

# THE RESPONSE OF 2 NATIVE HAWAIIAN BROADLEAF PLANTS TO 2 SEQUENTIAL APPLICATIONS OF PREEMERGENCE HERBICIDES

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## Introduction

Weed control is an important management activity in the production of all crops but is especially important in the production of seed crops. Seed production of native Hawaiian plants is required to provide planting material for revegetation of conservation areas. Two native Hawaiian plants aalii (*Dodonaea viscosa*, **Aa**)- and aweoweo (*Chenopodium oahuense*-**Aw**) are two species chosen by the Plant Materials Center on Molokai for this study. The purpose of this experiment is to determine the weed control and growth response of aalii and aweoweo two sequential applications of preemergence herbicides.

## Materials and Methods

Seeds of aalii (NRCS accession # 9079682) were planted to 72-cell trays on 02/14/02, and seeds of aweoweo (NRCS accession #9079734) were planted on 08/28/01. Seedlings were planted to experimental field plots on 08/05/02. A single row of each type was planted with a 2 ft. spacing within the row and a 2-ft. spacing between the row into experimental plots 6 ft. X 15 ft. in size, see Figure 1 for map of field plot. Irrigation was applied for 1 day to settle the soil around the roots prior to the application of herbicide spray treatments. Overhead irrigation was applied throughout the course of experiment daily to eliminate moisture stress as a factor in plant growth. On 08/06/02 all treatments were applied with an electric powered diaphragm pump calibrated to deliver 40 gallons per acre (GPA). Table 1 contains the description of the herbicide treatments that were applied to transplants. All treatments were applied again on 09/06/02 31 days after planting (DAP).

A visual rating of crop vigor in response to herbicide sprays was obtained on 09/05/02, 30 days after the first spray (30 DAS-01), and 09/27/02 (21 DAS02). Visual weed control ratings followed by the recording of time for 2 people to return plots to a weed free condition were also obtained on 09/05/02 (30 DAS-01). A visual rating of foliar injury to crop plants was made on 09/13/02 (07 DAS-02). On 11/19/02 (56 DAS-02) 3 representative plants of aalii and 2 of aweoweo were cut at the soil surface and placed in paper bags and dried in a forced air oven. Plant dry weights were used as a measure of growth in response to herbicide spray applications.

All treatments were replicated 4 times (see Figure 1). Data for vigor ratings and dry weight accumulation were analyzed as a completely randomized block design for herbicide treatments, designated as Factor A in the analysis of variance. The crop plants (Factor B) were a split plot on the herbicide treatments. Data on visual weed control ratings and timed weeding were analyzed as a completely randomized block design. When appropriate, means were separated using Duncan's Multiple Range Test. All statistical analyses were conducted using the MSTAT computer program. This experiment was conducted at the Natural Resources Conservation Service (NRCS) Plant Materials Center on Molokai.

## Results

Herbicide applications in this experiment were designed to simulate the foliar contact that plants would receive from a tractor mounted boom sprayer. Therefore foliage was fully exposed to herbicide sprays with no effort made to minimize contact. The analysis of variance (ANOVA) for crop vigor indicated a significant interaction between herbicides and the split plot factor of crop plants. This means that the crop plants response to herbicide treatments were significantly different. Visual ratings of plant vigor 30 DAS-01 indicated that the high rate of Gallery and both rates of Surflan significantly reduce the vigor of Aa, see Table 2. Surflan did not significantly reduce the vigor of Aw at either rate. Both rates of Pendulum, Ronstar and the higher rate of Gallery significantly reduced the vigor of Aw.

Visual weed control ratings, see Table 3, indicate that commercially acceptable weed control (rating of 7 or above) was obtained by all herbicide treatments for the weed species present in this experiment. Time for two people to return plots to a weed free condition allows for a ranking of herbicides for effectiveness in controlling the weed species present. Based on weeding times, herbicides ranked from best to worst weed control at this site are: Ronstar > Gallery = Surflan > Pendulum.

