

# Sierra-Cascade Intensive Forest Management Research Cooperative

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***ANNUAL REPORT***  
**2014**

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The year 2014 marked the fifteenth year as an organization for the Sierra Cascade Intensive Forest Management Research Cooperative.

Membership remained constant from 2013. The current membership consists of a mixture of landowners, forestry-related industries, State of California and federal agencies. There are currently sixteen member organizations in the Co-op.

Matt Busse made a presentation on the history of the Co-op at the Forest Vegetation Management Conference in January. His presentation was titled "Fourteen Years of Forestry Research: The Sierra Cascade Intensive Forest Management Research Cooperative". Also, two presentations of results from research supported by the Cooperative were presented by members of the Co-op at the Conference. Vanelle Peterson reported on her research on two herbicides, GoalTender and Pindar GT (Proposals 13-02). The title of her presentation was "Pindar GT, Potential Use in Forestry". Ed Fredrickson reported on additional studies with Milestone (Proposal 10-01). His presentation was titled "Milestone (Aminopyralid) A New Tool in Forestry Site Preparation and Release". All three of these presentations were well received by the audience.

The annual business meeting was held at the Forest Service office March 11, 2014 in Redding (a summary of the meeting can be found in this Annual Report). Seventeen Co-op members and guests attended. The first item of business was a review of membership status and the budget. The Co-op ended 2013 with a surplus of \$19,323.

Following the discussion on the budget, updates on five recently funded Co-op studies were presented: Proposal 11-02 GF 9999; Proposal 11-03 Mat 28 Site Prep; Proposal 12-03 Pindar GT; Proposal 13-01 Matrix Site Prep; and Proposal 13-02 Pindar/GoalTender. Executive Summaries of the last two studies are presented in this Annual Report. Short summaries of the progress of Proposal 12-02 Garden of Eden, Proposal 13-03 Ponderosa Remeasure, and Proposal 13-04 Study Plot Mapping were presented to the membership.

The next item of business at the annual meeting was the presentation of three new proposals for possible Co-op funding. The Co-op was able to finance two of these proposals (Proposal 14-01, Pindar Over the Top; and Proposal 14-02, Ponderosa Soils. A discussion of the third new proposal, Remeasure of Agenda 2020, is found later in this Summary.

The vacant research representative position on the Steering Committee was filled at the annual meeting. Matt Busse and Jianwei Zhang volunteered to serve as co-representatives to fill this vacancy. The membership approved this action. The Steering Committee is now composed of four members.

The three study sites for the Garden of Eden proposal were planted in the spring. Whitmore on March 12<sup>th</sup>, and Feather Falls on March 18<sup>th</sup>. Elk Horn was planted on April 15<sup>th</sup>. Planned release treatments and soil collecting have been accomplished. Survival issues at Elk Horn will require some replanting in 2015. This is tentatively planned for early February.

Treatments for the Pindar Over the Top study approved at the 2014 annual meeting were applied on March 27<sup>th</sup> and May 2<sup>nd</sup> at the Sonora site and on April 7<sup>th</sup> and May 16<sup>th</sup> at the Whitmore site.

All soil samples for the Pondsosa Soils proposal that was approved at the 2014 annual meeting were collected and processed by mid-May.

The Co-op field trip scheduled for June 17<sup>th</sup> on the Blacks Mountain Experimental Forest had a good turnout with 18 Co-op member and guests attending. Stops included studies illustrating LiDar applications, manual release, variable spacing and thinning effects, and variable retention fire salvage results. The final stop was at the Aspen Long Term Soil Productive Study which is almost 20 years old. Martin Ritchie and Jianwei Zhang of the PSW Research Lab in Redding conducted the tour.

Evaluations of results from the two ongoing herbicide studies (Matrix Site Preparation and Pindar/ GoalTender) were conducted in the fall after the end of the 2014 growing season. Evaluation of the new 2014 study (Pindar GT Over the Top) was also done in the fall.

With the 2014 funding of the Pondsosa Soils Proposal, it was decided to hold off on making a report on the results of the Pondsosa Remeasurement Proposal (data collection completed in December 2013) and combine the data from the two proposals and make a report to the membership and then publish on this combination of data. This approach would result in a more complete explanation on

what was going on at the Pondsosa site. As noted above, all soil samples have been collected for the 2014 proposal. Problems with the private lab hired to analyze our samples have resulted in the samples having to be reanalyzed at another lab. As soon as this can be accomplished, data will be analyzed and a manuscript drafted.

The Agenda 2020 study (Proposal 03-01) celebrated its tenth year after planting and herbicide treatment in 2014. A proposal was brought before the membership at the 2014 annual meeting to measure the tree growth at this ten year period. Shrub data would be collected in 2014 (5 years after the last shrub control treatment) and used as the basis for retreating plots – as needed – prior to collecting the initial measurement of tree growth in 10 years of study. Support for the study among Co-op members was mixed at the meeting. Many acknowledged the value of the study from a forest management perspective and commented on the significant time and effort already contributed to the study by Co-op members. However, others recognized the inherent challenges in meeting the original treatment design. Matt Busse decided to contribute a PSW field crew to remeasure shrubs on all plots in 2014 before seeking funding from the Co-op for the retreatment of shrubs and the conifer measurements. This shrub remeasurement was done in April. Results for shrub cover showed that (1) our targets for manzanita were severely over-optimist as manzanita cover did not surpass 6% in any plot at either site, and (2) ceanothus cover was well above the target values at the Flatwood site but well below the target values at Dana. Thus, the original objective

of the study is comprised and we acknowledge that a decision to retreat the plots, if made, needs to redefine the treatment comparisons and move forward with the knowledge that discrete treatments (0, 5, 15, 30, and 50% cover) are unattainable in a replicated study. Matt will present this information to the membership at the 2015 annual meeting and hopefully a decision can be made as to the future plans for the Agenda 2020 study

The year 2015 should be another busy one for the Co-op. New proposals are currently being submitted to the Co-op for funding consideration. Several funded study sites will have second year measurements taken. Based on the interest shown for field trips featuring Co-op study sites, another trip will be planned for 2015. Results from Co-op studies will continue to be presented at the Forest Vegetation Management Conference.

## 2014 MEMBERSHIP

### Land Manager Membership

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

### Associate Corporate Membership

Cal Forest Nurseries & Mountain Gate Gardens

### Affiliate Membership

Bayer CropScience  
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 11, 2014

The 2014 annual meeting was held at the Forest Service office in Redding, CA on March 11, 2014. Seventeen Co-op members and guests attended.

The 2013 Annual Report was the first item of business. Membership status was discussed. About 60% the members from 2013 have paid their 2014 dues. Those that have not paid to date indicated that their dues payments are on the way. Bayer CropScience is a new member in 2014. There are currently sixteen member organizations in the Co-op.

The next item of business was a discussion on the budget. The Co-op ended 2013 with a surplus of \$19,323. Dues received for 2014 at the time of the annual meeting totaled \$38,000, with another \$22,000 promised. To supplement the summary of the 2013 budget found in the Annual Report, spread sheets of the proposed budget/workload for 2014-2018 and the Co-op manager's time/contract costs through the same period were presented to the membership.

Plans for the 2014 Co-op field trip were discussed next. The membership definitely wanted a Co-op field trip in addition to the Weed Tour scheduled for July 15-16th. Several possible locations were suggested including a field trip centered around the Ponderosa Fire (Matrix and Pindar GT trials, Cajun's sediment study, and operational studies on SPI); a trip featuring research on

Challenge Experimental Forest (25 year old LTSP study, fuel reduction study, and a Nelder design study); and a field trip featuring research at Blacks Mountain Experimental Forest (20 year LTSP sites, variable density snag retention, aspen regeneration/restoration, and variable spacing reforestation with release). It was decided to send out a list of the possible sites for the field trip and let the membership decide which one would be selected (a field trip to Blacks Mountain was selected and scheduled for June 17<sup>th</sup>).

The next item on the agenda was funded proposal updates. Ed Fredrickson reported on results for Proposal 11-02 GF 9999, Proposal 11-03 Mat 28 Site Prep, Proposal 12-03 Pindar GT, Proposal 13-01 Matrix Site Prep, and Proposal 13-02 Pindar/Goaltender. A short summary on the progress of Proposal 12-02 Garden of Eden, Proposal 13-03 Ponderosa Remeasure, and Proposal 13-04 Study Plot Mapping completed this portion of the agenda. Executive summaries for the five studies updated by Ed plus the Garden of Eden proposal are found in the 2013 Annual Report. Progress reports on Proposals 13-03 and 13-04 are found in the Annual Report Summary.

Following the discussion of funded proposals, three new proposals were presented to the membership for possible funding in 2014. Ed Fredrickson presented

a proposal for an herbicide trial using Pindar over-the-top applications. Matt Busse presented a proposal for remeasuring the brush on the Agenda 2020 sites (Proposal 03-01) and based on the results from remeasuring the brush, determining what should be done with this study. Jeff Webster presented a proposal to collect/analyze soil samples from the Pondosa Study in order to help explain the results obtained during the 2013 remeasurement of this study.

After questions from members about the new proposals were addressed, it was decided that the proposals would be emailed to the voting membership for their ranking as to the order of funding.

The next item of business was to fill the vacant research representative position on the Steering Committee. Matt Busse and Jianwei Zhang volunteered to serve as co-representatives to fill this vacancy. The membership approved this action. The Steering Committee is now composed of four members.

Ryan DeSantis gave an update on the work he has done on the Co-op web site. It was decided by the membership to form a committee to determine how to proceed with this site. Scott Carnegie was "volunteered" to head this committee.

Mark Gray led a discussion on possible uses for the Glyphosate Study site (Proposal 07-

01). The membership decided that this item should be discussed at the upcoming Working Group II meeting scheduled for April 10<sup>th</sup>. Proposal options for this study site could be developed at this meeting and presented to the full membership for possible future funding.

