

The Response of Two Native Hawaiian Grasses and Weeds to Pre-emergence Herbicides in a Hydromulch Cap applied at Planting

Thesis Defense
By
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Outline

- Introduction
- Project goals
- Experiments
 - *Sporobolus virginicus*
 - *Heteropogon contortus*
- Conclusions
- Contractor specifications



Introduction

Native species re-vegetation

- **Ecosystem benefits of native planting**
 - Restore native habitat
 - Adapted to local environments
 - Mitigate spread of invasive and noxious weeds
- **Implementation on roadsides**
 - DOT native roadside re-vegetation mandates
 - Presidential executive orders for natives



Introduction

Primary study species

- *Heteropogon contortus*. Pili grass
 - Dryland range grass species
- *Sporobolus virginicus*. AkiAki
 - Coastal salt marsh wetland grass species



Introduction

H. Contortus

- Seed reproduction
- Direct seeding protocol



S. Virginicus

- Very low seed viability
- Vegetatively propagated
- Stem cutting planting protocol



Both planting protocols make use of hydromulch cover



Introduction

Hydromulch is a sprayable slurry mixture



Project Goal

Determine the response of two native grasses and weeds to pre-emergence herbicides at time of planting

- **Pili Grass – direct seeded**
- **Aki aki – cut stems**
- **Current studies with establishment only 2-4 mo.**



Experiment 1 & 2 Aki Aki

Response of *Sporobolus virginicus* and weeds to pre-emergence herbicides within a hydromulch cap.

- Summer 2009/2010- Molokai USDA PMC
- *S. virginicus* (Aki Aki) establishment with cut stems, 40-60 cm.
- 24 hour rooting hormone soaking (1:35 solution)
- 303 L hydrocap mix to cover 48 m²
- Oxadiazon (Ronstar) G and SC
- Application rate of 2.24 and 3.36 kg ai ha⁻¹
- Planting rate 1236 kg / hectare



Experiment 1 & 2 Aki Aki

Random complete block design

Five treatments and four replications



2009



2010



Experiment 1 & 2 Aki Aki



Planting rate of 1236 kg fresh stems / hectare

**Light application of hydromulch over cut stems
(75 liters of hydromulch / plot)**



Experiment 1 & 2 Aki Aki

Results

- **Analyzed as 2x factor RCBD combined experiment analysis of variance (over years)**
 - **Data expressed as % of control**
 - **All data, interaction (Y x F x R) was NS**
 - **Data pooled over years**
 - **Further data discussion as F x R**



AkiAki Rating 1

Time to Weed Free Status (1 person/ 8m² plot)

Form	Rate	Means (% of Control)
G	-	8.56
SC	-	8.62

-	Low	9.94*
-	Hi	7.25

ANOVA

- R x F interaction NS
- Formulation NS
- Rate Significant (5% level)
 - (F = 73.3, P = 0.001)



AkiAki Rating 1

New green shoot count means

Form	Rate	Means (% of Control)
G	-	279.8**
SC	-	186.4

-	Low	230.2
-	Hi	236.0

ANOVA

- R x F interaction NS
- Formulation Significant (1% level)
 - (F = 20.2, P = 0.0003)
- Rate NS



AkiAki Rating 1



Untreated



Oxadiazon G 2.25 kg
ai ha⁻¹



Oxadiazon G 3.36 kg
ai ha⁻¹

2009 trial - 47 days after hydro-cap



AkiAki Rating 2

Fresh weed biomass (kg / m²)

Form	Rate	Means (% of Control)
G	-	20.9*
SC	-	32.4

-	Low	30.8
-	Hi	22.5

ANOVA

- R x F interaction NS
- Formulation Significant (5% level)
 - (F = 5.20, P = 0.03)
- Rate NS



AkiAki Rating 2

***S. virginicus* aboveground biomass (g/m²)**

Form	Rate	Means (% of Control)
G	-	252**
SC	-	170

-	Low	236
-	Hi	184

ANOVA

- R x F interaction NS
- Formulation Significant (1% level)
 - (F = 9.43, P = 0.007)
- Rate NS



