and Milestone is a liquid that contains 2 pounds per gallon of the active ingredient aminopyralid. Currently, all products are registered for a variety of uses in California, however none are registered for forestry site preparation. All products can be applied as either a pre or post emergent herbicide for broadleaf weed control and some grasses.

None of the products have been extensively tested as a forestry site preparation tool under field conditions, with the exception of Milestone. Two of the four active ingredients have demonstrated a high degree of conifer tolerance. Oxyflourflen has long been used in forest nurseries and even the most chemically intolerant conifer species such as coast redwood show a high degree of tolerance. Aminopyralid is currently being tested as a site preparation chemical with ponderosa and Douglas-fir and early results show a high degree of tolerance. Seedling conifer tolerance with penoxsulam and dithiopyr has not been tested, although ornamentally planted conifers have shown tolerance to dithiopyr.

Combinations of Milestone with Pindar GT, Dimension EC, and Goaltender have exhibited long-term residual control of herbaceous vegetation in non-forestry settings. These combinations have been some of the most encouraging

Product and Rate	% Bare Ground	% Total Cover	% Cover Bull Thist	% Cover Grass	% Cover Squaw Carp	% Cover Snow Berry	% Cover G.L. Manz
3 oz GF 9999	88.3	12.0	10.0	0.7	0.0	0.3	0.0
6 oz GF 9999	86.7	13.3	8.3	1.0	1.3	1.0	0.7
9 oz GF 9999	90.7	10.3	7.0	0.7	0.3	1.7	0.0
12 oz GF 9999	88.3	11.7	4.3	3.3	0.3	3.0	0.3
9 oz GF 9999 + 1.33 lbs Velp DF	90.0	10.0	10.0	0.0	0.0	0.0	0.0
9 oz GF 9999 + 2 qts Acc XRT II	96.7	3.7	0.7	0.0	0.3	1.0	0.7
3.33 lbs Velp DF	97.7	2.3	1.0	0.0	0.0	0.3	0.3
Control	93.3	7.0	1.3	2.3	0.3	1.7	0.3

Table 1. Total percent cover, percent bare ground and percent cover by species for GF 9999 site prep trial 10 months after treatment. All rates are pounds product per acre. Acc = Accord XRT II, Velp = Velpar DF

Product and Rate	White Fir % Survival	P. Pine % Survival	Doug Fir % Survival	White Fir Dam Code	P. Pine Dam Code	Doug Fir Dam Code
3 oz GF 9999	96.7	96.7	60.0	7.0	3.0	8.0
6 oz GF 9999	86.7	100.0	80.0	7.3	2.7	7.7
9 oz GF 9999	90.0	93.3	53.3	7.0	2.7	8.3
12 oz GF 9999	70.0	100.0	60.0	7.7	4.3	8.0
9 oz GF 9999 + 1.33 lbs Velp DF	73.3	96.7	63.3	8.0	4.3	8.0
9 oz GF 9999 + 2 qts Acc XRT II	73.3	100.0	76.7	7.3	2.7	7.3
3.33 lbs Velp DF	90.0	100.0	86.7	7.0	2.7	7.7
Control	80.0	90.0	93.3	7.7	4.3	7.7

Table 2. White fir, ponderosa pine and Douglas-fir percent survival and damage ratings 10 months after treatment. Damage codes: 0 = No Damage, 10 = Dead.

variance and multiple comparison procedures using orthogonal contrasts will be used to analyze all data.

2012: A trial was established on April 2nd on land owned and managed by Sierra Pacific Industries near Burney, CA in an existing plantation that had poor survival and heavy herbaceous cover. Elevation is approximately 3500 feet with 0 to 5 percent slope. Due to the heavy vegetation at time of treatment, all treatments included one quart per acre of Accord XRT II to brownout the existing cover to allow us to look at the residual activity of the products. An Accord XRT II alone treatment was also included to compare with the other treatments. The site has not been treated with residual chemicals in several years.

Plots were laid out and sprayed on April 2nd. Ten seedlings each of Douglas-fir and white fir were planted into each plot on April 20th. Seedlings were measured at planting for caliper and height. Future seedling measurements will not occur until the end of the second growing season (this is a change from the original proposal).

Ocular evaluations of percent cover by species, percent bare ground, seedling survival, seedling percent brownout, and seedling damage ratings were taken on August 31st (end of first growing season). Similar evaluations will be done at the end of the second growing season.

