

Response of 3 Native Hawaiian grasses to 5 Postemergence grass herbicides.

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Introduction

The use of native plant species for revegetation efforts in conservation zones, highway rights-of-way and in commercial and government landscapes has received increased interest across the U. S. In Hawaii, Acts 73 and 236 are laws which encourage landscape architects in the to use “indigenous” and “Polynesian introduced” plants in State funded projects. Weed control is an important component of any successful crop production system and the establishment and production of native Hawaiian species is no different. Control of grassy weeds in production sites and newly established landscapes where native grasses are present is a challenging management issue. Herbicides that control grassy weeds while minimizing detrimental impact to stands of native Hawaiian grasses would be a powerful and important tool for plant producers and landscape managers.

Herbicides that can selectively control grassy weeds in broadleaf crops have been commercially available for 15-20 years. These grass herbicides can illicit a wide range of effects from complete kill to varying levels of growth suppression. There is no literature describing the response of native Hawaiian grasses to commercially available postemergence grass herbicides.

The research presented here was designed to characterize the response of 3 native Hawaiian grasses, with potential for use in revegetation efforts, to 5 commonly available grass herbicides. In this experiment, the growth response of Pili grass (PG-Heteropogon contortus, HA 5478, NRCS accession #9079683), Emoloa (EM-Eragrostis variabilis, HA 5746, NRCS accession #9079729) and Aki aki (AA-Sporobolus virginicus, HA 5802, NRCS accession #9079745) to spray applications of 5 commercially available selective postemergence grass herbicides will be determined.

The herbicides evaluated for injury and growth effects on 3 native Hawaiian grasses are: Assure II (quizalofop p-ethyl, DuPont), Fusilade DX (fluazifop-p-butyl, Syngenta), Plateau (imazapic ammonium salt, BASF T&O), Prism (clethodim, Valent) and Vantage (sethoxydim, Micro Flo Company LLC). All herbicides evaluated, except Fusilade DX have use sites that include highway rights-of-way, non-crop areas and out door ornamental sites.

Materials and Methods

Vegetatively propagated stems of AA were planted to 72-cell trays on 03/15/05, seeds of EM and PG were planted to 72-cell trays on 06/07/05 and 06/17/05, respectively. A single row of each grass was planted into field plots on 11/07/05 resulting in plant ages of 206, 153, and 143 days for AA, EM and PG respectively. All transplants were set in rows 2 feet apart. PG and EM were spaced 2 feet apart within rows, AA was spaced 4 feet apart in rows. An experimental unit consisted of 3 rows of grass within a plot that was 6 ft. x 15 ft. The 11 treatments in this experiment were replicated 4 times. The day after planting, on 11/08/05, a granular application of Ronstar (oxadiazon, Bayer) was applied over the entire experimental area at a rate of 200 lb of formulated product/acre (4.0 lb active ingredient/a). Overhead irrigation was supplied in a manner and amount consistent with maximum growth and establishment success. On 11/21/05, 14 days after planting, the entire

experimental area was fertilized with 50 lb N/a as 16-16-16 16 with minors (1% Mg, 1% S, 1.5% B, and 1% Fe).

On 01/17/06, 71 days after planting, herbicides treatment were applied with an electric powered 12-volt diaphragm pump sprayer calibrated to apply 40 gallons per acre with an operating pressure of 15 PSI using a 3 nozzle boom fitted with 8004 LP (TeeJet Spray Systems) spray tips. The finish spray volume was 3 liters. All spray treatments contained the non-ionic surfactant LI-700 (Loveland Industries) at .25% v/v. Herbicide rates were set at levels within the killing dose range as specified on the product label. A detailed description of the herbicides rates of application are provided in Table 1.

Table 1, Herbicides and rates for application to 3 native Hawaiian grasses. The herbicide formulations used in the experiment were Assure II (0.88 lb ai/gal), Fusilade DX (2.0 lb ai/gal), Vantage (1.0 lb ai/gal), Prism (0.94 lb ai/gal) and Plateau (70% DG-dry granular)

Herbicides	Labeled Recommended Rates of Formulated product per acre	lb. ai/a	Amount ml or grams/3liter of finished spray
1 Assure II (.88 lb ai/gal)	8 oz	.06	4.7 ml
2 Assure II	12 oz	.08	7.0 ml
3 Fusilade DX (2.0 lb ai/gal)	12 oz/a	.19	7.0 ml
4 Fusilade DX	16 oz/a	.25	9.4 ml
5 Vantage (1.0 lb ai/gal)	44 oz/a	.34	25.8 ml
6 Vantage	60 oz/a	.47	35.2 ml
7 Prism (.94 lb ai/gal)	24 oz/a	.18	14.1 ml
8 Prism	34 oz/a	.25	19.9 ml
9 Plateau DG (70 %)	2.88 dry oz	.13	1.6 g
10 Plateau DG	4.32 oz – 3-bags	.19	2.4 g
11 Untreated			