Matt Busse discussed some of the possible avenues that could be used to get results from Co-op studies published. Some possibilities, other than conference proceedings, included Research Station Papers and articles in refereed journals. The membership was concerned about the proprietary nature of the data being generated. Since these studies were funded by private parties and not with public funding, the membership felt they should have exclusive rights to the resulting information. Partial data sets could continue to be presented at conferences without violating this principle.

The final item of business was a discussion of the Timmer/Jopson Study (Proposal 00-05) presented by Tom Young. Tom wants to thin the replication located on Fruit Growers' lands on the Klamath River. The membership agreed that this item should be developed further at the Working Group II meeting set for April 10<sup>th</sup>.

The meeting adjourned at this time.

## Working Group II Meeting April 10, 2014

Working Group II met at the Forest Service office in Redding on April 10, 2014. Five Co-op members were in attendance.

The first item of discussion was the status of the Timmer/Jopson Study (00-05). This study has replications on Fruit Growers, Soper Wheeler, and the former Boise Cascade lands. Tom Young would like to thin the replication on Fruit Growers' lands. This replication is fully stocked with all three species (ponderosa pine, white fir, and Douglas-fir) and the planted trees are very healthy. The Soper replication also has three species represented (ponderosa pine, white fir, and Douglas-fir). Only the ponderosa pine need thinning. The replication on former Boise Cascade lands has ponderosa pine only, all planted trees being very thrifty. Tom proposed thinning the replications on Fruit Growers to 16 X 16 and 20 X 20 foot spacings. The trees were originally planted at 10 foot by 10 foot spacing. The group decided to propose, to the full membership for possible funding, that all three study sites be measured prior to doing any thinning of the plots. This remeasurement would be done at the end of the 2014 growing season. After this data were analyzed, a second proposal would be developed for the thinning. All three species would be thinned at Fruit Growers; only the ponderosa pine would be thinned at Soper Wheeler. Since the lands formerly owned by Boise Cascade have changed ownership and the new owners are not members of the

Co-op, thinning is not proposed for this site. Estimated costs to do the 2014 measurements will be developed and a proposal be presented to the membership.

The second item discussed was the status of the Slow Release Study (02-02). This study has replications on Beaty, Soper Wheeler, and C & D Lumber lands. All sites tested ponderosa pine and Douglas-fir; Soper Wheeler also tested sugar pine. The last measurements taken on this study were the fifth year measurements taken in the fall of 2008. The Working Group wondered if there had been significant differences in treatments at this 2008 measurement period and if so, should the study be remeasured again. It was decided to review the results of the 2008 measurements for significant results and decide if the study merited another measurement. This review was done on April 14<sup>th</sup> and revealed that, although there were some significant differences showing in 2008, the differences were slight and only between the extreme treatments (ie. highest fertilization rate vs lowest fertilization rate). Another measurement is probably not warranted at this time.

The next item concerned the Glyphosate Study (07-01) on Sierra Pacific lands. The group wondered how the various levels of weed cover affected conifer growth. As no conifer measurements were taken on this study (damage was noted), the group's question could not be answered by this study. It was decided to ask Ed Fredrickson

if some of the non-Co-op studies he has established might be able to provide information on this question.

The next question concerned "how do you treat gall rust infected stands?". Jianwei Zhang reported that a graduate student had done some work on this subject on some of the Garden of Eden sites and at Challenge Experimental Forest a few years ago. He thought a publication had resulted from this work and would try to locate the publication and send it out to the group. This follow-up was done a few days later. If the group expressed continued interest in this subject after reading the publication, a literature review could be done on the subject.

Tom Young discussed a project on Fruit Grower's land in which seedlings grown in Styro 2 containers were out-planted in July. Survival was exceptional. Tom proposed that if this could be done on an operational basis, seedlings could be produced quickly at a nursery in order to respond to an urgent need for seedlings, such as after a wild fire. Tom was going to check with Tom Jopson at Cal Forest Nursery, where the seedlings were raised, to see if this is feasible.

The last item brought before the group concerned Bill Oliver's 1970s study of inter-species competition. This study is located on Challenge Experimental Forest. Jianwei proposed remeasuring the study. There seemed to be little interest from the group in this proposal.

The meeting adjourned at this time.

Sierra Cascade Intensive Forest Management Research Cooperative Proposal 13-02  
Pindar GT/GoalTender “Over the Top”

Principal Investigator: Ed Fredrickson

Title: Broadcast Release “Over the Top” with Pindar GT and GoalTender

Year Approved: 2013

**Executive Summary:**

Over the last several years, there has been a concerted effort to find a residual site preparation chemical that not only provides effective vegetation control but also provides better conifer tolerance to hexazinone intolerant conifers such as Douglas-fir, white fir, sugar pine, and incense cedar. Much progress has been made, a large part of which has been a direct result of this cooperative. As of January 26, 2013, Milestone has been registered in California forestry by Dow AgroSciences and they are currently evaluating three other alternative site preparation chemicals: Pindar GT (oxyfluorfen + penoxulam), GoalTender (oxyfluorfen), and Dimension (dithiopyr). Pindar GT and GoalTender are two of the most promising residual chemicals to be tested to date. Several trials have been established to evaluate pre-plant site preparation efficacy and conifer tolerance. The results to date have been extremely good. Both products show excellent conifer tolerance and provide comparable vegetation control to the operational standard of Velpar DF.

Often it is not logistically possible to apply residual herbicides before planting occurs. Velpar DF applications have the advantage of being able to be applied pre or post

planting without added risk of conifer injury. It would be highly advantageous for any new residual chemistry to have the same flexibility. Goal 2XL (GoalTender’s predecessor) has been tested over many conifer species in forest nurseries with excellent tolerance, but neither GoalTender or Pindar GT has been tested over seedlings under field conditions. This proposal is for a series of trials that would evaluate the conifer tolerance associated with applications broadcast “over the top” of newly planted conifer seedlings in the spring and fall with Pindar GT and GoalTender,

This trial will be established in a freshly logged clearcut or wildfire that was slated for planting in the spring of 2013. The selected unit should not have had any residual chemical treatment to date. This trial will be completely randomized with four replications per treatment. Plot size will be 12 feet by 36.3 feet (0.01 acres). Plots would be established and marked prior to planting. All plots would be planted prior to application in the spring of 2013 with 15 trees each of ponderosa pine, Douglas-fir, and white fir. Five trees of each species would be designated as “dig” trees for destructive sampling to evaluate root growth. The remaining ten trees would be

measurement trees. The first ten trees by species in each plot would be initially measured for caliper and height at time of planting.

Two sets of plots would be established on the same site, one for a spring application and one for a fall application (all plots would be planted in the spring of 2013). Spring applications would occur within several weeks of planting. The fall timing would occur in October 2013. All applications would be at ten gallons per acre and applied with a CO<sub>2</sub> powered backpack sprayer with a twelve foot boom at 30 psi. The sprayer would be calibrated prior to application and each plot would be sprayed with one timed pass.

Treatments will include: 3 pts. Pindar GT per acre applied in the spring and fall; 6 pts. Pindar GT per acre applied in the spring and fall; 3 pts. GoalTender per acre applied in the spring and fall; 6 pts. GoalTender per acre applied in the spring and fall; and control.

Evaluations will occur in the fall of 2013, 2014, and 2015 (fall timing only in 2015). Only spring applications would be evaluated in the fall of 2013. Evaluations for the spring applications in the fall of 2013 would consist of percent bare ground, percent cover by individual competitive plant species and total percent cover to access vegetation control. The five trees designated for destructive sampling would be excavated and roots evaluated for number of new roots and root length. The measurement trees would be evaluated for

percent survival, percent brownout, and vigor. No caliper or height measurements would be taken in 2013. Both spring and fall timings would be evaluated in the fall of 2014 including all ratings taken in the fall of 2013, plus caliper, height, and stem volume for the spring timing only for all ten measurement trees per species. Only the destructive sampling trees from the 2013 fall application would be evaluated for root effects in the fall of 2014. All previous evaluation criteria plus caliper, height, and stem volume would be evaluated in the fall of 2015 for the fall timing only.

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

**2013:** A trial was established in 2013 on property owned and managed by Sierra Pacific Industries on the Pondosa Fire near Manton, CA. The objective of the trial was to evaluate the "over the top" conifer tolerance of Douglas-fir, white fir, and ponderosa pine to applications of Pindar GT and GoalTender at a standard and 2X standard rate.

All plots were planted on March 25<sup>th</sup> with 15 trees each of Douglas-fir, white fir, and ponderosa pine. Ponderosa pine were Styro 5 and all fir were Styro 8 container stock from Cal Forest Nursery. Ten of the 15 trees planted are measurement trees and the remaining five trees were slated as "dig" trees to evaluate root growth based on treatment.

Two spray timings were utilized for this trial consisting of a spring and fall application. The spring timing was applied on March 26<sup>th</sup> one day after planting. The fall application was on October 1st. Treatments included Pindar GT and GoalTender at 3 and 6 pints per acre at ten gallons per acre spray volume for both timings. Treatments also included a non-treated control. Due to the lateness of the fall treatment, data were only collected in 2013 for the spring application timing.

Evaluations were done on August 13<sup>th</sup>. Evaluations included percent bare ground, percent cover by species, conifer survival, conifer percent brownout, and number of new roots and root length for each conifer species.

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-Kuels least significant difference procedure. Orthogonal contrasts were used to make specific comparisons among treatments.

Seedling survival or percent brownout did not significantly differ by treatment for any species in the trial. Therefore, it can be inferred that applications of either Pindar GT or GoalTender had no effect on seedling health. Survival was greater than 96 percent for all species and percent brownout was under 10 percent. The only brownout that occurred on site was due to a May frost, and it was relatively minor (Table 2).

