

Clopyralid (DowElanco®) Demonstration Trial Yolo County, California

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Introduction

Yellow starthistle (*Centaurea solstitialis*) is an annual weed introduced into California more than 100 years ago (Thomsen, 1996). Its aggressive growth and high reproductive rate have resulted in its spread throughout the state in both wildlands and annual and permanent agricultural areas, where it effectively crowds out less competitive species, including forage crops, introduced rangeland grasses, and native grasses and forbs.

Yellow starthistle (starthistle) is recognized as a significant problem on annual rangeland in California. New and more effective methods for management and reduction of starthistle populations are being actively sought by private landowners, members of the cattle industry, professional organizations, private companies, and UC researchers. To that end, the herbicide clopyralid (Transline® DowElanco) is being tested in California for efficacy for starthistle control. Clopyralid is a selective, broadleaf herbicide that acts as a plant growth regulator. Post-application rains move it into upper soil layers where soil residual may provide extended control. Its effects may go into a second season, depending on the rate of application. Previous research indicates that applications made to exposed foliage may take up to 2 months to show full effects (pers. comm. J. DiTomaso).

Clopyralid is currently registered in 48 of the 50 states to control a variety of weeds in the sunflower, pea, buckwheat and nightshade families. Preliminary investigations and small replicated trials by UC researchers indicate good activity of clopyralid on starthistle with acceptable safety on other rangeland plants (pers. comm., J. DiTomaso).

Subsequent to small plot research, field scale trials can provide valuable input into herbicide performance under natural soil, climate, water and animal use conditions. An objective was to test clopyralid in typical, extensive rangeland conditions to provide public education, to observe field-scale performance, and to compare two different application methods.

Methods

Three unreplicated, field-scale demonstration trials were implemented on one ranch in the foothills of western Yolo County.

Trial #1 was applied by air using a Soloy Turbine Conversion Hiller helicopter at 10 gallons per acre with a 40 ft. boom. Two nozzle types were used: T-jet 45° spinners and T-jet 4

hole 45° spinners. Applications of two rates of Transline - 2.6 and 5.2 oz per acre (1 and 2 oz ai/A clopyralid) were made to 10 acre plots with an untreated buffer zone between rates and an untreated control immediately adjacent (see map "Transline Trial #1).

Trial #2 was applied by ground using a Honda 350 4-wheel ATV equipped with a Hardy rear-mounted, 50-gallon sprayer, a 30-ft boom and Tee Jet 8002 flat fan nozzles. Herbicide applications were made on three different plots at 25 psi using 5 gallons of water per acre (gpa). Transline was applied at the same two rates as in Trial # 1- 2.6 and 5.2 oz. per acre, and 2,4-D (4.0 lb/gal) was applied at 1 pint per acre. An adjacent untreated control was included for comparison (see map "Transline Trial #2).

Trial #3 was also applied by ground as in Trial #2, but rates of 1.3 and 2.6 oz per acre of formulated clopyralid were applied. The untreated area from Trial #1 was considered sufficiently close to serve as the control for this trial (see map "Transline Trial #3").

Applications for all three trials were made on March 14, 1997. On March 5, pre-treatment weed counts and estimates of percent cover of primary plant species were completed in all blocks except those of trial #3. For this and all subsequent evaluations, one-foot-square quadrats were randomly chosen throughout the central area of each block for a total of 10 locations per block. Percent cover within the quadrat was visually estimated for grasses, yellow starthistle, clover, filaree and other broadleaf weeds. Percent of bare ground was also noted. Total counts were taken of clover, filaree and other broadleaf weeds, whereas starthistle was counted in a specific 1/4-section of each quadrat and the number multiplied by 4. Grasses were considered too numerous to count. Post-treatment counts using similar methods were made on 4/11, 5/9 and 6/23 to track progressive effects on the target plants.