On 03/09/06, 49 days after herbicides were applied, a visual rating for % of maximum growth vigor was recorded and three plants of each grass types were cut at the soil surface and dried in a forced air oven to measure biomass accumulation in response to herbicide applications. Since all treatments did not contain 3 representative plants, dry weights are expressed on a per plant basis to more accurately reflect biomass accumulation. All plants not sampled for dry weight accumulation were also cut at the soil surface so that that a second dry weight sample could be collected with all plants responding to the same mowing treatment. After cutting plants, the entire experimental site was fertilized with 50 lb N/a applied as urea (46-0-0) and treated with 200 lb/a of Ronstar G (4.0 lb ai/a oxadiazon) preemergence herbicide. Irrigation continued on a similar basis as previously described.

On 06/07/06, which was 141 days after herbicide spray application and 90 days after the previous cutback of plants, a visual rating for growth vigor was recorded and two plants of each grass were sampled to a measure biomass accumulation in response to herbicide applications. As in the first sampling, not all treatments contained two representative plants to reflect an accurate growth response. In those plots, only one plant was collected. The data for dry weight accumulation for both harvest dates are expressed on a per plant basis.

All treatments were replicated 4 times. Data for individual grass species for vigor ratings and dry weight accumulation were analyzed as a completely randomized block design, see Table 2 for a field map of the experimental plots. Although all three grasses were present in each plot, their planting orientation was the same in all blocks, thus preventing data analysis as a two way factorial with factor A being the grass species and factor B being herbicide treatments. A factorial analysis would have allowed for comparisons between grass species for their response to herbicide treatments. Randomization of grass species orientation within plots or blocks was not done to simplify planting and to minimize differences in plant response due to grass growth habit (i.e. strong upright clump growth in PG, spreading clump growth with EM and vertically spreading stolon growth with AA). When appropriate, means were separated using Duncan’s Multiple Range test at the level of significance of the associated F-Test. All statistical analyses were conducted using the MSTAT computer program.

Table 2, field map at the Plant Materials Center on Molokai to determine the response of 3 native Hawaiian grasses to 5 post emergence grass herbicides applied at two rates. See Table 1 for a detailed description of herbicide treatments. An experimental unit was 6 feet wide and 15 feet long with a total of 11 treatments. Each experimental unit contained 3 rows of grasses with a between row spacing of 2 feet.

ENTIRE EXPERIMENT IS 165 FT. LONG	36 FEET WIDE			
	REP I	REP II	REP III	REP IV
	1	5	6	4
	9	7	10	3
	3	8	11	9
	5	11	9	6
	7	9	2	5
	11	3	1	10
	4	6	7	8
	10	2	4	7
	8	10	8	1
6	4	5	11	
2	1	3	2	

Results

The native Hawaiian grasses used in this experiment demonstrated a wide range of growth response to the application of selective postemergence grass herbicides. Growth vigor ratings and dry weight accumulation recorded at 49 days after spray application are presented in Table 3. Field plot images of representative treatments presented in Table 3 are illustrated in Table 5. Growth vigor ratings and dry weight accumulation recorded at 141 days after spray application and 90 days after the previous cutting for dry weight sampling is presented in Table 4. Field plot images of representative treatments presented in Table 4 are illustrated in Table 6.

At 49 days after spraying, it is clear that all herbicides except Plateau DG caused a reduction in vigor and dry weight accumulation in all grass species except PG. Dry weight accumulation in PG was not significantly reduced by Plateau DG and had a numerically higher value (at the higher rate) than untreated plants. The high rate of Plateau DG reduced the dry weight accumulation of EM and AA by 50% and 61% respectively.

At 141 days after spraying and 90 days after the previous cut back of plants, PG vigor and dry weight accumulation was significantly reduced by all herbicides except the high rate of Plateau DG. The dry weight accumulation of EM was significantly reduced by the higher rate of Assure II and Fusilade DX. The dry weight of AA was significantly reduced by the higher rates of Plateau DG, Fusilade DX and Vantage. All herbicides significantly reduce the growth vigor of all grasses except the higher rate of Plateau DG in PG. None of the herbicides were able to cause a complete kill on any grass species.