The main effect of treatment was not significant regarding the number of new roots or root length (see Appendix 1, page 11 for conifer damage and root codes). Orthogonal contrasts indicated that the combined treatments were not significantly different from the controls. Multiple comparison procedures also failed to show any significant differences between treatments (Table 3).

Treatment was a significant factor regarding vegetation control. This site was heavily dominated by squaw carpet which had not yet germinated at the time of the spring application. Both Pindar GT and GoalTender inhibited the germination of squaw carpet seedlings, but Pindar GT provided significantly better control than GoalTender ( $P \leq 0.05$ ). All Pindar GT treatments had significantly more bare ground and less squaw carpet cover than the control. There was no significant difference in percent bare ground between Pindar GT and GoalTender although Pindar GR provided slightly more bare ground. Applications of Pindar GT at either rate provided significantly more control of squaw carpet than the lower rate of

GoalTender. Squaw carpet control with the low rate of GoalTender was not significantly different than the control. There was no significant difference between the low and high rates within either the Pindar GT or GoalTender treatments (Table 1).

This trial provided several important observations. The conifer safety of Pindar GT and GoalTender appears to be excellent either as a pre-plant site preparation treatment or as an “over the top” release treatment. Neither the number of new roots or root length was affected by any treatment. Probably the most unexpected result was the inhibition of squaw carpet seedling germination with Pindar GT. GoalTender suppressed squaw carpet germination somewhat, but Pindar GT virtually stopped it altogether. This has significant implications to any vegetation management strategy.

**2014:** Second year measurements were taken after the end of the 2014 growing season. See the analysis for the Matix study for analysis process.

At the end of the second growing season, distinct differences in vegetation control were apparent (Table 1). Spring treatments with Pindar GT provided significantly less total cover than any of the fall treatments and non-treated controls. The highest rate of Pindar GT in the spring had significantly less total cover than the low rate and either rate of GoalTender in the spring. The high rate of GoalTender in the spring provided significantly less total cover than either rate of GoalTender in the fall. For the

GoalTender treatments, only the high rate in the spring had significantly less total cover than the non-treated control.

All spring Pindar GT treatments provided significantly more bare ground than the non-treated controls and the fall GoalTender treatments. Only the high rate of Pindar GT in the spring had significantly more bare ground than either rate of Pindar GT in the fall. Although Pindar GT treatments had more bare ground than GoalTender treatments in both the spring and fall, the differences were not significant within each timing. Low and high rates of either Pindar GT or GoalTender were not significantly different within each timing regarding bare ground.

The most important finding regarding vegetation control in this study was the ability of Pindar GT to control squaw carpet germination as a pre-emergent application. Either rate of Pindar GT in the spring had significantly less squaw carpet cover than any of the fall treatments or non-treated controls, as well as the low rate of GoalTender in the spring. The high rate of Pindar Gt had significantly less squaw carpet cover than all treatments. Rate was not a significant factor for squaw carpet cover for either product or timing. Fall applications with either Pindar GT or GoalTender did not significantly differ from the non-treated controls regarding squaw carpet cover. Some degree of squaw carpet control was seen with GoalTender treatments in the spring, but not to the degree of Pindar GT treatments. The high rate of GoalTender in the spring had

significantly less squaw carpet cover than either of the rates in the fall.

Manzanita cover did not significantly differ between treatments, although there was less cover in spring treatments compared to fall or the non-treated controls. There was very little annual grass on this site. All treatments had less annual grass than the non-treated controls, but only the spring GoalTender treatments and the high rates of either GoalTender or Pindar GT in the fall were significantly different. In reality, there was very little difference in annual grass control between any of the Pindar GT or GoalTender treatments (0.3%). The differences that were significant are most likely due to cover values being zero with no variance.

Ponderosa pine survival did not significantly vary among treatments (Table 2). Visual brownout ratings were also not significantly different among treatments. Damage ratings showed a couple of significant differences, but these can be attributed to zero ratings with no variation around the mean. In reality, the differences were minimal and most likely an artifact.

Ponderosa pine caliper, height and stem volume had significant differences among treatments (Table 4). In general, all herbicide treatments tended to have larger calipers, heights, and stem volumes than the non-treated controls with the exception of the high GoalTender rate in the fall which had the smallest trees. This treatment had significantly smaller caliper, shorter heights and less stem volume than either

GoalTender rate in the spring and had significantly smaller caliper than the high rate of Pindar GT in the spring. Tree size was virtually identical for all fall treatments compared to the non-treated controls due to lack of vegetation control. Overall, the largest pine occurred in the spring GoalTender treatments, followed by the spring Pindar GT treatments. Both were larger than the non-treated controls, but not significantly. No herbicide treatments were significantly larger than the non-treated controls.

Douglas-fir survival was not significantly affected by treatment (Table 2). Both rates of Pindar GT and the low rate of GoalTender in the spring had significantly less brownout and lower damage ratings than all other treatments. The high rate of GoalTender in the spring also had a significantly lower damage rating than the non-treated control. This is primarily due to greater levels of competition in the fall treated plots and the non-treated controls.

Douglas-fir seedlings treated with Pindar GT at either rate in the spring or GoalTender at the highest rate in the spring had significantly larger caliper and stem volume than either the non-treated control or the high rate of GoalTender in the fall (Table 4). Height was not as affected. Only the high rate of GoalTender had significantly taller trees than the non-treated control. No other significant differences existed.

White fir survival was not significantly affected by treatment, however brownout and damage rating were (Table 3). Spring

treatments of either Pindar GT or GoalTender at any rate had significantly less brownout and lower damage ratings than all other treatments with the exception of the low rate of GoalTender in the spring which was not significantly different from the low rate of Pindar GT in the fall regarding the damage rating.

For white fir, none of the spring treatments differed from each other regarding caliper, height or stem volume, although the GoalTender treated trees tended to be larger (Table 5). Caliper, height and stem volume did not differ significantly in the fall treatments from the non-treated controls. The high rate of Pindar GT and both rates of GoalTender in the spring had significantly larger caliper than the non-treated control. The high rate of GoalTender had the largest caliper and was also significantly different from the high rate of Pindar GT and both rates of GoalTender in the fall. The high rate of Pindar GT in the spring also had significantly larger caliper than the high rates of Pindar GT or GoalTender in the fall.

The tallest trees were in the spring GoalTender treatments and were significantly taller than all of the fall treatments and the non-treated controls, with the exception of the high spring GoalTender rate not being significantly different from the low rate of GoalTender in the fall. Height did not significantly differ between treatments within spring or fall application timings.

Stem volume was largest in the spring with the high rate of GoalTender and was

significantly larger than the high rate of Pindar GT and both rates of GoalTender in the fall as well as the non-treated controls. The high rate of Pindar GT and both rates of GoalTender in the spring had significantly larger stem volumes than the non-treated controls. No differences between treatments existed within spring or fall application timings.

In general, pre-emergent applications in the spring were superior to fall applications with both Pindar GT and GoalTender for vegetation control, but especially for Pindar GT. The major weed controlled in the spring was squaw carpet as the applications were made prior to squaw carpet emergence. By the fall treatments, squaw carpet had emerged and neither product was able to control it. While not all comparisons between Pindar GT and GoalTender applications in the spring were significantly different, Pindar GT had more bare ground and less total cover than the GoalTender treatments. Based on results here, Pindar GT should be applied prior to woody brush germination if used alone to be most effective. Established woody brush may require the addition of another herbicide for effective control.

Conifer tolerance was excellent in both the spring and fall. Trees in fall treated plots were smaller compared to spring treatments due to the increase in competition. This was not an herbicide effect. However, the fact that trees treated with GoalTender in the spring were larger than trees treated with Pindar GT suggests that the penoxsulam in Pindar GT may cause some growth

inhibition, although the trees were still two to three times as large as the non-treated control trees. This trial showed that over the top applications of either product are safe on ponderosa pine, Douglas-fir, or white fir.

The 2014 measurements/analysis are the final work on this proposal. The complete report and all supporting data are available at the Co-op's office in Redding.

Treatment	% Bare Ground	% Total Cover	Squaw Carpet	Greenleaf Manzanita	Annual Grass
3 pt Pindar GT Spring	70.0 (7.4) ab	35.8 (9.4) c	22.5 (6.0) cd	0.8 (0.5) a	0.2 (0.2) a
6 pt Pindar GT Spring	85.0 (2.0) a	17.0 (1.5) d	13.8 (2.4) d	0.5 (0.3) a	0.2 (0.2) a
3 pt GoalTender Spring	52.5 (4.8) abc	52.8 (3.9) abc	47.5 (4.8) ab	1.0 (0.4) a	0 (0) b
6 pt GoalTender Spring	60.0 (3.5) abc	45.8 (5.4) bc	30.0 (5.0) bc	0.8 (0.8) a	0 (0) b
3 pt Pindar GT Fall	41.2 (5.9) bc	64.0 (6.9) ab	51.2 (3.1) ab	7.0 (4.4) a	0.2 (0.2) a
6 pt Pindar GT Fall	40.0 (5.8) bc	63.2 (6.5) ab	51.2 (7.2) ab	2.2 (0.6) a	0 (0) b
3 pt GoalTender Fall	33.8 (2.4) c	71.5 (1.9) a	66.2 (2.4) a	3.0 (0) a	0.2 (0.2) a
6 pt GoalTender Fall	32.5 (6.6) c	74.8 (6.1) a	60.0 (7.4) a	2.5 (1.0) a	0 (0) b
Control	36.2 (7.5) c	73.8 (7.0) a	62.5 (8.5) a	2.2 (0.2) a	3.0 (2.3) a

Table 1. Year 2 percent bare ground and percent cover means for the 2013 Pindar GT and GoalTender over the top trial. Standard errors are in parenthesis. Means with the same letter are not significantly different ( $P \leq 0.05$ ).

