Is Imazapyr an Effective Alternative to Glyphosate for the Control of Jubatagrass?

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ABSTRACT

Jubatagrass is one of the most invasive plants in coastal Northern California. Though the herbicide glyphosate is commonly used to treat it, it has some limitations. It has been found to provide only partial control, and follow-up treatments are often required to control plants that recover or escape treatment. Therefore alternative herbicides have been sought that would give more complete control.

This study is an evaluation of the efficacy of herbicide imazapyr for the management of jubatagrass. Applications of imazapyr were made to jubatagrass by itself and in combination with glyphosate. In initial tests, foliar sprays of this herbicide caused severe stunting, chlorosis and inhibition of flowering but did not kill jubatagrass plants. Foliar applications of glyphosate provided much better control, and the combination of glyphosate and imazapyr was indistinguishable in its effect from that of glyphosate alone. However, a cut-stem treatment of concentrated imazapyr produced results comparable to or superior to that of a cut-stem treatment of glyphosate, and later tests of foliar applications of imazapyr appeared to provide good control of jubatagrass.

This suggests that the lack of efficacy may be due to the failure of jubatagrass plants to absorb imazapyr into the foliage or to translocate it to the root system. Additional research should be performed to determine the reasons for the inconsistent response of jubatagrass to imazapyr. Once the causes of this variability in response have been determined and more consistent control is achieved, imazapyr should prove to be an effective alternative to glyphosate for the management of jubatagrass.

INTRODUCTION

Jubatagrass (Cortaderia jubata) is considered one of the most invasive plants in California (Drewitz and DiTomaso 2004). It is usually controlled by mechanical methods or by applying the herbicide glyphosate. However, use of glyphosate often results in incomplete control and some re-growth often occurs (DiTomaso and Drewitz 2000). It has been suggested that the herbicide imazapyr might be a more effective alternative to glyphosate. This is a non-selective herbicide that works by inhibiting the synthesis of branched-chain amino acids (leucine, isoleucine and valine). In contrast, glyphosate works by blocking the synthesis of aromatic amino acids (tyrosine, tryptophan and phenylalanine).

Imazapyr has been used to control a number of invasive wildland weeds, including smooth cordgrass (Patten 2002). It has been used for the control of jubatagrass in New Zealand (Davenhill 1988) and in Australia (Harradine 1991). In California excellent control of jubatagrass with imazapyr was reported by Drewitz (DiTomaso 2000).

In this study I tested the effect of applying imazapyr, in the form of the herbicide BASF Habitat Herbicide, to jubatagrass plants in the watershed of the San Francisco Public Utilities Commission. Applications were made in test plots in a large infestation of jubatagrass in the Skyline Quarry.

Figure 1. Cut-stem treatment test plots as they appeared in 2010 (top) and in 2012 (bottom) showing greater re-growth of glyphosate treatment in 2012.

Figure 2. Appearance of jubatagrass plants in 2011 before test of Pentrabark spray penetrant (top) and in 2012 after treatment (bottom).

t-Test: Two-Sample Assuming Equal Variances		
	1.75 fl oz/gal	3 fl oz/gal
Mean Height (Inches)	20.38	14.64
Variance	46.10	30.55
Observations	145.00	109.00
Pooled Variance	39.43	
Hypothesized Mean Difference	0.00	
df	252.00	
t Stat	7.21	
P(T<=t) one-tail	0.000000000003	
t Critical one-tail	1.65	
P(T<=t) two-tail	0.000000000007	
t Critical two-tail	1.97	

Figure 3. Chart displaying results of t-test comparison of mean plant heights of jubatagrass treated with two different rates of imazapyr.

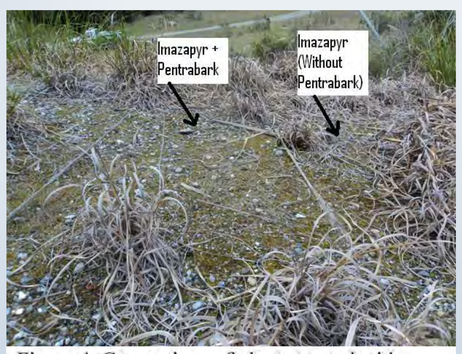

Figure 4. Comparison of plants treated with imazapyr with and without Pentrabark spray penetrant showing similar necrotic appearance.

METHODS

Comparative test of imazapyr and glyphosate. The Initial test of imazapyr on jubatagrass was made in July 2009. In this test a comparison was made of the effects of imazapyr applied at 1% (1.25 fl. oz. per gal. of Habitat Herbicide), of glyphosate applied at 2% (2.5 fl. oz. per gal. of Monsanto Aquamaster) and of the combination of 2% glyphosate and 1% imazapyr.

Test of different rates of imazapyr. To determine the lowest effective rate of imazapyr, a second set of tests was conducted in August 2009. In these tests imazapyr was applied to jubatagrass at the rates of 0.5%, 0.75%, 1%, 1.25% and 1.5% Habitat Herbicide. Because initial results suggested that these rates might be too low, in September 2009 this trial was extended to include higher rates. Additional applications were made of imazapyr at the rates of 1.75%, 2%, 2.5%, 2.75% and 3% Habitat Herbicide.