Discussion

It was somewhat surprising that none of the herbicide applications caused a complete kill of the grasses evaluated in this experiment. The rates of application for all herbicides were well within the killing dose range as specified on the product labels. All grasses were actively growing when treated thus insuring a rigorous screening for inhibitory effects caused by the herbicides. It is generally recognized that smaller plants are more susceptible to herbicides than larger ones. It is reasonable to assume that the application of these herbicides at the rates reported here would cause higher levels of stunting and even death if applied to younger plants than those used in this experiment.

The data provide clear direction for the use of these selective grass herbicides for the control of weeds in these three Hawaiian grass species. For PG, Plateau DG should be useful in controlling weeds actively growing when treated as well as weeds emerging from seeds. Plateau DG has both preemergence and postemergence activity and should be useful in both plant production and landscape settings. Plateau DG controls a wide range of grass and broadleaf weeds. The Plateau DG label should be consulted to determine if a specific weed can be controlled prior to using it on a large scale. The only other herbicide that appears to be safe enough for use in PG is Prism. Although the lower rate of Prism did cause a 60% reduction in PG biomass accumulation, it may be useful for controlling grassy weed seedling in larger stands of PG when employing a spot treatment application technique.

Herbicides were generally more inhibitory on EM than they were on PG and AA. Only the low rate of Vantage, Prism and Plateau DG should be used in EM and only as a spot treatment to small weed seedlings. AA was most sensitive species to Plateau DG and this is consistent with the product label that lists two

Sporobolus weed species as being control by this chemical. Assure II and Prism appears to be the only herbicides with potential use as spot treatment sprays to small grassy weed seedlings in AA.

The integration of numerical data and images of representative plots was used to rank herbicides from most inhibitory to least inhibitory for each grass species. With PG; Vantage > Assure II > Fusilade DX > Prism > Plateau DG. With EM; Assure II > Fusilade DX > Prism \geq Plateau DG \geq Vantage. With AA; Plateau DG > Vantage > Fusilade DX \geq Prism > Assure II.

All the herbicides evaluated in this experiment allow for application to weedy plants in a variety of locations that are important land managers of highway right-of-ways, airports, parks and other non-crop areas. Fusilade DX is the only product that does not have a non-crop use site. However, the same active ingredient packaged under the trade name Fusilade Turf and Ornamental (Syngenta) can be used in non-crop areas. This research has special importance where the growth of these native Hawaiian grasses is desired along roadways. All these herbicides can be used to kill certain grassy weeds in sites that include highway “right-of-ways”. Plateau DG also has broad leaf weeds listed on the label. No additional label changes are required to use these herbicide in and around stands of these native Hawaiian grasses when they are growing along road sides and similar non-crop areas.

Acknowledgements and Disclaimer

Trade names are used in this report for the convenience of readers and do not constitute and exclusive endorsement of the University of Hawaii, the Cooperative Extension Service, the USDA nor the Natural Resources Conservation Service. The information contained here is not a recommendation for use. It is a violation of state and federal law to use any pesticide in manner inconsistent with its labeling.

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Table 3, visual ratings of % maximum growth vigor and dry weight accumulation of 3 native Hawaiian grasses in response to spray application of 5 post emergence grass herbicides. Ratings and dry weight samples were collected on 03/07/06, which was 49 days after spray application of herbicides.

Herbicides	Recommended Rates of Formulated product per acre	PG Vigor (%)	PG Dry wt./plant (g)	EM Vigor (%)	EM Dry wt./plant (g)	AA Vigor (%)	AA Dry wt./plant (g)
1 Assure II	8 oz	27.50 b	5.90 c	16.25 d	4.20 b	60.00 b	8.20 b
2 Assure II	12 oz	25.00 b	7.00 c	6.25 d	3.70 b	53.75 b	7.30 b
3 Fusilade DX	12 oz/a	30.00 b	5.90 c	25.00 cd	5.20 b	61.25 ab	7.70 b
4 Fusilade DX	16 oz/a	28.75 b	4.40 c	16.25 d	4.80 b	48.75 b	6.90 b
5 Vantage	44 oz/a	32.50 b	9.40 c	41.25 bc	7.70 b	58.75 b	5.70 b
6 Vantage	60 oz/a	30.00 b	7.70 c	25.00 cd	5.50 b	48.75 b	5.10 b
7 Prism	24 oz/a	31.25 b	6.30 c	51.25 b	8.30 b	62.50 ab	5.40 b
8 Prism	34 oz/a	43.75 b	8.30 c	47.50 b	6.30 b	56.25 b	6.90 b
9 Plateau DG	2.88 dry oz	75.00 a	19.80 bc	50.00 b	7.30 b	55.00 b	5.80 b
10 Plateau DG	4.32 dry oz	84.00 a	46.50 a	43.75 bc	8.50 b	50.00 b	6.10 b
11 Untreated		92.50 a	40.50 ab	83.25 a	17.20 a	89.50 a	16.00 a
F-test level of significance		1%	1%	1%	1%	1%	1%

Means within a column followed by the same letter are not significantly different according to Duncan’s Multiple Range test.

