2006 Dalmatian Toadflax Monitoring

Introduction

Dalmatian toadflax (*Linaria dalmatica*) is a noxious weed that has invaded hundreds of acres across the Site and is a problem throughout much of the Front Range of Colorado. The species is an escaped ornamental plant from Europe. Dalmatian toadflax is listed as a List "B" species under the Colorado Noxious Weed Act (2006). This means it is established in the state and statewide eradication is not possible. The species is well adapted to arid environments and has a deep, extensive root system. The deep root system, waxy leaves, and high seed production make the species difficult to control. The species is a significant problem for ecological resource management because of its ability to replace native plant species and degrade the quality of the land for wildlife or grazing.

A three-phase study was conducted to evaluate the effectiveness of Tordon 22K® alone (applied at two different application rates [1 pint/acre and 1 quart/acre]) and Tordon 22K® (1 quart/acre) plus Telar® (1 ounce/acre) on dalmatian toadflax density.

Methods

Phase 1

During June 2003, several dense infestations of dalmatian toadflax in the Peripheral Operable Unit (POU; formerly the Buffer Zone) were sprayed with Tordon 22K® (1 pint/acre) to evaluate the effectiveness of this herbicide in reducing the density of toadflax populations. The locations selected for monitoring were established in the south POU at the Site (Figure 1). A control plot and treatment plot were established for comparative purposes. Two 50-meter transects were established in each plot and five 1-square meter (square shaped) quadrats were randomly located along each transect (total of 10 quadrats for each plot). Within each quadrat the density of dalmatian toadflax stems were counted. Each live stem, regardless of height, that was rooted within the quadrat was counted and the total number recorded on field data sheets. The average number of stems per quadrat was calculated from the data for the control plot and treatment plot. This data established the baseline for Phase 1 of the study. In 2004, 2005, and 2006, both the control and treatment plots were monitored to determine the effectiveness of the spraying (1 pint/acre) on reducing dalmatian toadflax densities.

Phase 2

A second phase was added to the project in 2004 when an application of Tordon 22K® (1 quart/acre) was applied to a large infestation of dalmatian toadflax adjacent to the control plot transects (Figure 1). Pre-treatment monitoring of toadflax density in this area was conducted along two 50-meter transects established using the same methodology described above. The control plots used for the first phase of the study were used as control plots for this phase as well. This data established the baseline for Phase 2 of the study. Monitoring was conducted in 2005 and 2006 to evaluate the effectiveness of an application of Tordon 22K® at 1 quart/acre on reducing dalmatian toadflax as compared to 1 pint/acre.

Phase 3

A third phase was added to the project in 2005 when an application of Tordon 22K® (1 quart/acre) plus Telar® (1 ounce/acre) was applied to a large infestation of dalmatian toadflax west of the original control plot transects (Figure 1). Pre-treatment monitoring of toadflax density in this area was conducted along two 50-meter transects established using the same methodology described above. The control plots used for the first phase of the study were used as control plots for this phase as well. This data established the baseline for Phase 3 of the study. Post-treatment monitoring was conducted in 2006 to evaluate the effectiveness of this herbicide combination on reducing dalmatian toadflax as compared to the other treatments.

Results and Discussion

From 2003 through 2005, dalmatian toadflax density in the control plot increased from 75.2 stems per square meter (stems/m^2) to 126.1 stems/m^2 (Figure 2). Some of the increase may have been due to the above average precipitation received in 2004 and 2005 (November to June precipitation; average [1992-2005] = 10.24 inches, 2004 = 13.08 inches, 2005 = 12.58 inches). In 2006, dalmatian toadflax density in the control plot dropped to only 56.5 stems/m^2 (Figure 2). This was likely in response to the below average precipitation received (November to June precipitation; 2006 = 4.98 inches).

In the Phase I study, looking at the effect of an application of 1 pint of Tordon 22K®/acre, dalmatian toadflax densities dropped annually from 72 stems/m^2 in 2003 to 28.4 stems/m^2 in 2005 (Figure 2). In 2006, the continued effect of the herbicide, plus the drought resulted in only 7.2 stems/m^2. In the Phase II study, dalmatian toadflax densities dropped from 64.8 stems/m^2 in 2004 to 23.7 stems/m^2 in 2005 in response to a single application of Tordon 22K® at 1 quart/acre (Figure 2). In 2006, the continued effect of the herbicide, plus the drought resulted in only 12.1 stems/m^2. In the Phase III study, dalmatian toadflax densities dropped from 117.0 stems/m^2 in 2005 to only 9.9 stems/m^2 in 2006.