Treatment	Ponderosa Pine			Douglas-Fir		
	% Surv	% Br Out	Damage	% Surv	% Br Out	Damage
3 pt Pindar GT Spring	97.5(2.5)a	0 (0) a	0 (0) b	97.5 (2.5) a	0 (0) b	0 (0) c
6 pt Pindar GT Spring	100 (0) a	0 (0) a	0 (0) b	97.5 (2.5) a	0 (0) b	0 (0) c
3 pt GoalTender Spring	100 (0) a	0 (0) a	0 (0) b	92.5 (4.8) a	0 (0) b	0 (0) c
6 pt GoalTender Spring	100 (0) a	0 (0) a	0 (0) b	95.0 (5.0) a	1.2 (1.2) a	0.2 (0.2) b
3 pt Pindar GT Fall	100 (0) a	2.5 (1.4) a	0.5 (0.3) a	97.5 (2.5) a	3.8 (2.4) a	1.0 (0.7) ab
6 pt Pindar GT Fall	100 (0) a	0 (0) a	0 (0) b	75.0 (6.5) a	6.2 (2.4) a	2.8 (0.9) ab
3 pt GoalTender Fall	100 (0) a	0 (0) a	0 (0) b	87.5(12.5) a	8.8 (7.2) a	2.2 (1.2) ab
6 pt GoalTender Fall	95.0(5.0)a	2.5 (1.4) a	1.0 (0.4) a	80.0 (8.2) a	5.0 (2.0) a	1.2 (0.5) ab
Control	95.0(5.0)a	1.2 (1.2) a	0.5 (0.3) b	82.5(11.1) a	13.8 (9.0) a	3.2 (1.7) a

Table 2. Ponderosa pine and Douglas-fir 2nd year percent survival and brown out, and damage rating means for the 2013 Pindar GT and GoalTender over the top trial. Standard errors are in parenthesis. Means with the same letter are not significantly different ( $P \leq 0.05$ ). Damage ratings are on a scale from 0 to 10 with 0 being no damage and 10 is dead.

Treatment	White Fir		
	% Surv	% Br Out	Damage
3 pt Pindar GT Spring	100 (0) a	0 (0) b	0 (0) c
6 pt Pindar GT Spring	97.5 (2.5) a	0 (0) b	0 (0) c
3 pt GoalTender Spring	90.0 (4.1) a	0 (0) b	0.2 (0.2) b
6 pt GoalTender Spring	95.0 (2.9) a	0 (0) b	0 (0) c
3 pt Pindar GT Fall	90.0 (7.1) a	10.0 (4.1) a	1.8 (0.8) ab
6 pt Pindar GT Fall	77.5 (8.5) a	12.5 (4.8) a	3.2 (1.0) a
3 pt GoalTender Fall	75.0 (13.2) a	21.2 (14.9) a	3.2 (1.7) a
6 pt GoalTender Fall	85.0 (6.5) a	17.5 (10.1) a	3.5 (1.6) a
Control	82.5 (8.5) a	31.2 (15.1) a	4.5 (1.6) a

Table 3. White Fir 2nd year percent survival and brown out, and damage rating means for the 2013 Pindar GT and GoalTender over the top trial. Standard errors are in parenthesis. Means with the same letter are not significantly different ( $P \leq 0.05$ ). Damage ratings are on a scale from 0 to 10 with 0 being no damage and 10 is dead.

Treatment	P Pine		P Pine Stem	D Fir		D Fir
	Caliper mm	Height cm	Vol cm <sup>3</sup>	Caliper mm	Height cm	Vol cm <sup>3</sup>
3 pt Pindar GT Spring	12.3 (0.7) ab	38.8 (2.1) ab	65.0 (7.6) ab	8.2 (0.4) a	36.1 (2.5) ab	27.1 (3.7) a
6 pt Pindar GT Spring	13.1 (0.7) a	38.8 (1.5) ab	72.1 (6.7) ab	8.2 (0.1) a	32.9 (1.0) ab	24.4 (1.8) a
3 pt GoalTender Spring	13.9 (0.4) a	44.9 (1.9) a	94.0 (9.6) a	7.6 (0.3) ab	34.4 (0.9) ab	22.5 (1.9) ab
6 pt GoalTender Spring	13.2 (1.3) a	44.3 (3.8) a	85.6 (22.5) a	7.7 (0.8) a	36.7 (3.3) a	28.3 (8.9) a
3 pt Pindar GT Fall	10.3 (0.9) ab	36.1 (1.9) ab	43.2 (7.8) ab	6.4 (0.4) ab	31.0 (0.8) ab	14.5 (2.1) ab
6 pt Pindar GT Fall	10.5 (1.3) ab	35.4 (2.9) ab	50.7 (16.6) ab	6.4 (0.9) ab	30.5 (3.7) ab	16.5 (6.4) ab
3 pt GoalTender Fall	10.5 (0.7) ab	37.6 (2.0) ab	44.0 (6.7) ab	6.1 (0.06) ab	30.7 (0.8) ab	13.4 (0.9) ab
6 pt GoalTender Fall	8.7 (0.3) b	32.8 (0.6) b	28.1 (2.4) b	5.5 (0.2) ab	30.1 (1.2) ab	9.7 (0.9) b
Control	9.2 (0.6) ab	32.7 (2.0) ab	31.9 (7.4) ab	5.3 (0.5) b	27.4 (2.8) b	9.1 (2.3) b

Table 4. Ponderosa pine and Douglas-fir 2nd year caliper, height and stem volume means for the 2013 Pindar GT and GoalTender over the top trial. Standard errors are in parenthesis. Means with the same letter are not significantly different ( $P \leq 0.05$ ).

Treatment	White Fir Caliper mm	White Fir Height cm	White Fir Vol cm <sup>3</sup>
3 pt Pindar GT Spring	6.8 (0.3) abcd	24.7 (1.4) abc	12.3 (1.0) abc
6 pt Pindar GT Spring	7.2 (0.7) ab	24.1 (2.3) abc	14.7 (4.0) ab
3 pt GoalTender Spring	7.1 (0.3) abc	27.9 (1.3) a	16.5 (2.4) ab
6 pt GoalTender Spring	7.4 (0.2) a	26.8 (1.5) ab	16.8 (1.8) a
3 pt Pindar GT Fall	6.1 (0.4) abcd	24.2 (1.6) c	9.8 (1.7) abc
6 pt Pindar GT Fall	5.5 (0.3) cd	21.2 (2.3) c	7.3 (1.5) c
3 pt GoalTender Fall	5.6 (0.4) bcd	22.9 (2.7) bc	8.7 (2.10) bc
6 pt GoalTender Fall	5.4 (0.2) cd	21.6 (1.9) c	7.2 (0.7) c
Control	5.0 (0.3) d	21.3 (1.4) c	6.3 (1.6) c

Table 5. White fir 2nd year caliper, height and stem volume means for the 2013 Pindar GT and GoalTender over the top trial. Standard errors are in parenthesis. Means with the same letter are not significantly different ( $P \leq 0.05$ ).

Sierra Cascade Intensive Forest Management Research Cooperative Proposal 13-01  
Matrix SG

Principal Investigator: Ed Fredrickson

Title: Pre-Plant Site Preparation with Matrix SG (Rimsulfuron)

Year Approved: 2013

**Executive Summary:**

One of the main priorities the last several years has been to find an alternative site preparation treatment for conifers intolerant to hexazinone. Many new and existing herbicides have been tested with mixed results. One product manufactured by DuPont that may have considerable potential is Matrix SG. Matrix SG is in the sulfonyleurea family of herbicides and is primarily an ALS inhibitor, an enzyme necessary for plant growth. Matrix has been successfully used as a bare ground herbicide in non-crop applications and has tolerance on fruit, grapes, and nut crops. It is also labeled for range and pasture applications to control invasive species. Bare ground applications have been extremely successful with Matrix alone or in combination with Telar XP (chlorsulfuron), Milestone (aminopyralid), and Oust XP (sulfometuron). Given the tolerance to fruit and nut crops along with grapes, Matrix may provide adequate tolerance to conifers.

It also has the benefit of being an extremely low use rate product, typically in the two to four ounce per acre range. It has a very favorable toxicity profile with oral LD-50 values greater than 5000 mg/kg of body weight in rats and very little toxicity to birds, fish or aquatic invertebrates. It has a

moderately short half- life, generally around 30 days.

This proposal is for a trial that would evaluate the potential of Matrix SG alone and in combination for pre-plant site preparation applications on ponderosa pine, Douglas-fir, and white fir with spring and fall applications.

This trial would be established on a recent clearcut or wildfire that was ready for planting but had not been previously treated with any residual herbicides. The site for this trial should be on the west side of the Cascade Range on good site ground. Preferably, high site two or better. The preferred timing for this site would be a spring treatment followed by a spring plant.

This trial will be completely randomized with four replications per treatment. Plot size will be 12 feet by 36.3 feet (0.01 acres). The trial would be sprayed in the spring of 2013 and planted shortly after. All plots would be planted with 15 trees each of ponderosa pine, Douglas-fir, and white fir. Five trees of each species would be designated as "dig" trees to evaluate root growth. The remaining ten trees would be measurement trees. The first ten trees by

species in each plot would be initially measured for caliper and height at planting.

All applications will be at ten gallons per acre and applied with a CO<sub>2</sub> powered backpack sprayer with a twelve foot boom. The sprayer will be calibrated prior to application and each plot will be sprayed with one timed pass.