Data were analyzed using SAS statistical software. Analysis of variance was used to determine significance of the main effects of treatment and orthogonal contrasts were used to make specific comparisons among treatments. Analysis of variance was used to determine if there were any differences in initial seedling size among treatments. If initial seedling size was found to be significantly different among treatments, analysis of co-variance was used to adjust for initial seedling size difference with initial tree size as the co-variate. Vegetation data were analyzed using analysis of variance for the main effects, and multiple comparisons of means were done using Student Newman Kewls least significant difference procedure. Orthogonal contrasts were used to make specific comparisons among treatments.

In general, vegetation control was excellent with all products tested with the exception of the Accord XRT II alone treatment which vigorously germinated soon after treatment (Table 1). All treatments were significantly different from the control ($P<=0.05$). Even the Milestone plus Accord XRT II increased percent bare ground twofold over the Accord XRT II alone treatment. This shows that once the vegetation is burned down, Milestone has the ability to suppress germination. The addition of Pindar GT, Goaltender, or Dimension 2EW (slightly different formulation from the one listed in the original proposal) to Accord XRT II significantly decreased total cover and increased per cent bare ground compared to Accord XRT II alone. While the addition of Milestone to Pindar GT, Goaltender, or Dimension 2EW did decrease total cover and increased bare ground, the results were not significant although the Dimension 2EW comparisons were close.

The addition of 1.33 pounds per acre of Velpar DF to 7 ounces of Milestone per acre with Accord XRT II significantly decreased total cover compared to the Milestone plus Accord XRT II treatment (P<=0.05). Neither percent bare ground or total cover were significantly different with the Velpar DF, Milestone plus Accord XRT II treatment compared to the operational standard of Velpar DF alone at 3.33 pounds per acre. However, the 1.33 pounds per acre treatment of Velpar DF plus Accord XRT II was also not significantly different from either the operational standard of Velpar DF alone or the Velpar DF plus Accord XRT II combination with Milestone.

Of all treatments tested, the ones with Velpar DF provided the best control of houndstongue and commom mullen. Downy brome was controlled well with all treatments with the exception of the Dimension 2EW plus Accord XRT II and the Accord XRT II alone treatment. It should be noted that control of downy brome was enhanced when 7 ounces of Milestone was added to Dimension 2EW. All treatments except the Accord XRT II alone provided good control of tumble mustard.

Frost severely impacted both white and Douglas-fir, however, treatment effects were still readily apparent. White fir survival was significantly affected by treatment (P<=0.05). All treatments had significantly greater survival than either the control or the operational standard of 3.33 pounds per acre of Velpar DF alone (Table 2). Survival of the Velpar DF standard was similar to the control (42.5 percent and 47.5 percent, respectively). The remaining treatments ranged from 67 to 90 percent survival and were not significantly different from each other. All treatments with Pindar GT, Goaltender, or Dimension 2EW alone or in combination with Milestone did have significantly greater white fir survival than the operational standard of Velpar DF alone. White fir percent brownout was also higher for the Velpar DF standard compared to other treatments. The Velpar standard had significantly more brownout compared to the 1.33 pounds Velpar DF plus 7 ounces of Milestone and Accord XRT II treatment. The Dimension 2EW plus Accord XRT II treatment had significantly less brownout compared to the same treatment with Milestone. White for damage rating did not significantly vary among treatments.

Douglas-fir survival was not affected by treatment other than all herbicide treatments has significantly greater survival than the control (P<=0.05). Although the main effect of treatment was not significant on Douglas-fir percent brownout or damage rating, one contrast did show that the addition of Milestone to the Dimension 2EW plus Accord XRT II mix significantly increased percent brownout and damage. This was similar to the white fir results for these treatments.

This trial produced several good alternatives to Velpar DF where conifer tolerance is a concern. Excellent conifer tolerance was seen in both Douglas-fir and white fir for Pindar GT, Goaltender, Dimension 2EW, and Milestone. Even though frost damage confounded results, treatment effects were clearly visible. Vegetation control was excellent for most treatments, especially when comparing Pindar GT and Goaltender to the operational standard of Velpar GT alone. Control was comparable with better conifer tolerance, especially with white fir. In this case, the addition of Milestone to any of the products did show a trend in reducing cover, however the differences were slight and not significant. It was clearly demonstrated however that Milestone when added to Accord XRT II did suppress germination compared to the Accord XRT II alone treatment.

