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

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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

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.

The site was clearcut and planted to a mix of ponderosa pine, Douglas-fir and white fir. The site was initially pre-harvest sprayed with Chopper and larger hardwoods were injected with Arsenal prior to logging. The site was ripped following logging. No other site preparation treatments occurred.

The plots were sprayed on April 22, 2011. Treatments and application procedures were similar to those used on the fall site.

Both sites were evaluated on August 29, 2011. Percent foliar brownout was evaluated for greenleaf manzanita, pondersa pine, Douglas-fir and white fir where it was present on the fall treatment site and for greenleaf manzanita, whitethorn, ponderosa pine and Douglas-fir on the spring treatment site. White fir was not part of the study but it did occur in the majority of the plots on the fall site. Tolerance was evaluated for white fir, but the results are anecdotal in nature only and any statistical analysis would be invalid. Terminal and lateral bud damage was assessed for all conifers on a scale from 0 to 10 with 0 being no damage and 10 dead. Caliper, height, survival and stem volume were also measured at both sites. A visual assessment of percent control for brush species was made on each site. See Tables 1- 6 for treatment means.

Statistical analysis was done using SAS software. Data were analyzed as a randomized complete block design. Analysis of variance was used to determine significance of the main effect of treatment. Tukeys HSD test was used for multiple comparisons of treatments.

Greenleaf Manzanita control was poor overall for either timing. Acceptable control was achieved in the fall with the highest rate of Vista XRT (1 lb a.i./ac), however this rate is twice the labeled rate. For the spring trial, only the 1 lb a.i./ac rate of Vista XRT was significantly different from the control ($p<.05$). In the fall trial, the lowest rate of Vista XRT (0.25 lb a.i./ac) alone or in combination with 0.5 lb a.i./ac Garlon 3A were not significantly different from the control. No significant differences existed between any of the Vista XRT treatments at 0.25 or 0.5 lbs a.i./ac alone or in combination with 0.5 lbs a.i./ac Garlon 3A. The highest rate of Vista XRT (1 lb a.i./ac) was significantly different from all treatments with the exception of the 0.5 lb Vista XRT with 0.5 lb Garlon 3A combination. Overall, greenleaf manzanita control was unacceptable at currently labeled rates for either Vista XRT by itself or in combination with Garlon 3A. It should be noted however, that these applications contained no adjuvants of any type. Control could have been improved with the addition of a surfactant but conifer damage would most likely have been dramatically increased.

Whitethorn was only present in the spring trial. Control of whitethorn was poor with all treatments and only the tank mix of Vista XRT and Garlon 3A at 0.5 lb a.i./ac each was significantly different from the control ($p<.05$). The significance is irrelevant due to the poor control of this treatment. Neither, Vista XRT by itself or Vista XRT with Garlon 3A provides acceptable control of whitethorn. Gooseberry was evaluated in the fall timing but was not in every plot and

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.

All evaluations are complete at this point for the fall timing of the Vista XRT trial. The final evaluation for the spring timing will be in the fall of 2012.

| 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.