Treatments will include: 2 oz/acre, 4 oz/acre, or 8 oz/acre Matrix SG; 1.33 lbs/acre Velpar DF with 2 or 4 oz/acre Matrix SG; 1.33 lbs/acre Velpar DF; 3.33 lbs/acre Velpar DF; 7 oz/acre Milestone; 4 oz/acre Matrix SG + 7 oz/acre Milestone; and control. (Due to heavy herbaceous cover at the time of treatment, 1.5 quarts Accord XRT II were added to all treatments to provide burn down to enable evaluation of the residual control of the herbicides tested. An Accord XRT II control was also added to the trial).

Evaluations will occur in the fall of 2013 and the fall of 2014. Evaluations for the spring timing in the fall of 2013 and the fall of 2014 will consist of percent bare ground, percent cover by species, and total percent cover to assess vegetation control. The five trees designated for digging will be excavated and roots evaluated for number of new roots and root length. The measurement trees will be evaluated for percent survival, percent brownout, and vigor. No caliper or height measurements will be taken in 2013. The trial will be evaluated at the end of the second growing season and include all previous evaluation criteria (except "dig" tree data) plus caliper,

height, and stem volume for all ten measurement trees per species.

**2013:** A trial was installed on property owned and managed by Sierra Pacific Industries on March 18<sup>th</sup> to evaluate DuPont's Matrix SG herbicide alone and in combination with Velpar DF and Milestone for conifer site preparation. The site is located approximately three miles southwest of Round Mountain, California.

Plots were planned to be planted with 15 trees each of ponderosa pine, Douglas-fir, and white fir. Due to a shortage of white fir, only 12 white fir were planted per replication. Trees were planted on March 28<sup>th</sup>. Ten trees were marked for measurement and the remainder were slated as "dig" trees to evaluate root growth.

Evaluations (August 20<sup>th</sup>) included percent bare ground, percent cover by species, conifer survival, conifer percent brownout, conifer damage rating, number of new roots and root length for each conifer species.

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.

Seedling survival, percent brownout, or damage rating did not significantly differ by treatment for any species tested in this trial. Conifer safety was high for all treatments tested. Ponderosa pine and Douglas-fir had excellent survival overall. Survival was lower for white fir, but there was high variability among blocks (Table 2).

Treatment variables also did not affect number of new roots or length of new roots (see Appendix 1 page 11 for conifer damage and root codes). Number of new roots could not be analyzed due to no variability between observations (all seedlings had the maximum root number rating). No herbicide effect was apparent on any root observations (Table 3).

Vegetation control was very good for all treatments (Table 1). No significant differences existed for percent bare ground between herbicide treatments, but all herbicide treatments had significantly more bare ground than the control ( $P \leq 0.05$ ). All treatments controlled other annual grasses, rattail fescue, and hedge parsley significantly more than the controls, with the exception of the 7 ounce Milestone treatment for rattail fescue which was not significantly different than the control.

Overall, conifer tolerance was exceptional for all treatments. White fir mortality did not appear to be related to treatment. It was difficult to assess how much Matrix contributed to vegetation control at this 2013 rating. Treatments with Matrix only provided slightly more control than the Accord XRT II only treatment, but that was the case for the operational standard of Velpar DF as well. It appears the initial knock down from the addition of Accord XRT II to all treatments held the site fairly well.

**2014:** Second year measurements were taken after the end of the 2014 growing season and were the same as those taken in 2013 except no root volumes were done and all trees were measured for caliper and height and stem volumes were calculated.

Second year data were analyzed using SAS statistical software. Vegetation and seedling data were analyzed using analysis of variance. Treatments were compared using a Tukey's test with adjusted probabilities. Initial seedling size parameters were used as covariates within the ANOVA'S for height, caliper, and volume. Analyses for size were weighted by the number of surviving seedlings in each plot. Least squared means for size included adjustments for the covariates, which resulted in some differences from the raw data means. Analyses utilized PROC MEANS, PROC MIXED and PROC GLIMMIX in SAS. PROC GLIMMIX was used when variances were unequal, and either the Poisson or gamma distribution was used. Where statements are made regarding statistically

significant differences in this document, the alpha level is  $P \leq 0.05$ .

By the end of the second growing season, no significant differences among treatments existed for bare ground (Table 1). Although not significant, treatments that contained Velpar DF and the Velpar DF operational standard had the greatest amount of bare ground. Treatments with Matrix alone at any rate had bare ground values similar to those of the Accord XRT II controls. Most treatments still had more bare ground than the non-treated controls.

There were a few significant differences regarding total cover. The Velpar DF operational standard had significantly less total cover than either the non-treated control or the middle rate of Matrix alone. No other differences existed.

No significant difference existed among treatments for percent cover of hedge parsley, rose clover or dandelion. Rat tail fescue had significantly less cover in the Velpar DF operational standard than all other treatments.

While conifer survival tended to be higher in the herbicide treatments, no significant differences among treatments existed for any species (Table 2). Survival for the white fir was poor in general and not related to treatment effects. Visual damage ratings also showed no significant differences among treatments for ponderosa pine and Douglas-fir. The mid rate of Matrix had a significantly lower damage rating than all other treatments, but the difference is slight

and most likely the result of having a zero value with no variation. It is most likely an artifact.

Caliper, height or stem volume did not significantly vary among treatments (Tables 3 and 4). While trees in the herbicide treatments tended to be larger than the non-treated and mostly larger than the Accord XRT II controls, high variability from browse coupled with initial tree size being a significant co-variant inhibited any significance.

Overall, treatments with Matrix as a site preparation tool appeared weak in this study. Even the first year results showed only slight increases in vegetation control over the Accord XRT II only treatment. The only Matrix treatments that showed some potential were those that were tank mixed with a low rate of Velpar DF. However, even those treatments did not differ from the low rate of Velpar DF alone.

Conifer tolerance to Matrix was good overall, but based on the poor vegetation control on this site, it may have little relevance.

The 2014 measurements/analysis are the final work on this proposal. The complete report and all supporting data are available at the Co-op's office in Redding.

Treatment	% Bare Ground	% Total Cover	% Cover Hedge Parsley	% Cover Rattail Fescue	% Cover Dandelion	% Cover Rose Clover
2 oz Matrix	61.2 (15.2) a	45.0 (20.4) ab	6.8 (6.1) a	16.5 (8.8) a	8.2 (4.4) a	4.2 (3.6) a
4 oz Matrix	46.2 (6.6) a	62.2 (7.3) a	17.5 (4.8) a	10.8 (5.8) a	15.0 (3.5) a	7.5 (1.4) a
8 oz Matrix	47.5 (22.1) a	62.8 (26.6) ab	11.2 (8.0) a	22.8 (13.5) a	14.0 (6.7) a	6.5 (2.0) a
2 oz Matrix + 1.3 lb Vel	76.2 (7.5) a	28.2 (9.1) ab	5.0 (2.9) a	6.8 (4.5) a	2.5 (1.4) a	8.2 (3.9) a
4 oz Matrix + 1.3 lb Vel	78.0 (8.2) a	24.0 (8.8) ab	2.2 (1.0) a	8.8 (4.3) a	2.5 (1.0) a	1.2 (0.8) a
4 oz Matrix + 7 oz Milestone	51.2 (17.8) a	51.2 (16.0) ab	17.0 (5.6) a	7.0 (3.3) a	11.2 (5.5) a	6.2 (3.1) a
1.33 lb Velpar DF	76.2 (4.3) a	25.5 (5.5) ab	5.8 (1.5) a	3.8 (2.4) a	2.5 (1.0) a	6.0 (3.0) a
7 oz Milestone	63.8 (17.7) a	39.5 (17.9) ab	10.0 (8.4) a	16.2 (9.0) a	2.0 (1.2) a	1.8 (1.2) a
3.33 lb Velpar DF	89.2 (4.0) a	12.5 (4.9) b	5.0 (2.9) a	0 (0) b	1.0 (0.6) a	1.2 (1.2) a
1.5 qts Accord XRT II	51.2 (17.1) a	50.0 (16.2) ab	4.2 (0.8) a	15.0 (6.1) a	12.8 (6.5) a	3.8 (3.8) a
Control	32.5 (11.3) a	79.8 (15.7) a	4.8 (1.9) a	28.8 (10.5) a	28.0 (15.7) a	5.0 (2.0) a

Table 1. 2nd year percent bare ground and percent cover means for the 2013 spring Matrix site preparation trial. Standard errors are in parenthesis. Means with the same letter are not significantly different ( $P \leq 0.05$ ).

Treatment	Ponderosa Pine		Douglas-Fir		White Fir	
	% Survival	Damage Rating	% Survival	Damage Rating	% Survival	Damage Rating
2 oz Matrix	90.0 (10.0) a	3.0 (1.7) a	72.5 (8.5) a	1.2 (0.6) a	30.0 (12.9) a	2.8 (2.4) a
4 oz Matrix	100 (0) a	0.2 (0.2) a	80.0 (4.1) a	0.2 (0.2) a	45.0 (5.0) a	0 (0) b
8 oz Matrix	92.5 (2.5) a	1.2 (0.9) a	70.0 (14.7) a	0.2 (0.2) a	37.5 (16.5) a	2.8 (2.4) a
2 oz Matrix + 1.3 lb Vel	87.5 (7.5) a	1.8 (1.0) a	85.0 (6.5) a	0.8 (0.5) a	30.0 (10.8) a	0.5 (0.3) a
4 oz Matrix + 1.3 lb Vel	100 (0) a	1.0 (1.0) a	90.0 (10.0) a	0.8 (0.8) a	30.0 (12.2) a	2.5 (2.5) a
4 oz Matrix + 7 oz Milestone	100 (0) a	0.2 (0.2) a	90.0 (5.8) a	0.2 (0.2) a	55.0 (15.5) a	1.0 (0.7) a
1.33 lb Velpar DF	100 (0) a	1.8 (1.4) a	85.0 (6.5) a	0.2 (0.2) a	67.5 (14.9) a	0.2 (0.2) a
7 oz Milestone	100 (0) a	1.5 (0.6) a	85.0 (8.7) a	0.5 (0.3) a	80.0 (5.8) a	0.2 (0.2) a
3.33 lb Velpar DF	97.5 (2.5) a	1.5 (1.5) a	82.5 (6.3) a	0.5 (0.5) a	40.0 (12.2) a	0.5 (0.5) a
1.5 qts Accord XRT II	92.5 (4.8) a	1.5 (0.9) a	92.5 (2.5) a	0.5 (0.3) a	75.0 (6.5) a	1.0 (0.4) a
Control	90.0 (10.0) a	3.8 (1.6) a	65.0 (8.7) a	1.0 (0.4) a	50.0 (18.3) a	1.0 (0.6) a

Table 2. 2nd year ponderosa pine, Douglas-fir and white fir survival and damage ratings for the 2013 spring Matrix site preparation trial. Standard errors are in parenthesis. Means with the same letter are not significantly different ( $P \leq 0.05$ ). Damage ratings are on a scale from 0 to 10 with 0 being no damage and 10 is dead.