Results/Discussion

Topography and animal use of each trial was slightly different. The area for Trial #1 consisted of low hills moving to steeper hills. The entire field was 90 acres, with 30 acres devoted to Trial #1 and approximately 10 acres to Trial #3 (low rate of Transline). Trials #1 and #3 were adjacent, such that the untreated "Control" area was common to both. This field was lightly grazed starting 1 week post-treatment with approximately 25 head of cattle for 2 weeks. Trial #2, which was 33 acres, was primarily flat with edges moving to low hills. It was also lightly grazed starting, approximately 1 week post-treatment with 8 - 9 heifers for 1 month. Trial #3 bordered a riparian area. The low rate of Transline was applied in the same field as Trial #1. The higher rate in this trial was applied on the opposite side of the fence in an adjacent field that was 300 acres in size. The largest percentage of this field was steep hill country. Fifty cattle that were present there for 6 weeks preferentially grazed the lower portion of the field. Field conditions were considered fairly normal early in the season. Two days post-application (3/16/97), between ½ and ¾ inches of rain fell. However, no further rainfall occurred beyond that date. Subsequent rangeland conditions were very dry much earlier in the season than usual.

At the pre-treatment evaluation date on March 5, Yellow starthistle plants were in the seedling stage, had an average of 4-5 leaves and were approximately 2 inches in diameter and 3

inches tall. Clovers had an average of 2-4 mature leaves emerged and grasses were 4-6 inches tall.

By 4/11, seedheads were exerted in the wild oats, medusahead and soft chess. A size difference was noted between starthistle in the treated and untreated areas in the aerial trial (trial # 1). In blocks treated with clopyralid, starthistle plants were essentially the same size as on 3/5 (3-inch diameter and 3 inches tall) and were still green. Starthistle rosettes in the untreated areas varied between 6 and 10 inches in diameter and were approximately 6 inches tall. In trial #2, height and diameter differences were not as dramatic, but growth stage differences were apparent (greater number of mature leaves in untreated areas). The already very dry rangeland conditions may have contributed to or amplified herbicidal effects. This same trial, perhaps coincidentally, showed patchy, high concentrations of goatgrass and medusahead.

On May 9, untreated yellow starthistle in the aerial trial (Trial #1, Control) was between full rosette and bolting stage and 8 to 10 inches both in width and height. Where herbicide treatments were made, most starthistle plants had not progressed beyond the growth stage noted on 4/11 and were mostly or completely desiccated. In the trials where applications were made by ground, the dry conditions caused most plants to be reduced in vigor and many appeared to go through early senescence. However, starthistle was essentially absent in the blocks treated with clopyralid, was strongly present in the untreated area, and where 2,4-D was used, some starthistle plants were stunted, dead or dying and some appeared to be unaffected. The latter were likely seedlings that germinated after treatment.

For each evaluation date, simple averages were calculated for each plant category using the data from all 10 quadrats. A standard deviation was calculated for the same data sets. Because these were unreplicated trials, further statistical analyses could not be performed. The calculations for standard deviation indicated a high degree of overall variability; however, the values for estimated percent cover showed less variability than plant counts and may be more indicative of the actual field situation. A larger sample size (more than 10 quadrats) would likely have decreased the overall variability in the data, but time limits were a strong dictator of sample size. Variability in the data decreased as the season progressed and as yellow starthistle began to show full effects of the herbicide treatment.

Trial #1 was applied aerially and showed pre- and immediately post-treatment counts of Yellow starthistle whose averages ranged from 9 to 34.5 seedlings/ft², covering between 4.5 and 15.5% of the surface area (Fig 1a. and 1b). Some individual quadrats were almost completely dominated by grass, with no starthistle present. Rangeland grasses were abundant and fairly consistent throughout all plots, with occasional presence of clover and filaree. On the 3 subsequent evaluation dates, percent cover of Yellow star thistle showed a consistent decline for both rates of clopyralid, with none present on the final evaluation date. The untreated control, though starting with low levels, showed an increase in percent cover of Yellow starthistle to a final average value of 22.5% cover. Visual observations in specific Control plots, however, ranged as high as 50% cover. Counts showed a similar pattern of decline in the treated blocks and elevated levels of yellow starthistle in the untreated area.

Although filaree and clovers showed a steady, gradual decline, levels were very low to begin with. This, combined with drought conditions may have masked or confounded the

herbicide effects. Although some of the clovers did show slight herbicide symptoms at the 2nd and 3rd evaluation dates, it is difficult to say whether their ultimate decline was due more to the herbicide rate used, the extremely dry rangeland conditions throughout the season, or a combination of both.

In trial #2, applied by ground, initial Yellow starthistle levels were fairly consistent and high throughout the entire field. The average initial cover ranged from 29.3 to 35.9% over all four plot areas (Fig. 2a). Rangeland grasses were similarly consistent and high. Yellow starthistle seedling counts ranged from 79.2 to 105.6 seedlings/ft² (Fig. 2b). Variability of data was again high between individual quadrats, but less so in the estimates of percent cover as compared to counts.