Excluding the 2006 drought effects, both the Phase I and Phase II studies (2003-2005 data) have shown that the herbicide applications have had a substantial impact on dalmatian toadflax density. Stem densities were reduced by 61% and 63% in the Phase I and Phase II studies, respectively, while densities continued to increase during the same timeframe in the control plot (increase of 68%). In 2006, adding in the effect of the drought, plus the residual herbicide effects, the dalmatian toadflax densities have been reduced by 90% and 81% in the Phase I and Phase II studies, respectively. In the Phase III study, the herbicide effects plus drought effects have reduced the dalmatian toadflax density by more than 91% in a single year. Based on this information alone and given the small differences in results between the different treatments, a single application of Tordon 22K® at a rate of 1 pint per acre is just as effective as the higher application rates of the other two treatments. It is also evident that drought has a substantial effect on dalmatian toadflax density. The effect of the drought alone on the control plot reduced dalmatian toadflax density from 126.1 stems/m^2 in 2005 to 56.5 stems/m^2 in 2006 (a reduction of 55%).

Although the drought complicates the interpretation of the results, because the drought alone also reduces dalmatian toadflax densities, the fact that the drought occurred across all three treatments equally, at least somewhat negates its effect. A different analysis was done to try and take into

account the effect of the drought on the study results. If 55% of the dalmatian toadflax density reduction from 2005 to 2006 is attributable to the drought (based on the control), then only 20% or 5.7 stems/m^2 of the stem reduction at the Phase I study from 2005−2006 is attributable to the continued effect of the herbicide. This amount combined with the reductions that occurred from 2003 to 2005, means a reduction from 72 stems/ m^2 in 2003 to 22.7 stems/ m^2 in 2006 (68% reduction in stem density) is attributable to the herbicide effects at the Phase I study. Thus the application of 1 pint of Tordon 22K® per acre reduced dalmatian toadflax density by 68%. At the Phase II study, none of the reduction in stem density from 2005-2006 was attributable to the herbicide because the percentage change at the Phase II locations was less than 55% during this time frame. Thus an overall stem density reduction of 63% is attributable to an application of 1 quart of Tordon 22K® for the Phase II study. For the Phase III study, if the 55% reduction in stem density attributable to drought is removed, only 36% or 42 stems/m^2 of the stem density reduction observed in 2006 is attributable to the herbicide application of Tordon 22K® plus Telar®. Based on this analysis, it is apparent that a single application of Tordon 22K® at a rate of 1 pint per acre is more effective at reducing dalmatian toadflax density than the other two treatments. This would also be more cost effective and have less potential environmental side-effects.