The analysis of visual ratings for foliar injury to crop plants also revealed a significant interaction between herbicide treatments and crop plants. Injury ratings are expressed as the percent of treated foliage showing necrosis or other growth distortions such as yellowing or misshapen leaf form. Both Gallery and Surflan caused injury to 30% to 55% of the Aa foliage, see Table 4. Aw foliage showed only minor injury symptoms that were not significantly different than the untreated plants that were responding to drift from nearby treatments.

Visual ratings of plant vigor 21 DAS-02 indicated that all herbicides reduced the vigor of both Aa and Aw, see Table 5. In general Aa showed a greater reduction in crop vigor in response to the herbicide sprays than Aw (the ANOVA had a significant interaction between herbicides and the split plot factor of crop plants). The vigor reduction imposed by the herbicide sprays did not prevent the growth recovery of both crop types. Table 6 contains the dry weight accumulation data of Aa and Aw in response to 2 sequential herbicide applications. Plant samples for dry weight accumulation were obtained 56 days after the second spray application. At this date, none of the treatments caused a significant reduction in dry weight accumulation for Aa. The lowest numerical weight was recorded in the unweeded plots and the highest was recorded in the low rate of Ronstar plots. However, Aw weights were reduced in all treatments in comparison to untreated plants except for the low rate of Gallery. Rankings for herbicide safety on Aa are: Ronstar > Gallery > Surflan = Pendulum. The ranking for herbicide safety for Aw are: Gallery > Pendulum > Surflan > Ronstar.

## Discussion

The data collected in this experiment indicate that Aa and Aw respond differently to the herbicides applied. Although Aa showed more acute foliar injury to spray applications it was able to recover and produce biomass that was not significantly different than untreated plants. This indicates that the observed contact burn to foliage did not affect long term growth potential. It also indicates that herbicides did not reduce growth through root abortion. Aw on the other hand showed less contact injury but herbicides were able to reduce long term biomass accumulation in all treatments except the low rate of Gallery.

The practical information derived from this experiment is good weed control for Aa can be obtained from all the herbicides at the lower of the two rates used in this experiment. To maximize Aa growth, sprays should be directed to the base of plants to avoid the short term foliar contact burn. Ronstar at the lower rate should be used for weed control in Aa plantings and as direct spray in newly transplanted fields. Weed control choices in Aw are more limited based on the data collected here. Although acute foliar injury was less than Aa, biomass accumulation indicates that the low rate of Gallery is the best choice for weed control in a newly plant crop using transplants.

These data highlight the differences in plant response to herbicide applications. The procedure described here can also provide an example of herbicide screening protocol for other native Hawaiian plants grown for seed production.

### **Acknowledgements and Disclaimer**

Trade names are used in this report for the convenience of readers and does not constitute an 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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Figure 1. Field map with treatment labels at the Plant Materials Center on Molokai. Values in the top and bottom row of the plot map contain values for plot width and indicator row location. Numbers in the diagram correspond to treatments described in Table 1.