	P Pine	P Pine	P Pine Stem	D Fir	D Fir	D Fir
Treatment	Caliper mm	Height cm	Vol cm <sup>3</sup>	Caliper mm	Height cm	Vol cm <sup>3</sup>
2 oz Matrix	8.6 (2.2) a	35.3 (6.0) a	42.0 (21.4) a	6.2 (1.2) a	32.8 (4.0) a	16.2 (6.4) a
4 oz Matrix	11.4 (1.6) a	44.7 (4.9) a	74.3 (23.5) a	7.5 (0.2) a	39.6 (1.4) a	26.3 (2.0) a
8 oz Matrix	9.3 (2.3) a	41.0 (5.0) a	52.8 (25.6) a	7.0 (1.2) a	35.7 (5.8) a	25.0 (9.1) a
2 oz Matrix + 1.3 lb Vel	9.7 (2.4) a	40.7 (6.0) a	55.2 (26.8) a	6.4 (1.0) a	33.8 (4.6) a	17.3 (6.6) a
4 oz Matrix + 1.3 lb Vel	10.8 (2.1) a	42.5 (6.4) a	68.3 (22.9) a	7.5 (1.4) a	39.4 (6.2) a	30.0 (9.2) a
4 oz Matrix + 7 oz Milestone	9.2 (1.8) a	38.8 (4.7) a	46.3 (20.9) a	6.9 (1.0) a	36.7 (4.3) a	22.1 (7.6) a
1.33 lb Velpar DF	10.5 (1.4) a	41.1 (3.4) a	59.0 (19.5) a	7.2 (1.0) a	38.7 (4.5) a	26.6 (10.9) a
7 oz Milestone	9.2 (2.3) a	39.7 (5.1) a	48.9 (23.3) a	6.2 (1.0) a	34.7 (2.4) a	16.6 (5.8) a
3.33 lb Velpar DF	10.5 (2.3) a	39.7 (6.9) a	62.9 (30.5) a	7.9 (1.5) a	38.3 (5.1) a	32.9 (15.0) a
1.5 qts Accord XRT II	9.4 (1.6) a	39.9 (5.0) a	47.4 (18.6) a	7.1 (1.2) a	38.9 (5.0) a	27.0 (10.8) a
Control	7.3 (1.5) a	32.2 (4.7) a	24.5 (11.5) a	5.8 (0.9) a	32.2 (2.9) a	32.2 (2.9)

Table 3. 2nd year caliper, height and stem volume for ponderosa pine and Douglas-fir for the 2013 spring Matrix site preparation trial. Standard errors are in parenthesis. Means with the same letter are not significantly different ( $P \leq 0.05$ ).

	White Fir	White Fir	White Fir
Treatment	Caliper mm	Height cm	Vol cm <sup>3</sup>
2 oz Matrix	7.1 (1.4) a	36.1 (3.1) a	23.8 (12.3) a
4 oz Matrix	6.9 (0.5) a	36.1 (2.1) a	20.3 (3.6) a
8 oz Matrix	5.8 (0.6) a	33.2 (4.2) a	12.9 (3.9) a
2 oz Matrix + 1.3 lb Vel	6.2 (0.9) a	31.8 (3.7) a	15.4 (5.6) a
4 oz Matrix + 1.3 lb Vel	8.6 (0.09) a	41.8 (1.0) a	34.1 (2.5) a
4 oz Matrix + 7 oz Milestone	5.5 (0.4) a	30.2 (3.1) a	10.3 (2.5) a
1.33 lb Velpar DF	7.1 (0.6) a	35.8 (2.3) a	22.2 (5.7) a
7 oz Milestone	6.2 (1.1) a	32.5 (4.7) a	16.7 (7.1) a
3.33 lb Velpar DF	7.0 (1.4) a	30.9 (5.6) a	20.8 (10.3) a
1.5 qts Accord XRT II	6.6 (0.8) a	33.2 (3.5) a	18.0 (5.5) a
Control	5.3 (1.1) a	26.1 (6.1) a	10.8 (5.4) a

Table 4. 2nd year caliper, height and stem volume for white fir for the 2013 spring Matrix site preparation trial. Standard errors are in parenthesis. Means with the same letter are not significantly different ( $P \leq 0.05$ ).

Sierra Cascade Intensive Forest Management Research Cooperative Proposal 14-01  
Pindar GT Over the Top

Principal Investigator: Ed Fredrickson

Title: Over The Top Conifer Tolerance and Post Emergent Vegetation Control with Pindar GT on Sugar Pine, Incense Cedar and Ponderosa Pine Seedlings, Pre and Post Budbreak with and without Surfactant

Year Funded: 2014

**Executive Summary:**

Over the last several decades, mixed conifer plantations have become more and more common due to better planting stock, disease resistant seed and better vegetation management practices more conducive to herbicide intolerant species. These vegetation management practices are often more costly than standard site preparation applications due to the necessity of having to treat by directed hand treatments opposed to broadcast helicopter or ground applications. Residual herbicides that have tolerance to sensitive species such as sugar pine, incense cedar, western larch, Douglas-fir and white fir are lacking.

Historically, the site preparation herbicide of choice has been hexazinone for most situations. However, if hexazinone sensitive species are present on site such as those listed above, hexazinone either cannot be used or if used, some level of conifer damage is accepted by the land manager as a result of the application. Currently, the cost of hexazinone is becoming prohibitive as well.

Recent trial work since 2011 has shown that applications of Pindar GT (oxyflourfen + penoxulam) can provide both adequate vegetation control and conifer tolerance to hexazinone sensitive species when applied as a pre-emergent

application or when glyphosate is added to the treatment to burn down any existing vegetation. Pindar GT has also been shown to be safe when applied as an "over the top" application to established ponderosa pine, Douglas-fir and white fir seedlings immediately after planting. No glyphosate was included in these applications. These trials were still a pre-emergent timing on herbaceous vegetation and brush.

To date, no trial work has been conducted with Pindar GT over the top of sugar pine or incense cedar. There is also no data from a forestry site that evaluate the potential of Pindar GT to control established vegetation without the aid of glyphosate.

The stated objective of this study is to evaluate conifer tolerance of sugar pine, incense cedar and ponderosa pine pre and post bud break with "over the top" applications of Pindar GT with and without surfactant to assess post emergent vegetation control. This proposal is for a trial that would evaluate the conifer tolerance of Pindar GT when applied over the top of sugar pine, ponderosa pine and incense cedar applied at two timings (pre and post bud break). The trial would also evaluate the ability of Pindar GT to control emerged vegetation. Applications would include treatments with and without surfactant,

both to assess the partial contribution of surfactant on vegetation control and conifer tolerance.

This proposal is for two sites, one on the northern end of the sugar pine range and a second site in the southern Sierra Nevada Range. The sites required would be either a recent wildfire or clearcut that has not had any prior chemical vegetation management treatments. The site should be flat to 20 percent slope, not encumbered by slash or large rocks and have good access.

The study design will be a completely randomized block design with four replications. Plot size will be 12' x 36' (0.01 acre). Plots will be planted with 10 trees each of sugar pine, ponderosa pine and incense cedar. Stock type will be dependent on what is operationally planted by the cooperators. Seedlings and three planters will be provided by the timber company supplying the site. Planting will be supervised by Thunder Road Resources.

The trial will consist of two spray timings. The first will be shortly after planting as soon as the herbaceous vegetation germinates, but prior to conifer bud break. If conifer bud break appears to be near and vegetation has not germinated yet, the pre bud break timing will be applied regardless. The second spray timing will be post bud break after a good influx of vegetation has germinated. Treatments will consist of three individual rates of Pindar GT with and without 0.25 percent R-11. All plots will be sprayed at 10 gallons per acre at 30 psi with a 12 foot CO<sub>2</sub> powered backpack boom sprayer. All plots will be sprayed with one timed pass and the sprayer will be calibrated prior to

application. All chemicals will be provided by Dow AgroSciences.

All seedlings will be initially measured for caliper and height at planting. Total percent cover and percent cover by species will also be recorded at the time of each application. Plots will be evaluated at the end of the first and second growing seasons. First season evaluations will consist of ocular data only, including percent bare ground and percent cover by species for vegetation assessments. Seedling data collected in first season will be percent survival, percent brownout and needle and bud damage ratings. Second season evaluations will consist of all the above measurements, but seedlings will be measured for caliper and height and stem volumes will be calculated.

A written progress report will be delivered to the group after the first year evaluation prior to the scheduled business meeting to allow time for review. An oral report will be given to the membership at the annual meeting following the first year evaluation. The final written report will be delivered after the second year evaluation, also prior to the next annual meeting at which time a final oral report will be delivered.