AkiAki Rating 2

S. virginicus percent visual coverage

Form	Rate	Means (% of Control)
G	-	76*
SC	-	63

-	Low	71
-	Hi	68

ANOVA

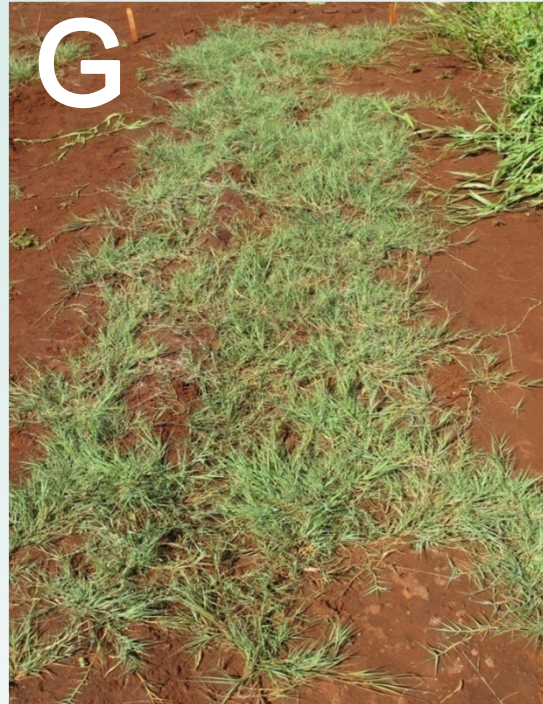
- R x F interaction NS
- Formulation Significant (5% level)
 - (F = 7.65, P = 0.012)
- Rate NS



Aki Aki Rating 2



Untreated



Oxadiazon G 2.25 kg
ai ha⁻¹



Oxadiazon SC 2.25 kg
ai ha⁻¹

Biomass & Percent Cover
2009 trial - 110 days after hydro-cap



AkiAki Conclusions

Weed response

- **1st rating**
 - **Significantly greater weeding time with low rate of oxadiazon application.**
- **2nd rating**
 - **Significantly less weed biomass with granular oxadiazon application.**



AkiAki Conclusions

AkiAki response

- **1st rating**
 - **Significantly greater shoot counts with granular formulation of oxadiazon application.**
- **2nd rating**
 - **Significantly greater Akiaki aboveground biomass and plant counts with granular oxadiazon application.**



Pili grass – Charcoal safening

Screening of pre-emergent herbicides to determine injury to *Heteropogon contortus*, using charcoal safening to protect native grass seed germination.

- June 2010- Magoon research and instructional facility.
- *H. contortus* direct seeded
- Hydromulch cap
- Herbicides applied over hydromulch cap
 - Two rates of oxadiazon, 2.24 and 3.36 kg ai ha⁻¹
 - With charcoal and w/o charcoal in cap, 0.64 kg
 - One control treatment



Pili grass

Split plot experimental design
Charcoal main plot, oxadiazon rate sub plot



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Pili grass

Split plot experimental design
Charcoal main plot, oxadiazon rate sub plot



Pili grass

Data collection

- 48 days after planting
 - *H. contortus* plant counts
 - Aboveground biomass per treatment

Results

- Analyzed as split plot design
 - charcoal as main plot
 - chemical treatment sub plot
 - two rates 2.24 kg ai ha⁻¹ and 3.36 kg ai ha⁻¹



Pili grass

Results

- No significant differences found w/ charcoal
 - Pooling of means w/ and w/o charcoal

Weed control 48 DAP

- Both oxadiazon rates provided 100% weed control
- Control plot 0% weed control



Control (0% control)



Oxadiazon (100% control)

Pili grass

***H. Contortus* aboveground biomass. 48 DAP**

Charcoal	Treatment rate	Means (g/ .09m ²)
w/o	-	9.2
w	-	8.1
<hr/>		
-	1- un	11.5** a
-	2- low	8.6 ab
-	3- hi	2.4 b

ANOVA

- Charcoal x Treatment interaction NS
- Treatment Significant (1% level)
 - (F = 7.65, P= 0.001)
 - Tukey's mean separation