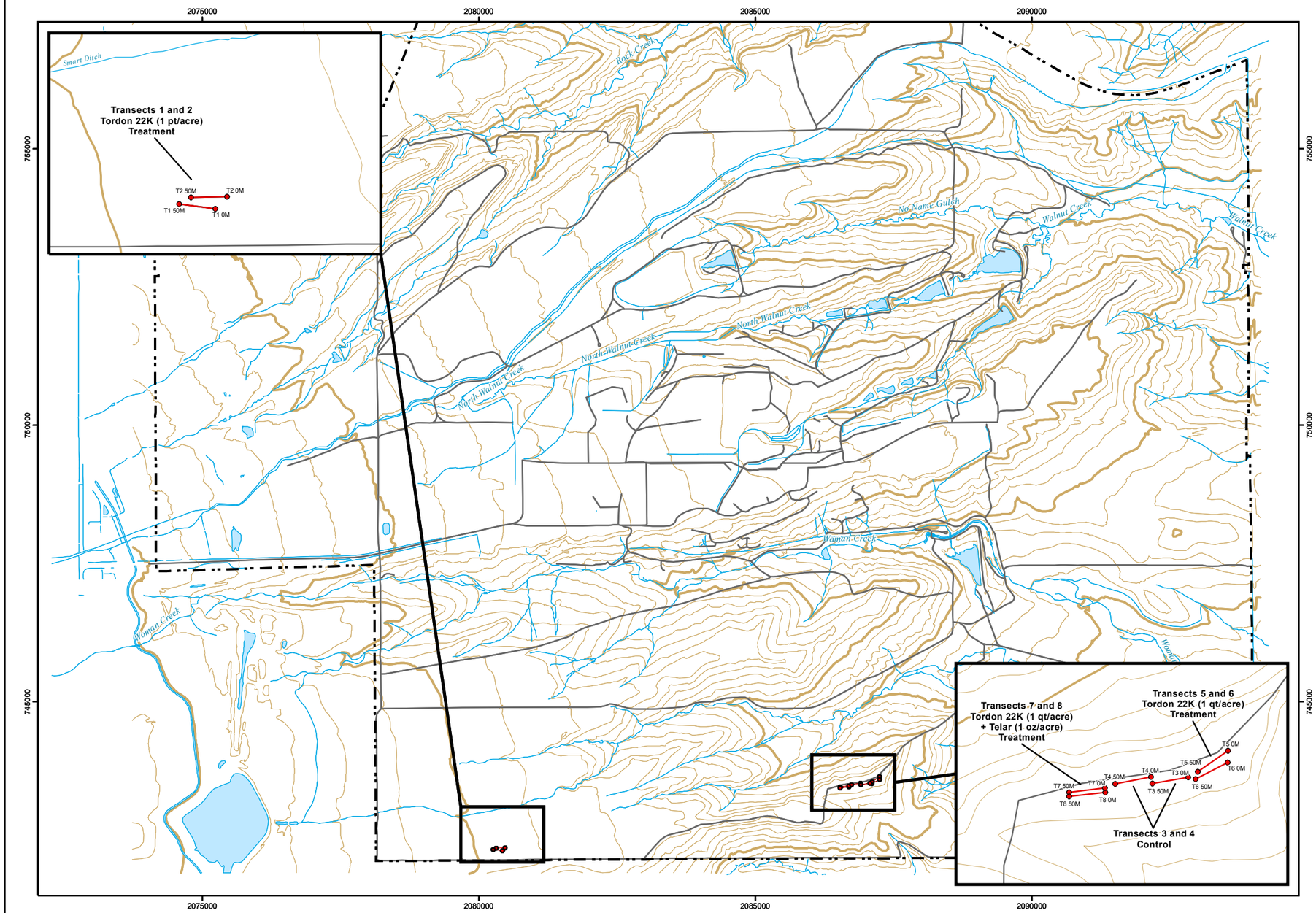
The final conclusion is that using either type of data analysis the results are the same. A single application of Tordon 22K® at a rate of 1 pint per acre just as effective at reducing dalmatian toadflax density as the other two treatments.

Summary

A study was set up in the south POU at the Site to evaluate the impact of three different herbicide applications on dalmatian toadflax density. A three-phase study was conducted to evaluate the effectiveness of Tordon 22K® alone (applied at two different application rates [1 pint/acre and 1 quart/acre]) and Tordon 22K® (1 quart/acre) plus Telar® (1 ounce/acre) on dalmatian toadflax density. The conclusion of the study was that a single application of Tordon 22K® at a rate of 1 pint per acre was more effective at reducing dalmatian toadflax density that the other two treatments under the conditions of this study. So applying higher rates of herbicide did not accomplish greater control (i.e., stem density reduction) of dalmatian toadflax density. This information will help reduce herbicide costs and usage at the Site and reduce the potential environmental impacts of using higher application rates for herbicides.

Dalmatian Toadflax Herbicide Monitoring Transects

Figure 1



LEGEND

- Transect endpoint
- Transect
- Site boundary
- Road
- Stream, ditch, or other drainage feature
- Lake or pond
- Topographic contour (20-foot interval)
- Topographic contour (100-foot interval)

N

SCALE IN FEET

1,000 0 1,000 2,000

STATE PLANE COORDINATE SYSTEM
COLORADO CENTRAL ZONE
NORTH AMERICAN DATUM OF 1927

INSET SCALE = 1:6,000
1 INCH REPRESENTS 500 FEET

U.S. DEPARTMENT OF ENERGY GRAND JUNCTION, COLORADO	Work Performed by **S.M. Stoller Corporation** Under DOE Contract No. DE-AC01-02GJ79491
DATE PREPARED: January 29, 2007	FILENAME: S0296600-01

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Figure 2. Dalmatian Toadflax Stem Density Response to Herbicide Applications