Total Vegetation Control for Industrial Sites
Second Year Results

Introduction

Total vegetation control is required for several types of industrial sites, including power substations, roadside vegetative free zones, storage lots, pipeline facilities, etc. Maintenance and safety issues are prevalent in these sites as the presence of vegetation can have several detrimental effects. Power substations and pipeline yards need to be vegetative free to remove fire fuel load and decrease the possibility of vegetation causing equipment failure and increased maintenance costs. Highway roadsides need to have a vegetative free zone underneath guardrails and in vehicle recovery zones for several reasons. Vegetation existing at pavements edge can block drainage resulting in standing water. These areas will also pose safety and maintenance concerns if vegetated due to fire concerns from accidents and littering of ignited material (i.e. cigarettes) and the effects vegetation will have in increasing the amount of cracks in the pavement and increasing freeze – thaw potential.

Applications of broad spectrum residual herbicides have become the mainstay for bareground maintenance operations. Preemergent type herbicides work by inhibiting the germination of seeds present in the soil / strata or being translocated via the roots and/or seed shoots. Examples of these types of herbicides are those containing prodiamine, pendimethalin, bromacil, and diuron. If actively growing weeds are present, it is necessary to combine the preemergent compound with a postemergent herbicide such as glyphosate or imazapyr. Many compounds offer both pre and post emergent activity. Examples of these include flumioxazin, diuron, and sulfumeturon. There is a balance in choosing the most effective compounds to create the desired results while minimizing off target damage and cost per acre.

A study was initiated in April of 2004 to examine the ability of several 'bareground' products and combinations with other herbicides for duration of control. The entire study was reapplied on the same plots in April of 2005 to determine the effect of sequential applications on duration of total vegetation control and effectiveness of site reclamation.

Methods and Materials

The study was initiated in April of 2005 to compare flumioxazin, pendimethalin, and diuron as bareground products for length of control. The study site was a retired storage area along Interstate 75 in central Kentucky. The study site had areas completely covered with herbaceous vegetation while other areas still completely void of vegetation from the previous years application. The substrate was a compacted gravel base with little to no soil present with essentially no slope differences within and between the study blocks. Twenty seven chemical treatments and one untreated control were screened in a completely randomized block design with three replications (Table 1).

Table 1: Treatment list for bareground trial (Note: Prices based on 2004 estimates)

Treatment	Compound	Active Ingredient(s)	Rate per acre	Cost per acre
1	Payload + Arsenal	flumioxazin + imazapyr	8 oz + 12 fl oz	$71.00
2	Payload + Arsenal	flumioxazin + imazapyr	8 oz + 16 fl oz	$77.00
3	Payload + Arsenal	flumioxazin + imazapyr	8 oz + 32 fl oz	$106.00
4	Payload + Arsenal	flumioxazin + imazapyr	10 oz + 12 fl oz	$82.00
5	Payload + Arsenal	flumioxazin + imazapyr	10 oz + 16 fl oz	$89.00
6	Payload + Arsenal	flumioxazin + imazapyr	10 oz + 32 fl oz	$118.00
7	Payload + Arsenal	flumioxazin + imazapyr	12 oz + 12 fl oz	$94.00
8	Payload + Arsenal	flumioxazin + imazapyr	12 oz + 16 fl oz	$101.00
9	Payload + Arsenal	flumioxazin + imazapyr	12 oz + 32 fl oz	$130.00
10	Payload	flumioxazin	8 oz	$49.00
11	Payload	flumioxazin	10 oz	$61.00
12	Payload	flumioxazin	12 oz	$73.00
13	Payload + Oust	flumioxazin + sulfumeturon	8 oz + 3 oz	$81.00
14	Payload + Oust	flumioxazin + sulfumeturon	10 oz + 3 oz	$93.00
15	Payload + Oust	flumioxazin + sulfumeturon	12 oz + 3 oz	$105.00
16	Payload + RoundUp Pro	flumioxazin + glyphosate	8 oz + 64 fl oz	$71.00
17	Payload + RoundUp Pro	flumioxazin + glyphosate	10 oz + 64 fl oz	$83.00
18	Payload + RoundUp Pro	flumioxazin + glyphosate	12 oz + 64 fl oz	$95.00
19	Pendulum AquaCap + Arsenal	pendimethalin + imazapyr	64 fl oz + 12 fl oz	$46.00
20	Pendulum AquaCap + Arsenal	pendimethalin + imazapyr	64 fl oz + 16 fl oz	$53.00
21	Pendulum AquaCap + Arsenal	pendimethalin + imazapyr	128 fl oz + 12 fl oz	$70.00
22	Pendulum AquaCap + Arsenal	pendimethalin + imazapyr	128 fl oz + 16 fl oz	$77.00
23	Sahara	diuron + imazapyr	12 lb	$107.00
24	Sahara	diuron + imazapyr	16 lb	$143.00
25	Sahara + RoundUp Pro	diuron + imazapyr + glyphosate	12 lb + 64 fl oz	$130.00
26	Sahara + RoundUp Pro	diuron + imazapyr + glyphosate	16 lb + 64 fl oz	$165.00
27	Endurance + Arsenal	prodiamine + imazapyr	2 lb + 12 fl oz	$83.00
28	Untreated			