Herbicide effects did not begin to show until the second post-treatment evaluation date on May 9, at which time, both clopyralid rate treatments showed effective control of yellow starthistle, with complete control at the high rate and 7.5% cover at the low rate. Although less dramatic the 2,4-D treatment also showed a measure of control at the same date. Weed levels in the 2,4-D plot showed final percent cover values comparable to the clopyralid plots; however, late-season seedlings were emerging in the 2,4-D plot alone. By July, yellow starthistle cover in the 2,4-D treated plots had increased dramatically compared to the low rate of clopyralid (no data taken). Starthistle counts also declined slightly in the 2,4-D and control treatments (Fig. 2b). Based on observations, the decline appeared, in part, to be due to extremely dry rangeland conditions.

Trial #3 used a very low rate of clopyralid (1.3 oz formulated product per acre) along with a standard rate (2.6 oz formulated product per acre), which together could be instructive in understanding rate-related soil residual affects. Inclusion of this trial was determined at a late date so no pre-treatment data were available for the treated areas. However, this trial was conducted in the same field and was adjacent to Trial #1. Pre-treatment data from the untreated control for Trial #1 was thus used for comparison.

Considering mean percent cover and using the untreated control from Trial #1 as a baseline, Yellow starthistle started out at low levels, increased until the second evaluation date and remained high in the untreated area. Starthistle levels dropped to zero in the clopyralid treated areas where the 2.6-oz per acre rate was used (Fig. 3a). Mean counts showed a similar pattern in the control as well as the treated areas, again with the higher rate causing eventual elimination and the lower rate sustaining low numbers of starthistle by the time of the last evaluation on 6/23 (Fig. 3b).

Visual assessment of all of the trials showed dramatic differences by the time of the final assessments on 6/23. Areas treated with clopyralid appeared totally free of starthistle; whereas untreated areas showed dense, green cover of starthistle plants. As the season progressed, starthistle clearly dominated the landscape in untreated areas. Sharp dividing, lines were apparent where treatments stopped or began. Areas treated with 2,4-D appeared to be starthistle-free from a distance, but close examination revealed younger plants - otherwise concealed by range grasses - which produced flowers and seed by late summer.

There is interest and concern over the effect of clopyralid on desirable rangeland forbs. Clovers and filaree were present in these trials only at very low levels, with only the occasional quadrat having 1 to 3 plants. However, observations were made that provide information that the quadrat counts do not illustrate. Filaree was present in numbers too low to comment on. Clovers observed in the treated areas (primarily rose-clover) did show leaf burn and some stunting by 4/11. By the final evaluation date, most of the dried plant remnants that were present had mature seed heads and appeared to have completed their life cycle in spite of some limited damage early on.

The trends shown in these demonstration trials do not seem to differ by method of application. Control of Yellow starthistle was accomplished in both the aerial and ground trials. Reasons for using different application methods will likely depend upon both cost and soil conditions at the time that application is needed. The landowner/cooperator for this trial calculated costs for both application methods, based on an estimated cost for clopyralid. Aerial applications of the 1-oz rate of clopyralid were approximately \$ 1.35/acre higher than ground applications. The ground application was in turn approximately \$4.70/acre higher than a 1-pint/A application of 2,4-D. In evaluating cost vs. benefit, consideration should be given to efficacy and residual control as well as costs. With landowner permission, these same treated areas will be re-evaluated during the following growing season in the absence of additional herbicide treatment to observe levels of residual control by each of the herbicides as compared to untreated areas.

In spite of the fact that treatments were not replicated, results from this field-scale demonstration trial indicate excellent potential for control of Yellow Starthistle using clopyralid (Transline). Dependence strictly upon chemical control measures can, however, lead to such problems as herbicide resistance. An integrated approach that also includes burning and/or land management techniques is likely to provide the most satisfactory and effective long-term control.

This field-scale application of clopyralid proved to be a very valuable demonstration and education opportunity for researchers as well as rangeland managers. The opportunity to make successive field visits and observations provided insight into starthistle control under normal animal-use conditions and, through a late-season field day, allowed a broad variety of professionals and practitioners to observe results and learn about new methods for starthistle control.