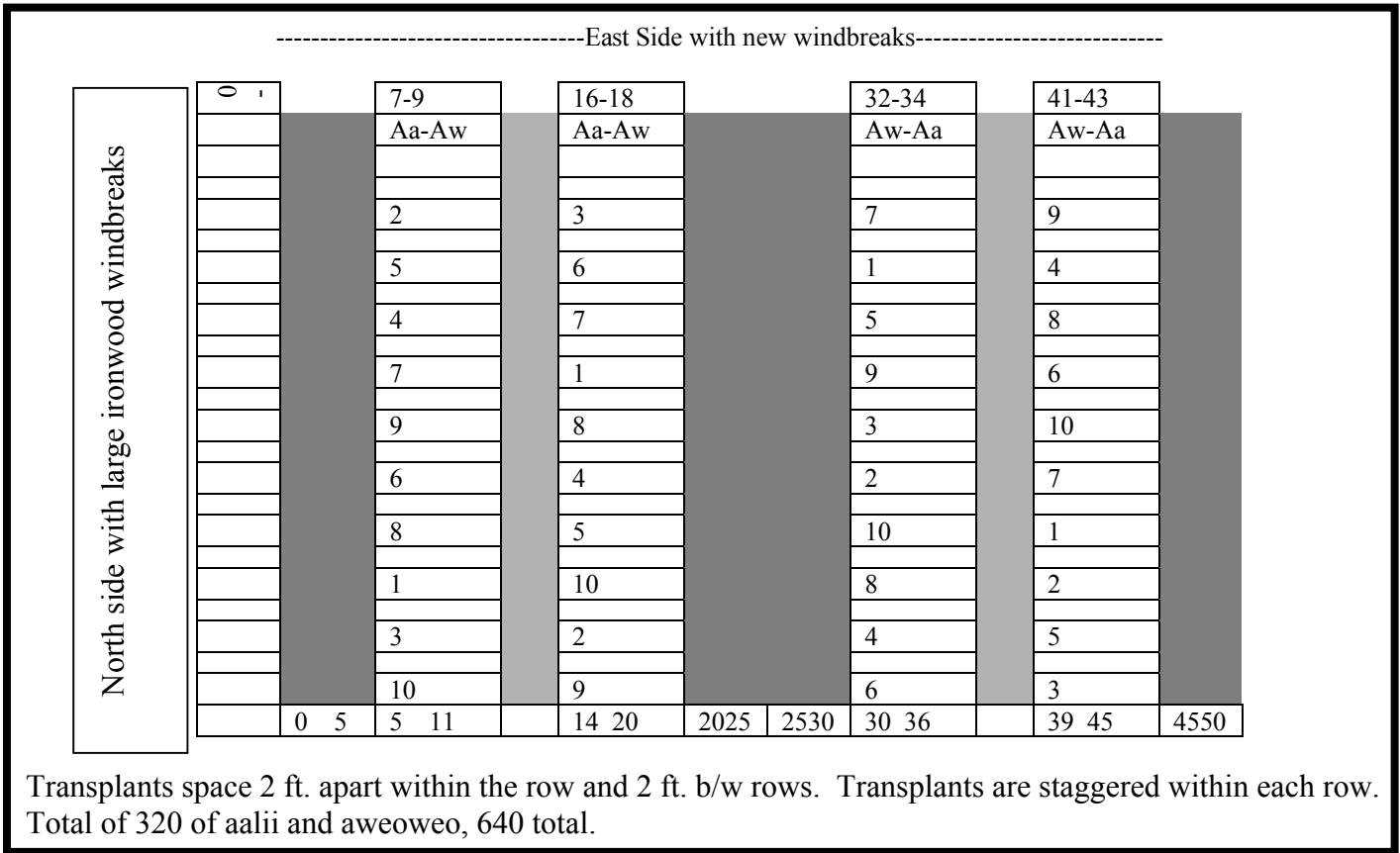


Table 1. Preemergence herbicide treatments applied to crop transplants. Finished spray solutions were applied from 3-liter containers. Herbicides were applied with a backpack sprayer mounted with a 12-volt electric pump. Herbicides were applied at 22 PSI with a carrier volume of 40 gallons per acre, using a 3 nozzle boom containing 8004 LP TeeJet spray tips. Treatments were replicated 4 times.

Herbicides	Amount	lb. ai/a <sup>z</sup>	Amount ml or
	per acre		grams/3liter
1Pendulum 60% WDG (pendimethalin)	3.3 lb	2.0	29.7 g
2 Pendulum 60% WDG (pendimethalin)	6.6 lb	4.0	59.4 g
3Ronstar (oxadiazon) 50WP	4.0 lb	2.0	36.0 g
4 Ronstar (oxadiazon) 50WP	8.0 lb	4.0	72.0 g
5 Gallery 75 DF (isoxaben)	.66 lb	0.5	6.0 g
6 Gallery 75 DF (isoxaben)	1.32 lb	1.0	12.0 g
7 Surflan 4AS (oryzalin)	2.0 qt.	2.0	37.5 ml
8 Surflan 4 AS (oryzalin)	4.0 qt.	4.0	75.0 ml
9 Un-weeded non chemical.	-		
10 Weeded non chemical	-		

<sup>z</sup> lb ai/a means pounds of active ingredient per acre.