Predominant vegetation at the second year initiation included decumbent lespedeza, white and red clover, and tall fescue. Plots were 3.3’ X 20’ with 5’ running checks in between plots. Applications were made on April 20th, 2004 using a CO_2 powered sprayer equipped with 2 TeeJet 8008 SS flat fan nozzles at 50 GPA. All treatments included a nonionic surfactant at 0.25 % v/v. Costs per acre are approximate and are for comparison purposes only.

Data collected in the first trial included pre-application measurement of cover by species, percent cover of dead vegetation, and percent cover bareground. Follow up measurements were taken at approximately two week intervals after treatment. Data were analyzed using analysis of covariance (pre-application data as the covariate) in SAS software and adjusted treatment means were compared at each time interval using Tukey's Honest Significant Difference (HSD) method at p = 0.05.

The second application was performed on April 15th, 2005 with the same methodology as the first trial. Data collected was performed on a less intense schedule than the first trial and was collected at 3, 10, 15, and 21 WAT (weeks after treatment). Data analysis was performed with the same methodology as the first year's data set.

Results and Discussion

Results discussed here will focus on the results of the 2005 application as compared to the 2004 application. Complete results from the 2004 application discussing site reclamation with one application can be found in Noncrop and Industrial Vegetation Management Weed Science 2004 Annual Research Report (Information Note 2005 NCVM-1). Results presented here will statistically compare treatment means with the 2005 year and discuss differences and similarities with the 2004 trial.

Second Year Results

All treatments, including the untreated, had relatively high levels of percent bareground (> 65%) at 3WAT (Table 2). The levels of bareground achieved at this time interval is higher than that at a similar time period in the first year (Table 3). This shows the effectiveness of these treatments to provide increased levels of control at early stages of evaluation after sequential applications.

There were no statistically significant differences in any of the Payload / Arsenal tank mixes at any evaluation interval during the second year trial (Table 2). The highest levels of control generally occurred at 10 WAT, with the exception of Payload @ 10 oz + Arsenal @ 16 fl oz, which occurred at 3 WAT, and Payload @ 10 oz + Arsenal @ 32 fl oz, which occurred at 15 WAT; however, these differences should not be considered operationally significant. A trend does exist that shows increased levels of control with the high rate of Arsenal (32 fl oz) regardless of the rate of Payload. Second year results generally showed operationally higher levels of control at the end of the trial as compared to the end of the first year trial (Figure 1). This can be attributed to the effect of the 2004 application in reducing weed pressure and difference in precipitation amounts between the two years as rainfall levels in 2004 were above normal while rainfall levels in 2005 were below normal.

Two rates of Payload alone, 8 and 10 oz, had effective levels of control (> 85 %) at 3 WAT (Table 2). Similar to the first year results, these control levels began to decrease between the 3 and 10 WAT evaluations and continued to decline throughout the trial. The Payload / Oust tank mixes produced similar results in the second year as in the first year. Levels of control were far superior to that of the Payload alone treatments through the entire second year. Levels of control with the Payload / Oust tank mixes were relatively higher at the end of the second year as compared to the end of the first year (Figure 2). Payload / RoundUp tank mixes provided effective levels of control at 3 WAT in the second year (> 90 %); however, declined to unacceptable levels at the end of the second year (Figure 2). Results with the Payload / RoundUp tank mixes at the end of the second growing season were similar to those at the end of the first growing season (Figure 2).

Pendulum Aquacap treatments showed acceptable levels of control at 3WAT; however, control levels began to decrease between the 3 and 10 WAT evaluations. The high rate of Pendulum Aquacap (128 fl oz) tank mixed with RoundUp at 64 fl oz showed acceptable levels of percent bareground (> 90 %) at 15 WAT yet these control levels dropped sharply (69 %) at 21 WAT (Table 2). Results of the Pendulum Aquacap treatments at the end of the second year were consistent with the results of the same treatments at the end of the first year (Figure 3).