Pili grass

H. Contortus plant counts. 48 DAP

Charcoal	Treatment rate	Means
w/o	-	20.1
w	-	16.6
<hr/>		
-	1- un	34.5** a
-	2- low	8.7 b
-	3- hi	2.5 b

ANOVA

- Charcoal x Treatment interaction NS
- Treatment Significant (1% level)
 - (F = 14.2, P = 0.007)
 - Tukey's mean separation



Pili grass

- Complete (100%) weed control was found in both rates of chemical application. Control plot (0%)
- Biomass, high rate significantly less than untreated.
- Plant counts, chemical treatments were significantly less than the control.
- Further research is needed to determine the rate of oxadiazon at which *H. contortus* growth is maximized, and weed control remains complete.



Pili grass rates

Follow up study

Evaluation of weed control and injury of oxadiazon at varying rates to direct seeded *Heteropogon contortus*.

- October 2010 – Magoon research and instructional facility.
- *H. contortus* direct seeded
- Hydromulch capped
- Herbicides applied over hydromulch cap
 - Four rates of oxadiazon
 - 1.4, 1.68, 1.96 and 2.24 kg ai ha⁻¹
 - One untreated treatment



Pili grass rates

Random complete block design



Pili grass rates

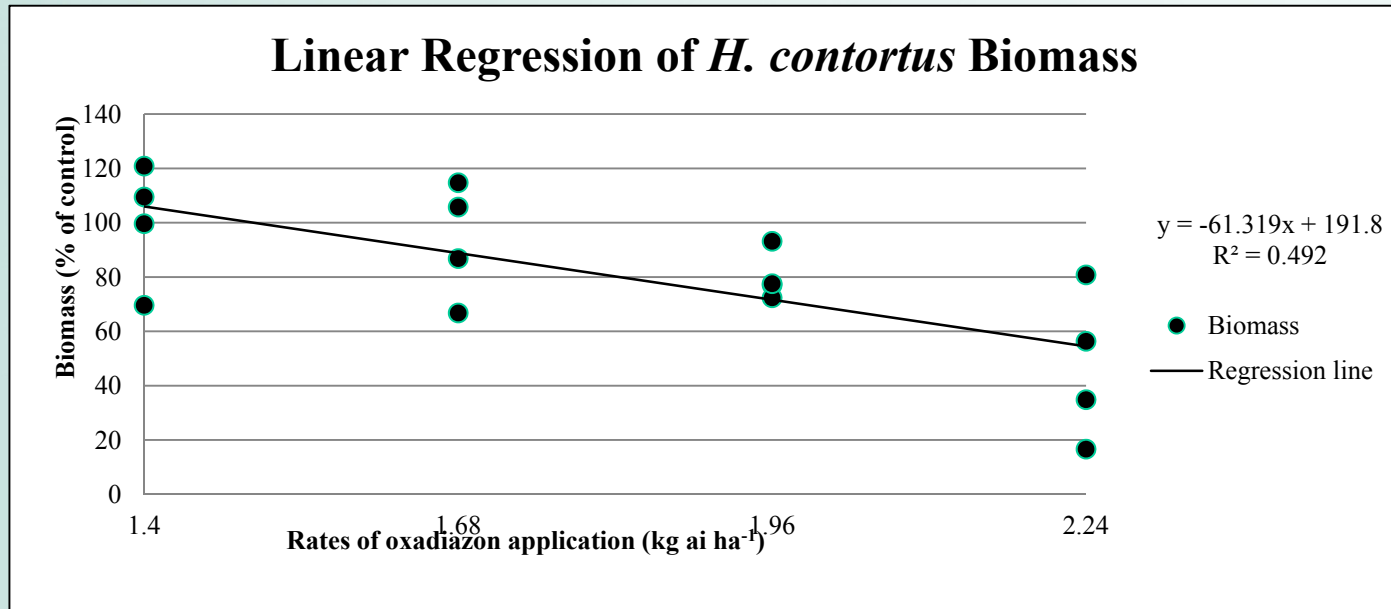
Data collection

- 35 days after planting
 - Percent weed control
 - Weed biomass
- 63 days after planting
 - *H. contortus* plant counts
 - *H. contortus* dry biomass