Table 4, visual ratings of % maximum growth vigor and dry weight accumulation of 3 native Hawaiian grasses in response to spray application of 5 post emergence grass herbicides. Rating and dry weight samples were collected on 06/07/06, which were 141 days after spray application of herbicides and 90 days after previous cutting.

Herbicides	Recommended Rates of Formulated product per acre	PG Vigor (%)	PG Dry wt./plant (g)	EM Vigor (%)	EM Dry wt./plant (g)	AA Vigor (%)	AA Dry wt./plant (g)
1 Assure II	8 oz	33.75 efg	25.50 b	17.25 de	14.00 abc	60.00 bc	48.75 a
2 Assure II	12 oz	33.75 efg	23.75 b	6.25 e	2.25 c	62.50 b	45.38 ab
3 Fusilade DX	12 oz/a	52.50 de	49.75 b	29.75 cde	16.50 abc	55.00 bc	54.63 ab
4 Fusilade DX	16 oz/a	37.50 defg	34.13 b	12.75 e	5.00 bc	35.00 c	33.00 b
5 Vantage	44 oz/a	28.75 fg	26.25 b	53.50 bc	35.00 ab	48.75 bc	40.25 b
6 Vantage	60 oz/a	23.75 g	15.13 b	42.25 bcd	21.13 abc	36.25 bc	31.38 b
7 Prism	24 oz/a	55.00 cd	61.00 b	58.50 abc	33.50 abc	62.50 b	48.75 ab
8 Prism	34 oz/a	47.50 def	31.00 b	41.00 bcd	20.50 abc	52.50 b	41.63 ab
9 Plateau DG	2.88 dry oz	73.75 bc	71.75 b	62.25 ab	20.88 abc	62.50 b	41.50 ab
10 Plateau DG	4.32 dry oz	87.00 ab	126.4 a	47.25 bc	14.25 abc	33.75 c	24.25 b
11 Untreated		95.25 a	150.0 a	83.50 a	42.25 a	95.75 a	75.25 a
F-test level of significance		1%	1%	1%	1%	1%	5%

Means within a column followed by the same letter are not significantly different according to Duncan's Multiple Range test.

Table 5, images of 3 native Hawaiian grasses in response to 5 herbicides applied as sprays. Images recorded on 03/09/06, which was 49 days after herbicide applications. In all images, the grasses from left to right are AA, EM and PG.



Photo 1, Assure II at 8.0 oz/a

Photo 2, Assure II at 12 oz/a



Photo 3, Fusilade DX at 12 oz/a

Photo 4, Fusilade at 16 oz/a



Photo 5, Vantage at 44 oz/a

Photo 6, Vantage at 60 oz/a

Table 5 con't, images of 3 native Hawaiian grasses in response to 5 herbicides applied as sprays. Images recorded on 03/09/06, which was 49 days after herbicide applications. In all images, the grasses from left to right are AA, EM and PG.



Photo 7, Prism 24 oz/a

Photo 8, Prism at 34 oz/a



Photo 9, Plateau DG at 2.88 dry oz/a

Photo 10, Plateau DG at 4.32 dry oz/a



Photo 11, Untreated

Table 6, images of 3 native Hawaiian grasses in response to 5 herbicides applied as sprays. Images recorded on 06/07/06, which were 141 days after spray application of herbicides and 90 days after previous cutting. In all images, the grasses from left to right are AA, EM and PG.



Photo 1, Assure II at 8.0 oz/a

Photo 2, Assure II at 12 oz/a



Photo 3, Fusilade DX at 12 oz/a

Photo 4, Fusilade at 16 oz/a



Photo 5, Vantage at 44 oz/a

Photo 6, Vantage at 60 oz/a

Table 6 con't, images of 3 native Hawaiian grasses in response to 5 herbicides applied as sprays. Images recorded on 06/07/06, which were 141 days after spray application of herbicides and 90 days after previous cutting. In all images, the grasses from left to right are AA, EM and PG.



Photo 7, Prism 24 oz/a



Photo 8, Prism at 34 oz/a



Photo 9, Plateau DG at 2.88 dry oz/a



Photo 10, Plateau DG at 4.32 dry oz/a



Photo 11, Untreated