Table 2. Visual vigor ratings of 'A'alii (*Dodonaea viscosa*)-Aa and 'aweoweo (*Chenopodium oahuense*)-Aw in response to preemergence applied 1 day after planting. Ratings recorded 09/05/02, 30 DAS1. A rating of 100% represents the maximum vigor of plants and 0% indicates plants are dead.

Herbicides	Amount per acre	Vigor ratings (%)	
		Aa	Aw
1Pendulum 60% WDG (pendimethalin)	3.3 lb	73.75 cdef	68.75 cdefgh
2 Pendulum 60% WDG (pendimethalin)	6.6 lb	81.25 abc	58.75 efgh
3Ronstar (oxadiazon) 50WP	4.0 lb	66.25 cdefg	71.25 cdefg
4 Ronstar (oxadiazon) 50WP	8.0 lb	71.25 cdefg	57.50 fgh
5 Gallery 75 DF (isoxaben)	.66 lb	76.25 bcd	75.00 bcde
6 Gallery 75 DF (isoxaben)	1.32 lb	38.75 i	61.25 defgh
7 Surflan 4AS (oryzalin)	2.0 qt.	56.25 gh	94.25 a
8 Surflan 4 AS (oryzalin)	4.0 qt.	52.50 hi	91.25 ab
9 Un-weeded non chemical.	-	82.50 abc	94.25 a
10 Weeded non chemical	-	75.00 bcde	91.25 ab

Means followed by the same letter are not significantly different based on Duncan's Multiple Range Test at the 5% level.

Table 3. Visual rating of weed control recorded on 09/05/02 30 DAS1. A pre-transformed scale (0-10) was used to quantify weed control activity of applied herbicides. A rating of 10 means complete control, 0 is no weed control and 7 is the minimum value for commercially acceptable weed control. Weed ID Codes: GOSG (*Eleusine indica*), AMRT (*Amaranthus spinosa*), GDSP (*Chamaense hirta*), and ILMA (*Sida sp.*). Weed free means time in seconds for two people to return an experimental unit (6 x 15 ft.) to a weed free condition.

	Amount per acre	GOSG	AMRT	GDSP	ILMA	Weed free (sec.)
1Pendulum WDG (pendimethalin)	3.3 lb	10.0 a	10.0 a	10.0 a	8.0 d	64 b
2 Pendulum WDG (pendimethalin)	6.6 lb	10.0 a	10.0 a	10.0 a	9.8 ab	30 c
3Ronstar (oxadiazon) 50WP	4.0 lb	10.0 a	10.0 a	10.0 a	10.0 a	15 d
4 Ronstar (oxadiazon) 50WP	8.0 lb	10.0 a	10.0 a	10.0 a	10.0 a	14 d
5 Gallery 75 DF (isoxaben)	.66 lb	9.3 a	10.0 a	10.0 a	9.3 abc	55 b
6 Gallery 75 DF (isoxaben)	1.32 lb	9.8 a	10.0 a	10.0 a	9.8 ab	27 c
7 Surflan 4AS (oryzalin)	2.0 qt.	10.0 a	10.0 a	10.0 a	8.5 cd	55 b
8 Surflan 4 AS (oryzalin)	4.0 qt.	10.0 a	10.0 a	10.0 a	9.0 bc	38 bc
9 Un-weeded non chemical.	-	0.5 b	1.0 b	0.75 b	0.0 e	0 e
10 Weeded non chemical	-	0.0 b	0.5 b	0.0 b	0.0 e	406 a
F-test level		1%	1%	1%	1%	1%

Means within a column, followed by the same letter, are not significantly different based on Duncan's Multiple Range Test.

Table 4. Visual rating of % of a'alii (*Dodonaea viscosa*)-Aa and 'aweoweo (*Chenopodium oahuense*)-Aw foliage with injured tissue or abnormal growth in response to foliar contact with preemergence sprays applied 1 day after planting. Ratings recorded 09/13/02, 7 DAS2 and 38 DAS1. A rating of 100% represents the maximum vigor of plants and 0% indicates plants are dead.