Sahara treatments performed very well and had control levels greater than 90% for all treatments through 15 WAT (Table 2). These treatments maintained somewhat acceptable levels of control (> 85 %) through 21 WAT. There were no significant differences between any of the Sahara treatments during the entire second year. Results at the end of the second growing season were comparable to those at the end of the first growing season (Figure 3).

Table 2: Least Square Means for Second Year Application of Bareground Trial

TRT	3WAT*	$HSD_{0.05}$ 23.93	10WAT*	$HSD_{0.05}$ 28.72	15WAT*	$HSD_{0.05}$ 36.71	21WAT*	$HSD_{0.05}$ 36.75
1	92.43	abc	97.84	a	88.88	ab	81.28	a-d
2	90.39	abc	98.64	a	82.83	ab	67.64	a-d
3	92.77	abc	96.04	ab	94.79	ab	85.48	a-d
4	85.27	abc	92.84	abc	85.21	ab	70.11	a-d
5	95.71	a	93.85	ab	80.69	abc	71.44	a-d
6	90.08	abc	95.21	ab	97.18	a	84.73	a-d
7	92.77	abc	96.04	ab	89.79	ab	66.31	a-d
8	84.11	abc	91.04	a-d	88.63	ab	70.97	a-d
9	92.51	abc	97.51	ab	92.51	ab	85.17	a-d
10	86.73	abc	63.11	de	76.27	abc	62.14	a-d
11	93.28	a	78.49	a-e	69.74	abc	56.14	cd
12	68.85	c	68.94	b-e	60.26	bc	60.16	a-d
13	94.81	a	96.67	ab	81.55	abc	95.59	a
14	93.86	a	96.37	ab	97.34	a	94.92	a
15	95.91	a	97.01	ab	97.43	a	96.37	a
16	92.97	ab	78.54	a-e	80.41	abc	58.22	bcd
17	95.01	a	92.51	abc	86.33	ab	60.01	a-d
18	99.11	a	92.99	abc	81.74	ab	74.47	a-d
19	91.45	abc	89.13	a-d	82.71	ab	60.68	a-d
20	91.99	abc	94.85	ab	84.15	ab	69.31	a-d
21	73.13	bc	64.51	cde	59.83	bc	54.03	d
22	82.24	abc	94.87	ab	92.31	ab	69.36	a-d
23	92.26	abc	95.89	ab	91.11	ab	88.78	a-d
24	91.17	abc	95.55	ab	97.23	a	86.84	a-d
25	94.49	a	97.35	ab	97.47	a	92.14	abc
26	94.49	a	97.35	ab	97.47	a	94.64	ab
27	82.45	abc	89.85	a-d	84.31	ab	72.83	a-d
28	69.24	bc	49.97	e	44.98	c	17.03	e

Note: An asterisk (*) denotes significant treatments effect at p = 0.05 at corresponding evaluation interval.

Table 3: Least Square Means for First Year Application of Bareground Trial

Trt	2WAT*	$HSD_{0.05}$ 55.25	10WAT*	$HSD_{0.05}$ 40.33	14WAT*	$HSD_{0.05}$ 66.18	18WAT*	$HSD_{0.05}$ 61.5
1	52.9	a	88.6	abc	85	ab	63.1	a
2	30	a	84.1	abc	57.9	ab	47.9	a
3	51.3	a	91.4	ab	84.3	ab	72.3	a
4	45.6	a	82.8	abc	83.1	ab	71.7	a
5	27.7	a	63.2	abcde	67	ab	50	a
6	58.8	a	89.4	ab	83.8	ab	71.5	a
7	40.6	a	85.2	abc	78.1	ab	53.9	a
8	45.9	a	77.6	abcd	73.3	ab	58.7	a
9	53.9	a	97.2	ab	86.3	ab	64.4	a
10	21	a	39.8	de	50.7	ab	48.6	a
11	47.1	a	80	abc	80.6	ab	71.8	a
12	48.2	a	46	cde	50	ab	50.4	a
13	43.3	a	90.7	ab	88.1	ab	71.8	a
14	44.6	a	96.1	ab	91.4	ab	87.5	a
15	33.1	a	98.4	a	98.2	a	89.7	a
16	54.5	a	68.8	abcde	82.8	ab	60.4	a
17	42.3	a	72	abcd	66.1	ab	42.5	a
18	46.9	a	84	abc	84.4	ab	83.8	a
19	34.6	a	57.4	bcde	63.3	ab	62.9	a
20	27.6	a	83.7	abc	77.9	ab	69.1	a
21	33.6	a	75.7	abcd	76.3	ab	62.6	a
22	35.7	a	79.1	abcd	74.4	ab	64.8	a
23	37.5	a	97.3	a	93.1	ab	82.7	a
24	57.7	a	95.9	ab	95.7	a	89.7	a
25	48.9	a	100	a	97	a	88.1	a
26	49	a	100	a	99.7	a	91.6	a
27	32.3	a	65.9	abcde	50.1	ab	59.4	a
28	20.5	a	32	e	45.2	b	55.3	a