**2014:** Two sites were chosen for this trial. The first is located near Sonora, California in the Rim Fire on land owned and managed by Sierra Pacific Industries. The site is at approximately 4800 feet elevation with five to fifteen percent slope and an easterly aspect. The area was burned by wildfire in the summer of 2013, subsequently logged and ripped in the fall of 2013. No chemical site preparation was applied to the site. The second site is near

Whitmore, California also on land owned and managed by Sierra Pacific Industries. The unit is a clearcut that was logged in the fall of 2013. It had been pre-harvest sprayed with glyphosate and imazapyr in the summer of 2011. No mechanical site preparation was applied to the site. The area is approximately 4900 feet elevation with zero to five percent slope and a slight northerly aspect.

All plots were planted with 10 trees each of ponderosa pine, incense cedar and sugar pine. The Sonora site was planted on March 27<sup>th</sup>, 2014 and the Whitmore site was planted on April 4<sup>th</sup>, 2014. Planting stock consisted of styro 5 ponderosa pine, styro 6 incense cedar and styro 8 sugar pine from Cal Forest Nursery on the Whitmore site. The Sonora site was planted with ponderosa pine and incense cedar 1-0 bare root seedlings from Fowler Nursery and styro 8 sugar pine from Cal Forest. There was a nursery issue with the bare root ponderosa pine on the Sonora site. Most of the trees died before the second application, and the ponderosa pine were eliminated from the study on that site. All seedlings were measured at planting for caliper and height.

Two spray timings were utilized in this trial, a pre and post bud break timing. The pre bud break timing was applied the day after planting and the post bud break timing was several weeks later when trees had actively started height growth and new leaders were present. Treatments consisted of three rates of Pindar GT alone at three, four and a half, and six pints per acre, with and without 0.25 % of the non-ionic surfactant R-11 applied at both timings. The Sonora site was sprayed on March 27<sup>th</sup>, 2014 and

May 2<sup>nd</sup>, 2014, whereas the Whitmore site was sprayed on April 7<sup>th</sup>, 2014 and May 16<sup>th</sup>, 2014. No Accord XRT II was included in these applications due to the applications being over the top of freshly planted trees.

Evaluations consisted of the previously mentioned seedling measurements and ocular evaluations at the end of the first growing season including percent bare ground, percent total cover, percent cover by species, percent survival, percent brownout and a seedling vigor rating. Evaluations at the end of the second growing season will include the same, plus caliper, height and stem volume measurements.

Data were analyzed using SAS statistical software. Vegetation and seedling data were analyzed using analysis of variance. Treatments were compared using a Tukey's test with adjusted probabilities. Initial seedling size parameters were used as covariates within the ANOVA' for height, caliper and volume. Analyses for size were weighted by the number of surviving seedlings in each plot. Least squared means for size included adjustments for the covariates, which resulted in some differences from the raw data means. Analyses utilized PROC MEANS, PROC MIXED and PROC GLIMMIX in SAS. PROC GLIMMIX was used when variances were unequal, and either the Poisson or gamma distribution was used. Where statements are made regarding statistically significant differences in this document, the alpha level is  $P \leq 0.05$ .

Of the two sites, the Sonora site had the most vegetative cover (Table 1). At Sonora, all treatments increased percent bare ground and decreased total cover

compared to the non-treated controls although not all treatments were significantly different. All treatments had significantly more bare ground than the non-treated controls with the exception of the middle rate of Pindar GT with no surfactant at the post bud break timing. Only the two lower rates of Pindar GT with no surfactant and the two highest rates of Pindar GT with a surfactant at the pre bud break timing had significantly less cover than the non-treated controls. No herbicide treatments significantly differed from each other regarding either percent bare ground or total cover.

All treatments at Sonora significantly reduced the amount of Spanish clover which was the predominant vegetation on the site compared to the non-treated controls with the exception of the lowest rates of Pindar GT applied post bud break either with or without a surfactant. All herbicide treatments had lower cover values for *Epilobium* sp. and hedge parsley than the non-treated controls but not significantly.

While not significantly different, there is a trend that the pre-emergent application timing provided better control than the post-emergent timing. The addition of surfactant did not make a significant difference in control.

At the Whitmore site, percent bare ground ranged from ninety five to one hundred percent and percent total cover was less than five percent for all treatments, apparently carry over from the pre harvest application of imazapyr and glyphosate in 2011 (Table 3). While there were some significant differences, they appear to be an anomaly based on low variation around the mean. General

tends showed that all treatments had slightly more bare ground, less total cover and less bull thistle cover than the non-treated, but only slightly.

Conifer tolerance was excellent for all herbicide treatments at both sites. At Sonora, percent survival of incense cedar did not significantly vary among treatments (Table 2). However, sugar pine survival was significantly higher in all herbicide treatments compared to the non-treated controls by a large margin. There were no significant differences in percent survival among treatments at the Whitmore site for any species (Tables 4 and 5). Over ninety percent survival was observed for all species on this site.

Percent brownout and damage ratings showed significant differences at the Sonora site. All herbicide treatments in the post bud break timing either with or without surfactant had significantly less brownout and damage than the non-treated controls or any of the pre bud break treatments with the exception of the middle rate of Pindar GT without a surfactant for incense cedar. Sugar pine percent brownout was significantly lower in the herbicide treatments compared to the non-treated controls with the exception of the high rate of Pindar GT with no surfactant in the pre bud break timing and the middle rate of Pindar GT with no surfactant in the post bud break timing. Sugar pine damage ratings were lower in the herbicide treatments compared to the non-treated controls, however, only the middle rate of Pindar GT with no surfactant and the two highest rates with surfactant in the pre bud break timing and the high rate of Pindar GT with no surfactant and the two highest rates with surfactant in the post bud break timing were significantly

different. Neither brownout or damage rating significantly differed among treatments at the Whitmore site.

Although the Whitmore site produced little vegetative data, The Sonora site showed some valuable trends. It appears that Pindar GT when used alone may be more effective as a pre-emergent treatment than post. The addition of surfactant to either timing had little if any effect on efficacy. Competing vegetation had a significant effect on sugar pine survival.

The conifer tolerance data in this trial are of particular importance. It appears that Pindar GT has a level of conifer safety that is equal to or better than atrazine. Even at a 2X operational rate, pre or post bud break and with or without a surfactant, conifer tolerance

was extremely high for all species. This is especially remarkable considering sugar pine and incense cedar are two of the most intolerant species to hexazinone, which has been the operational standard for decades. The 2013 trial also showed high tolerance for Douglas-fir and white fir, which also tend to be hexazinone intolerant. It does appear that there is a suitable herbicide for herbaceous and pre-emergent woody brush site preparation, where mixed conifer forests are established.

Treatment	% Bare Ground	% Cover Spanish clover	% Cover epilobium sp.	% Cover hedge parsley	% Total Cover
3 pt Pindar GT - Pre	86.2 (3.8) a	2.8 (1.0) b	0.2 (0.2) a	0.5 (0.5) a	11.5 (3.0) b
4.5 pt Pindar GT - Pre	86.2 (5.2) a	2.2 (1.0) b	0 (0) a	0 (0) a	14.0 (5.0) b
6 pt Pindar GT - Pre	81.8 (6.9) a	0.8 (0.5) b	0 (0) a	0 (0) a	17.3 (6.3) ab
3 pt Pindar GT + 0.25% R-11 - Pre	77.5 (6.6) a	2.0 (0) b	0 (0) a	0.5 (0.3) a	21.8 (5.8)ab
4.5 pt Pindar GT + 0.25% R-11 - Pre	90.5 (5.2) a	2.5 (1.0) b	0 (0) a	0 (0) a	12.0 (6.4) b
6 pt Pindar GT + 0.25% R-11 - Pre	90.5 (3.2) a	1.8 (0.5) b	0 (0) a	0 (0) a	9.8 (2.8) b
3 pt Pindar GT - Post	73.2 (8.1) a	6.0 (3.1) ab	0.8 (0.8) a	0.5 (0.5) a	26.8 (7.1) ab
4.5 pt Pindar GT - Post	55.0(16.5)ab	3.5 (0.9) b	2.5 (1.4) a	1.8 (1.2) a	43.8 (15.7) ab
6 pt Pindar GT - Post	67.5 (17.9) a	4.2 (2.1) b	1.0 (0.7) a	0.8 (0.8) a	31.3 (16.1) ab
3 pt Pindar GT + 0.25% R-11 - Post	74.2 (6.7) a	6.5 (2.2) ab	0.8 (0.5) a	1.0 (0.7) a	28.3 (7.8) ab
4.5 pt Pindar GT + 0.25% R-11 - Post	77.5 (1.4) a	3.0 (0.7) b	1.8 (1.2) a	0.5 (0.3) a	24.3 (1.9) ab
6 pt Pindar GT + 0.25% R-11 - Post	81.2 (4.7) a	1.5 (0.6) b	0.8 (0.8) a	0 (0) a	20.3 (4.6) ab
Control	30.0 (15.1) b	25.8 (7.9) a	11.2 (8.0) a	9.2 (5.7) a	75.3 (18.5) a

Table 1. Sonora percent bare ground and percent cover means for the 2014 spring over the top Pindar GT release trial. Pre and Post refer to pre and post bud break application timings. Standard errors are in parenthesis. Means with the same letter are not significantly different ( $P \leq 0.05$ ).