Product & Rate	% Bare Ground	% Total Cover	% Cover Downy Brome	% Cover Tumble Mustard	% Cover Hounds Tongue	% Cover Bull Thistle	% Cover Common Mullen
7 oz MVM	86.2	14.0	3.2	1.0	5.2	0.0	3.0
1.5 qts Pindar GT	88.0	13.0	1.2	0.8	4.0	0.5	3.0
1 qt Dimension 2EW	71.2	33.2	20.8	2.0	3.8	0.5	2.8
1.5 qts Goaltender	82.5	19.2	2.0	0.5	4.0	0.8	9.5
1.5 qts Accord XRT II	41.2	58.2	21.2	8.0	3.2	0.8	5.0
1.5 qts Pind GT + 7 oz MVM	94.0	7.2	1.0	0.0	1.2	0.5	4.2
1 qt Dim 2EW + 7 oz MVM	86.2	13.8	1.5	0.0	5.2	0.2	0.5
1.5 qts GoalT + 7 oz MVM	87.5	12.8	1.2	0.2	3.8	0.0	6.5
1.33 lbs Velp DF + 7 oz MVM	97.8	2.2	0.5	0.0	0.8	0.0	1.0
1.33 lbs Velp DF	95.8	4.8	0.2	0.0	0.8	0.2	0.2
3.33 lbs Velp DF	98.5	1.5	0.2	0.0	0.2	0.2	0.2
Control	23.8	91.2	63.8	9.2	5.5	3.2	2.0

Table 1. Total percent cover, percent bare ground and percent cover by species for Pindar GT site prep trial 4 months after treatment. All rates are pounds product per acre. Acc = Accord XRT II, Velp = Velpar DF, MVM = Milestone, Pind GT = Pindar GT, Dim 2EW = Dimension 2EW, GoalT = Goaltender.

Product & Rate	White Fir % Survival	Douglas-Fir % Survival	White Fir % Brownout	Douglas-Fir % Brownout	White Fir Dam Code	Douglas-Fir Dam Code
7 oz MVM	70.0	77.5	17.5	18.8	4.0	5.2
1.5 qts Pindar GT	77.5	82.5	13.8	11.2	3.0	3.2
1 qt Dimension 2EW	85.0	85.5	5.0	7.5	2.0	2.0
1.5 qts Goaltender	80.0	90.0	17.5	20.0	3.2	4.0
1.5 qts Accord XRT II	80.0	77.5	11.2	12.5	3.2	3.0
1.5 qts Pind GT + 7 oz MVM	90.0	80.0	11.2	18.8	3.2	4.2
1 qt Dim 2EW + 7 oz MVM	67.5	72.5	13.8	21.2	4.2	6.0
1.5 qts GoalT + 7 oz MVM	77.5	82.5	12.5	16.2	3.8	3.5
1.33 lbs Velp DF + 7 oz MVM	72.5	75.0	11.2	15.0	3.2	4.5
1.33 lbs Velp DF	82.5	92.5	15.0	13.8	3.8	3.0
3.33 lbs Velp DF	42.5	80.5	32.5	12.5	5.5	2.5
Control	47.5	57.5	37.5	23.8	5.8	5.5

Table 2. White and Douglas-fir percent survival, percent brownout and damage rating for the Pindar GT site prep trial 4 months after treatment.

Sierra Cascade Intensive Forest Management Research Cooperative
Income/Expense Statement
Calendar Year Report for the Period Jan. 1 to Dec. 31, 2012

Beginning Balance on January 1, 2012		$6,966.21
Total Income (Membership Dues)		$58,000.00
Expenses:		
Soil Pits	$296.00	
Pindar Proposal	$6,300.00	
G.O.E. Proposal	$5,000.00	
Co-op Manager Expenses	$30,000.00	
Total Expenses		$41,596.00
Year End Balance as of December 31, 2012		$23,370.21

WORKING GROUP MEMBERSHIP

Working Group I
Seed to Establishment

Tom Jopson, Chair
Bob Amesbury
Scott Carnegie
Mark Gray
Lewis Howe
Scott Worden
Tom Young

Working Group II
Out-planting through Precommercial Thinning

Jason Warshawer, Chair
Bob Amesbury
Scott Carnegie
Mark Gray
Lewis Howe
Scott Worden
Bob Powers
Tom Young