Thomsen, C.D., et. al. 1996. Yellow Starthistle Biology and Control. UC/DANR Publication No. 21541. 19 pp.

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Figure 1a

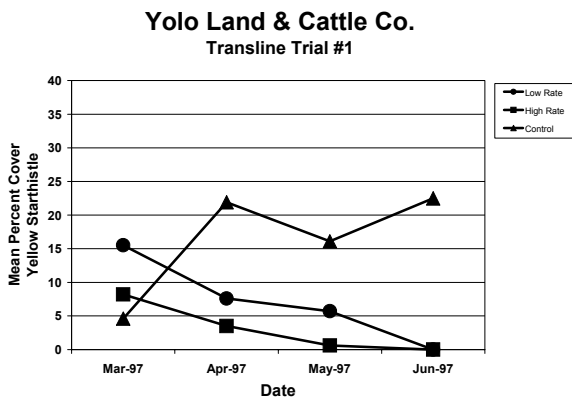


Figure 1b

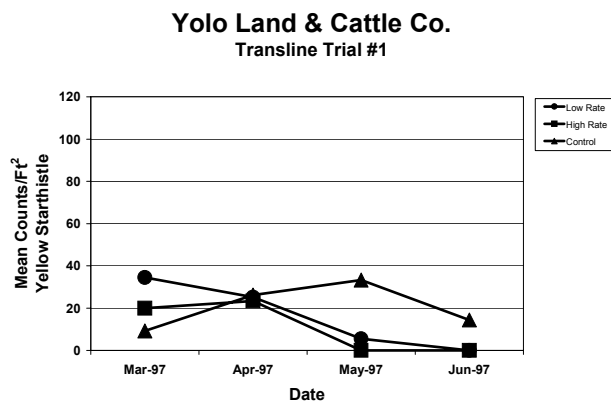


Figure 2a

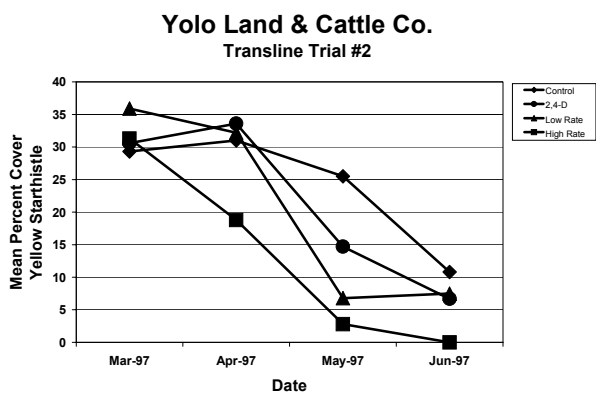


Figure 2b

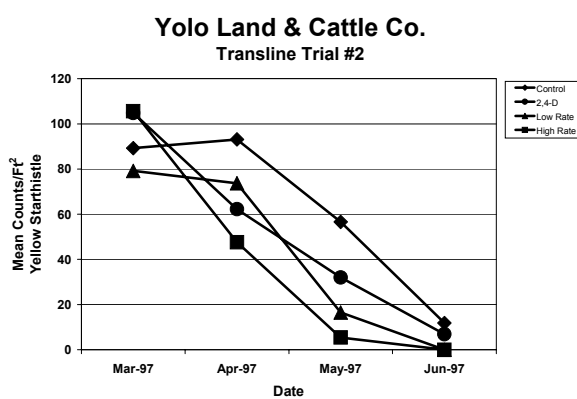


Figure 3a

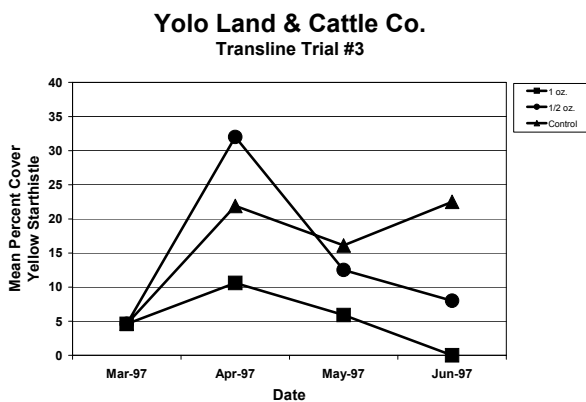


Figure 3b