Treatment	Incense Cedar			Sugar Pine		
	% Surv	% Br Out	Damage	% Surv	% Br Out	Damage
3 pt Pindar GT - Pre	60.0 (4.1) a	6.2 (4.7) a	1.0 (0.7) a	97.5 (2.5) a	1.2 (1.2) b	0.2 (0.2) a
4.5 pt Pindar GT - Pre	72.5 (8.5) a	1.2 (1.2) a	0.2 (0.2) a	97.5 (2.5) a	0 (0) c	0 (0) b
6 pt Pindar GT - Pre	77.5 (6.3) a	5.0 (2.9) a	1.0 (0.6) a	72.5 (16.0) a	3.8 (2.4) ab	0.8 (0.5) a
3 pt Pindar GT + 0.25% R-11 - Pre	75.0 (6.5) a	5.0 (3.5) a	0.8 (0.5) a	87.5 (9.5) a	0 (0) c	0.2 (0.2) a
4.5 pt Pindar GT + 0.25% R-11 - Pre	77.5 (6.3) a	3.8 (3.8) a	0.8 (0.8) a	97.5 (2.5) a	0 (0) c	0 (0) b
6 pt Pindar GT + 0.25% R-11 - Pre	67.5 (11.1) a	1.2 (1.2) a	0.2 (0.2) a	90.0 (4.1) a	0 (0) c	0 (0) b
3 pt Pindar GT - Post	82.5 (7.5) a	0 (0) b	0 (0) b	87.5 (4.8) a	1.2 (1.2) b	0.2 (0.2) a
4.5 pt Pindar GT - Post	72.5 (4.8) a	5.0 (2.9) a	0.8 (0.5) a	70.0 (21.2) a	6.2 (3.8) ab	0.8 (0.5) a
6 pt Pindar GT - Post	82.5 (7.5) a	0 (0) b	0 (0) b	80.0 (16.8) a	0 (0) c	0 (0) b
3 pt Pindar GT + 0.25% R-11 - Post	90.0 (5.8) a	0 (0) b	0 (0) b	90.0 (7.1) a	1.2 (1.2) b	0.2 (0.2) a
4.5 pt Pindar GT + 0.25% R-11 - Post	87.5 (4.8) a	0 (0) b	0 (0) b	92.5 (2.5) a	0 (0) c	0 (0) b
6 pt Pindar GT + 0.25% R-11 - Post	95.0 (2.9) a	0 (0) b	0 (0) b	97.5 (2.5) a	0 (0) c	0 (0) b
Control	72.5 (13.1) a	8.8 (5.2) a	1.2 (0.8) a	17.5 (6.3) b	35.0 (21.7) a	4.0 (2.0) a

Table 2. Sonora incense cedar and sugar pine percent survival and brown out, and damage rating means for the 2014 spring Pindar GT over the top release trial. Standard errors are in parenthesis. Means with the same letter are not significantly different ( $P \leq 0.05$ ). Damage ratings are on a scale from 0 to 10 with 0 being no damage and 10 is dead.

	% Bare Ground	% Cover Bull Thistle	% Total Cover
3 pt Pindar GT - Pre	97.8 (0.5) ab	0.8 (0.2) ab	2.8 (0.6) a
4.5 pt Pindar GT - Pre	98.8 (0.8) a	0.2 (0.2) b	1.8 (1.0) a
6 pt Pindar GT - Pre	99.0 (0.4) a	0 (0) c	1.2 (0.6) a
3 pt Pindar GT + 0.25% R-11 - Pre	96.2 (0.8) ab	2.0 (0.6) ab	4.8 (0.9) a
4.5 pt Pindar GT + 0.25% R-11 - Pre	98.2 (0.2) ab	0 (0) c	1.8 (0.2) a
6 pt Pindar GT + 0.25% R-11 - Pre	97.2 (0.9) ab	0.8 (0.5) ab	3.8 (1.3) a
3 pt Pindar GT - Post	98.5 (0.3) ab	1.0 (0.4) ab	2.0 (0.6) a
4.5 pt Pindar GT - Post	99.0 (0) a	0.5 (0.3) ab	1.5 (0.3) a
6 pt Pindar GT - Post	98.2 (0.5) ab	0.5 (0.3) ab	2.5 (1.2) a
3 pt Pindar GT + 0.25% R-11 - Post	98.0 (0.4) ab	0 (0) c	2.5 (0.6) a
4.5 pt Pindar GT + 0.25% R-11 - Post	99.0 (0.4) a	0 (0) c	1.0 (0.4) a
6 pt Pindar GT + 0.25% R-11 - Post	98.5 (0.3) ab	0.5 (0.3) ab	2.2 (0.6) a
Control	95.5 (1.8) b	3.8 (2.1) a	5.2 (2.0) a

Table 3. Whitmore percent bare ground and percent cover means for the 2014 spring over the top Pindar GT release trial. Pre and Post refer to pre and post bud break application timings. Standard errors are in parenthesis. Means with the same letter are not significantly different ( $P \leq 0.05$ ).

Treatment	Incense Cedar			Sugar Pine		
	% Surv	% Br Out	Damage	% Surv	% Br Out	Damage
3 pt Pindar GT - Pre	100 (0) a	0 (0) a	0 (0) a	92.5 (7.5) a	0 (0) a	0 (0) a
4.5 pt Pindar GT - Pre	97.5 (2.5) a	0 (0) a	0 (0) a	100 (0) a	0 (0) a	0 (0) a
6 pt Pindar GT - Pre	95.0 (2.9) a	0 (0) a	0 (0) a	90.0 (7.1) a	0 (0) a	0 (0) a
3 pt Pindar GT + 0.25% R-11 - Pre	97.5 (2.5) a	0 (0) a	0 (0) a	97.5 (2.5) a	0 (0) a	0 (0) a
4.5 pt Pindar GT + 0.25% R-11 - Pre	97.5 (2.5) a	0 (0) a	0 (0) a	92.5 (7.5) a	0 (0) a	0 (0) a
6 pt Pindar GT + 0.25% R-11 - Pre	100 (0) a	0 (0) a	0 (0) a	92.5 (4.8) a	0 (0) a	0 (0) a
3 pt Pindar GT - Post	97.5 (2.5) a	0 (0) a	0 (0) a	90.0 (0) a	0 (0) a	0 (0) a
4.5 pt Pindar GT - Post	100 (0) a	0 (0) a	0 (0) a	97.5 (2.5) a	0 (0) a	0 (0) a
6 pt Pindar GT - Post	97.5 (2.5) a	0 (0) a	0 (0) a	92.5 (4.8) a	0 (0) a	0 (0) a
3 pt Pindar GT + 0.25% R-11 - Post	100 (0) a	0 (0) a	0 (0) a	100 (0) a	0 (0) a	0 (0) a
4.5 pt Pindar GT + 0.25% R-11 - Post	97.5 (2.5) a	0 (0) a	0 (0) a	100 (0) a	0 (0) a	0 (0) a
6 pt Pindar GT + 0.25% R-11 - Post	100 (0) a	0 (0) a	0 (0) a	97.5 (2.5) a	0 (0) a	0 (0) a
Control	100 (0) a	0 (0) a	0 (0) a	100 (0) a	0 (0) a	0 (0) a

Table 4. Whitmore incense cedar and sugar pine percent survival and brown out, and damage rating means for the 2014 spring Pindar GT over the top release trial. Standard errors are in parenthesis. Means with the same letter are not significantly different ( $P \leq 0.05$ ). Damage ratings are on a scale from 0 to 10 with 0 being no damage and 10 is dead.

Treatment	Ponderosa Pine		
	% Surv	% Br Out	Damage
3 pt Pindar GT - Pre	92.5 (4.8)	0 (0) a	0 (0) a
4.5 pt Pindar GT - Pre	92.5 (4.8)	0 (0) a	0 (0) a
6 pt Pindar GT - Pre	95.0 (2.9)	0 (0) a	0 (0) a
3 pt Pindar GT + 0.25% R-11 - Pre	97.5 (2.5)	0 (0) a	0 (0) a
4.5 pt Pindar GT + 0.25% R-11 - Pre	95.0 (5.0)	0 (0) a	0 (0) a
6 pt Pindar GT + 0.25% R-11 - Pre	97.5 (2.5)	0 (0) a	0 (0) a
3 pt Pindar GT - Post	97.5 (2.5)	0 (0) a	0 (0) a
4.5 pt Pindar GT - Post	97.5 (2.5)	0 (0) a	0 (0) a
6 pt Pindar GT - Post	100 (0)	0 (0) a	0 (0) a
3 pt Pindar GT + 0.25% R-11 - Post	100 (0)	0 (0) a	0 (0) a
4.5 pt Pindar GT + 0.25% R-11 - Post	95.0 (5.0)	0 (0) a	0 (0) a
6 pt Pindar GT + 0.25% R-11 - Post	95.0 (2.9)	0 (0) a	0 (0) a
Control	95.0 (5.0)	0 (0) a	0 (0) a

Table 5. Whitmore ponderosa percent survival and brown out, and damage rating means for the 2014 spring Pindar GT over the top release trial. Standard errors are in parenthesis. Means with the same letter are not significantly different ( $P \leq 0.05$ ). Damage ratings are on a scale from 0 to 10 with 0 being no damage and 10 is dead.

Sierra Cascade Intensive Forest Management Research Cooperative  
Income/Expense Statement  
Calendar Year Report for the Period Jan. 1 to Dec. 31, 2014

Beginning Balance on January 1, 2014	\$19,323.00
Total Income (Membership Dues)	\$58,000.00
Expenses	
Pindar Over the Top Study	\$14,000.00
Pondosa I Study	\$500.00
Pondosa II Study	\$1,620.00
Mat 28 Study	\$132.00
GF 9999 Study	\$132.00
Research Study Mapping	\$130.00
Website	\$1,440.00
Co-op Manager Expenses	\$35,000.00
Total Expenses	\$52,954.00
Year End Balance as of December 31, 2014	\$24,369.00

## WORKING GROUP MEMBERSHIP

### **Working Group I** Seed to Establishment

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

### **Working Group II** Out-planting through Precommercial Thinning

Scott Worden, Chair  
Bob Amesbury  
Scott Carnegie  
Mark Gray  
Ken Scott  
Tom Young