Note: An asterisk (*) denotes significant treatments effect at p = 0.05 at corresponding evaluation interval.

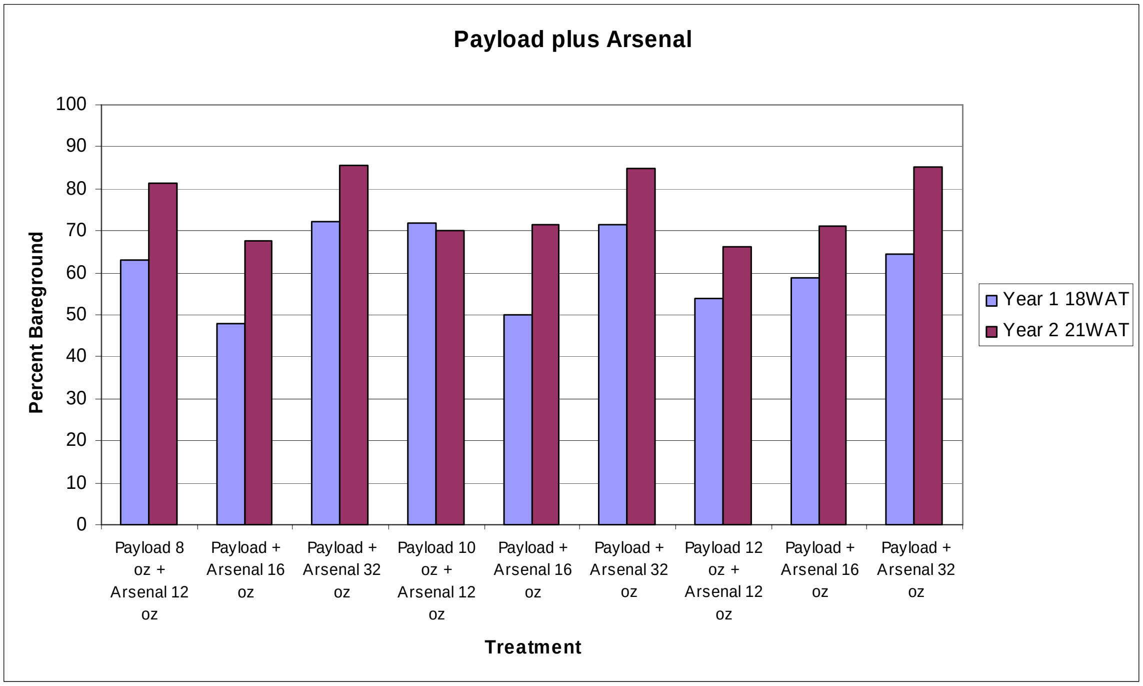

Figure 1: Least Square Means for First and Second Year Trials at End of Evaluation for Payload / Arsenal Tank Mixes