Herbicides	Amount per acre	Injury ratings (%)	
		Aa	Aw
1Pendulum 60% WDG (pendimethalin)	3.3 lb	8.0 c	4.3 c
2 Pendulum 60% WDG (pendimethalin)	6.6 lb	1.0 c	4.5 c
3Ronstar (oxadiazon) 50WP	4.0 lb	10.0 c	2.0 c
4 Ronstar (oxadiazon) 50WP	8.0 lb	4.0 c	0.8 c
5 Gallery 75 DF (isoxaben)	.66 lb	30.0 b	3.0 c
6 Gallery 75 DF (isoxaben)	1.32 lb	33.8 b	2.5 c
7 Surflan 4AS (oryzalin)	2.0 qt.	37.5 b	1.0 c
8 Surflan 4 AS (oryzalin)	4.0 qt.	55.0 a	0.8 c
9 Un-weeded non chemical.	-	1.8 c	0.8 c
10 Weeded non chemical	-	1.0 c	0.8 c

Means followed by the same letter are not significantly different based on Duncan's Multiple Range Test at the 1% level.

Table 5. Visual vigor ratings of A'alii (*Dodonaea viscosa*)-Aa and 'aweoweo (*Chenopodium oahuense*)-Aw in response to 2 applications of preemergence herbicides. Ratings recorded on 09/27/02, 21 DAS2 and 52 DAS1. A rating of 100% represents the maximum vigor of plants and 0% indicates plants are dead.

Herbicides	Amount per acre	Vigor ratings (%)	
		Aa	Aw
1Pendulum 60% WDG (pendimethalin)	3.3 lb	32.5 i	62.5 d
2 Pendulum 60% WDG (pendimethalin)	6.6 lb	58.8 de	58.8 de
3Ronstar (oxadiazon) 50WP	4.0 lb	16.3k	56.3 e
4 Ronstar (oxadiazon) 50WP	8.0 lb	42.5 gh	75.0 c
5 Gallery 75 DF (isoxaben)	.66 lb	47.5 fg	40.0 h
6 Gallery 75 DF (isoxaben)	1.32 lb	22.5 j	45.0 fgh
7 Surflan 4AS (oryzalin)	2.0 qt.	23.8 j	50.0 f
8 Surflan 4 AS (oryzalin)	4.0 qt.	13.8 k	71.3 c
9 Un-weeded non chemical.	-	81.3 b	93.8 a
10 Weeded non chemical	-	85.0 b	94.5 a

Means followed by the same letter are not significantly different based on Duncan's Multiple Range Test at the 5% level.

Table 6. Dry weight accumulation of representative plants of A'alii (*Dodonaea viscosa*, 3 plants per sample)-Aa and 'aweoweo (*Chenopodium oahuense*, 2 plants per sample)-Aw in response to 2 applications of preemergence herbicides. Plant samples collected on 11/01/02, 56 DAS2 and 87 DAS1. Plant samples were cut at the soil surface and dried in a forced air oven.

Herbicides	Amount per acre	Dry weight (g)	
		Aa-3 plants	Aw-2 plants
1Pendulum 60% WDG (pendimethalin)	3.3 lb	104.8 fg	300.3 cd
2 Pendulum 60% WDG (pendimethalin)	6.6 lb	69.5 fg	311.9 bcd
3Ronstar (oxadiazon) 50WP	4.0 lb	145.7 efg	195.9 cdefg
4 Ronstar (oxadiazon) 50WP	8.0 lb	79.6 fg	108.9 fg
5 Gallery 75 DF (isoxaben)	.66 lb	115.6 fg	445.8 ab
6 Gallery 75 DF (isoxaben)	1.32 lb	107.9 fg	323.9 bc
7 Surflan 4AS (oryzalin)	2.0 qt.	99.4 fg	289.0 cde
8 Surflan 4 AS (oryzalin)	4.0 qt.	78.7 fg	212.1 cdef
9 Un-weeded non chemical.	-	43.6 g	166.4 defg
10 Weeded non chemical	-	103.0 fg	516.8 a

Means followed by the same letter are not significantly different based on Duncan's Multiple Range Test at the 5% level.