Test of imazapyr and glyphosate as cut-stem treatment. In April 2010 a third set of tests was performed to compare the effect of imazapyr applied as a cut-stump treatment with that of glyphosate. Both imazapyr and glyphosate were applied at the rate of 50%, and to both treatments was added the penetrant Pentrabark at 3 fl. oz. per gal. A control treatment was also made in which jubatagrass stems were cut but not treated.

Test of spray penetrant. In March 2011 a fourth set of test was performed to evaluate the effect of adding the penetrant Pentrabark to imazapyr spray applications to increase absorption of the herbicide. The treatments were 2% Habitat, 2% Habitat plus Pentrabark applied at the rate of 1 fl. oz. per gal, and a control treatment of Pentrabark applied alone at 1 fl. oz. per gal. Later in March an additional treatment was added of 2% Habitat plus Pentrabark at the rate of 3 fl. oz. per gal, and an additional control treatment was also made of Pentrabark alone at the rate of 3 fl. oz. per gal.

RESULTS

Comparative test of imazapyr and glyphosate. In the comparison of the effects of imazapyr and glyphosate, there appeared to be no effect from the application of imazapyr alone. There were no visible phytotoxic effects a year after treatment. However, the glyphosate treatment caused severe phtotoxicity, and the combination of imazapyr and glyphosate appeared to be identical to glyphosate alone in its effect.

Test of different rates of imazapyr. As in the previous test, there was initially no apparent effect of the imazapyr application in this test, but within 6 months phytotoxic effects were beginning to be seen, and a year after treatment they were quite evident. None of the treated plants were killed, but they appeared chlorotic and stunted, and there was an almost complete inhibition of flowering (Figure 6). There appeared to be differential effects among application rates with higher rates producing greater inhibition of growth, and these differences were statistically significant (Figure 3). These symptoms of chlorosis, stunting and flower inhibition persisted into 2012.

Test of imazapyr and glyphosate as cut-stem treatments. In the cut-stem test the effect of the cut-stem treatments was quite evident by the end of 2010. Most of the plants treated with imazapyr and glyphosate appeared to be dead, with no regrowth, and there appeared to be no difference between treatments. In contrast, untreated control plants recovered and appeared healthy by the end of the year. However, later it was observed that there was re-growth of many of the glyphosate-treated plants, and the two herbicide treatments began to differ significantly. In mid-2012 49 per cent of the glyphosate-treated jubatagrass plants had recovered, while only 19 per cent of the imazapyr treated plants had recovered (Figure 1).

Test of spray penetrant. In the test of adding the spray adjuvant Pentrabark to imazapyr to increase absorption, it was found that this spray mixture produced severe phytotoxicity and apparent death of all treated plants within 8 months after application. However, this effect could not be attributed to addition of Pentrabark because the same effect was observed for plants treated with imazapyr alone (Figure 4). Phytotoxicity was not caused by the Pentrabark because control plants treated with only Pentrabark exhibited none of the symptoms of phytotoxicity.

DISCUSSION

In previous tests, good control of jubatagrass has been achieved with imazapyr. For example, in a New Zealand study imazapyr gave 100 per cent control of jubatagrass approximately 1 year after treatment (Davenhill 1988).

In the present study control of jubatagrass with imazapyr was inconsistent. Applications made in 2009 failed to kill plants but resulted in chlorosis, stunting and inhibition of flowering. However, cut-stump applications made in 2010 gave good efficacy, and foliar applications applied in 2011 proved to be very effective.

These results are in agreement with those of DiTomaso, Drewitz and Kyser (2008). They found that control with imazapyr was inconsistent from year to year and between seasons, with rates of control varying from 99 per cent to less than 20 per cent, and that plants recovered 2 years after treatment.

This inconsistent response to imazapyr is difficult to explain. It could be due to poor absorption of imazapyr, to poor translocation within the plant or to the combined effects of both. The adjuvant Pentrabark was added to the spray mixture to overcome a possible problem with poor absorption. However, this effect was not demonstrated because the treatment containing imazapyr but lacking Pentrabark was equally effective.

Unlike the relatively rapid response to glyphosate, the response to imazapyr took months to be exhibited. It appears that jubatagrass plants may be able to survive for a much longer period of time when starved of branched chain amino acids than when starved of aromatic amino acids.

Additional tests should be performed to determine the barriers to herbicidal activity. If lack of absorption is a factor, additional tests with a spray penetrant, such as Pentrabark, may reveal this to be the cause. If lack of translocation within the plant is due to seasonality in the direction of phloem flow, tests could be performed in different months of the year to determine the optimum time of year for application of imazapyr.

Imazapyr appears to be at least as effective as glyphosate as a cut-stump treatment for the control of jubatagrass. Because of this, it should also be as effective as a foliar treatment if the barriers to control can be understood and overcome.

Figure 5. Chlorotic, stunted jubatagrass plants treated with imazapyr in background with untreated plants in foreground for contrast.

Figure 6. Closer view of chlorotic, stunted jubatagrass plants treated with imazapyr.

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