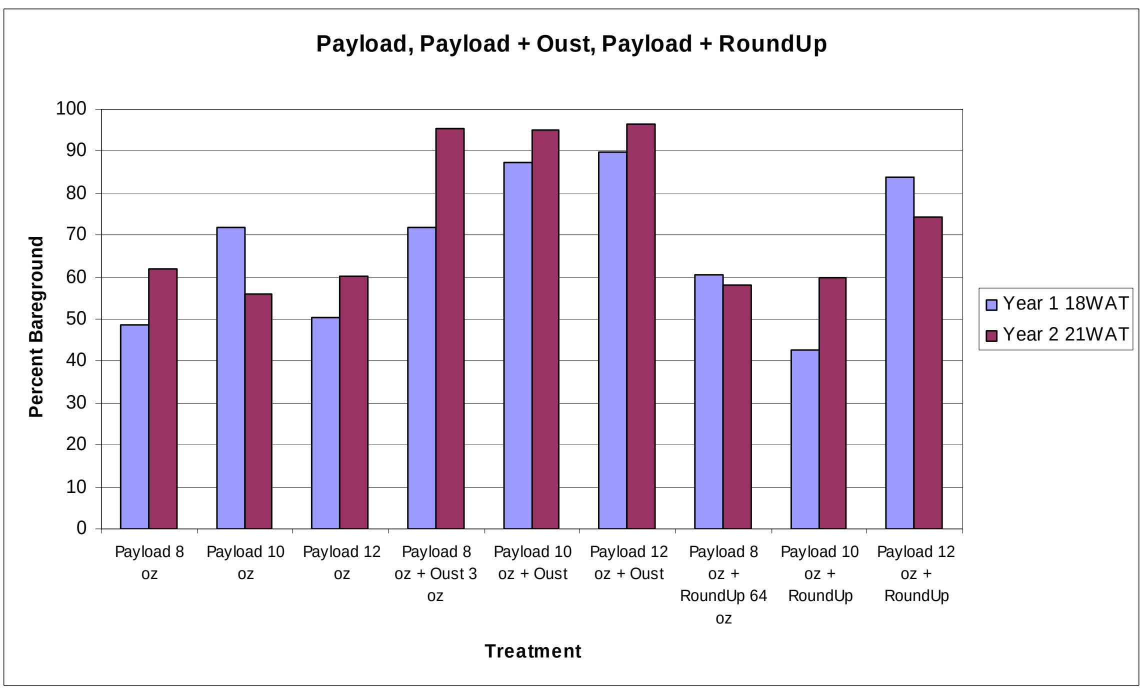

Figure 2: Least Square Means for First and Second Year Trials at End of Evaluation for Payload / Oust, Payload / RoundUp Tank Mixes and Payload Alone

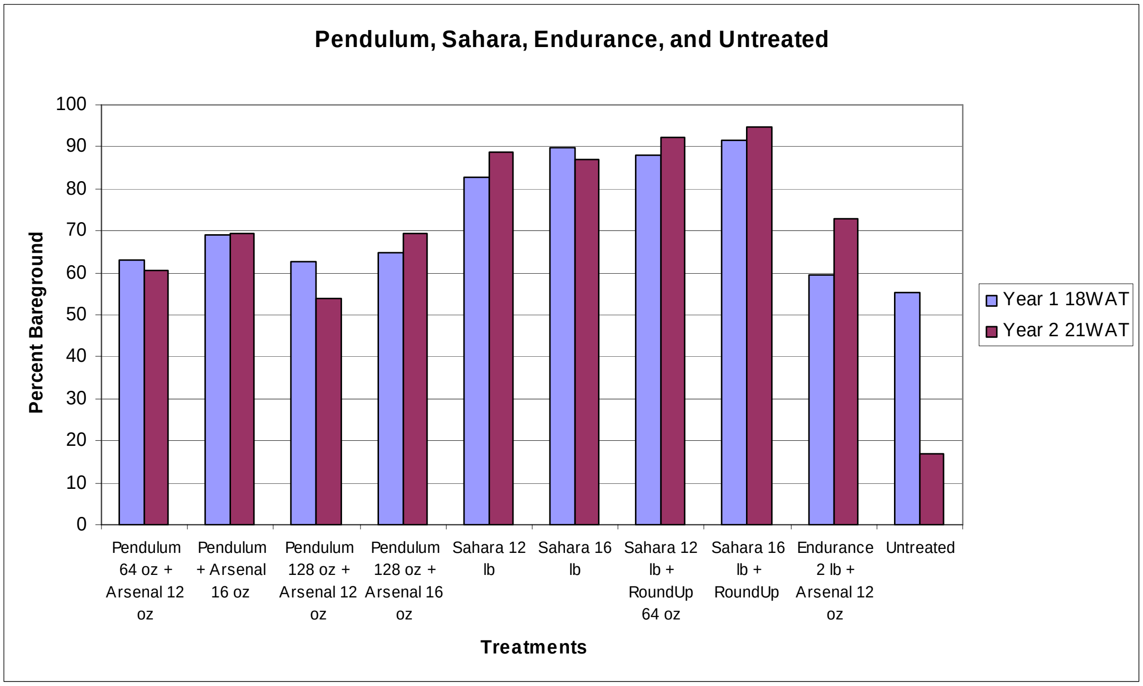

Figure 3: Least Square Means for First and Second Year Trials at End of Evaluation for Pendulum Aquacap, Sahara, Endurance, and Untreated