Pili grass rates

Data collection at 63 DAP

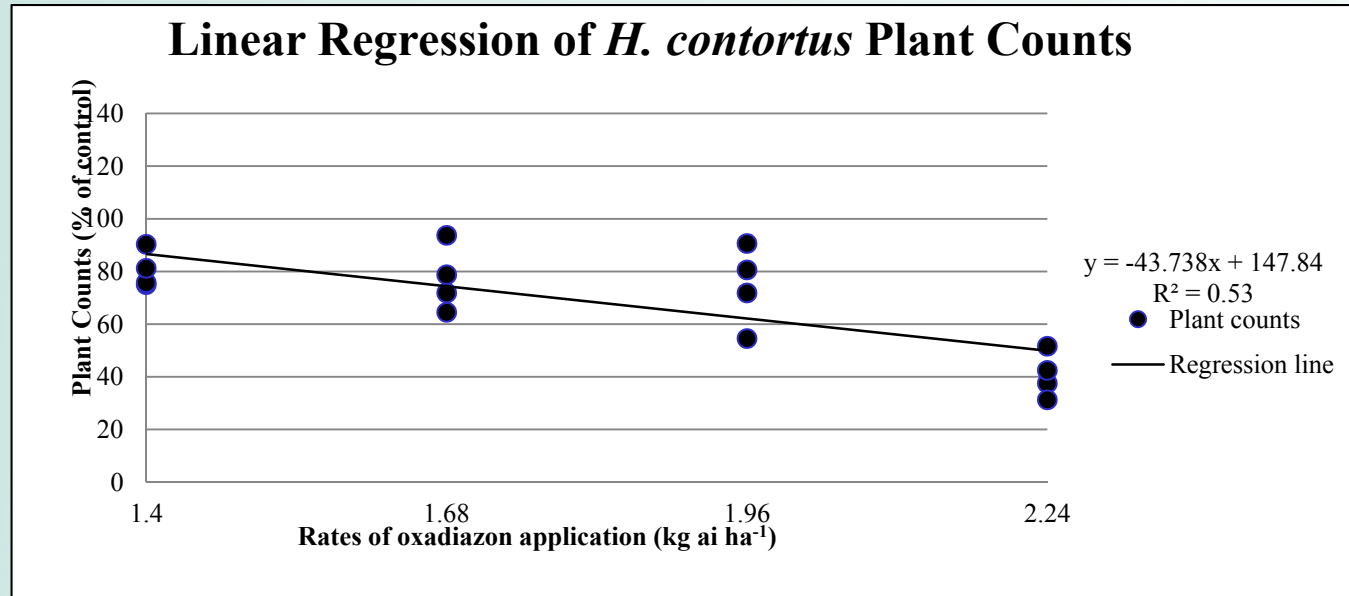


ANOVA

- Linear significant ($F = 13.56$, $P = 0.002$)
- Quadratic NS
- Cubic NS

Pili grass rates

Data collection at 63 DAP



ANOVA

- Linear significant ($F = 15.78$, $P = 0.001$)
- Quadratic NS
- Cubic NS



Pili grass rates

Sources of variation

- Overhead irrigation amounts
- Small experimental plots



102
56478



402
53156



302
36544

Overhead irrigation rates (liters/ ha/ 30 minutes)



Pili grass rates

Results 63 DAP

- Highest plant counts and biomass found among treated plots with 1.4 kg ai ha⁻¹ rate of oxadiazon
- Complete weed control, no weed biomass



Untreated



Oxadiazon 1.4 kg ai ha⁻¹



Oxadiazon 2.24 kg ai ha⁻¹

Pili grass rates, trial 2

1. Dec. 2010 – Magoon research and instructional facility.
2. Replicate in time.
3. One herbicide at four rates
4. Hand seeded
5. Covered with hydromulch cap



Pili grass rates, trial 2

15 DAP

- 151 mm rainfall in 12 hours
 - Herbicidal movement
 - Data not reliable



Conclusions

- *S. virginicus*, granular oxadiazon at 2.24 kg ai ha⁻¹ in the hydromulch cap. Best establishment and weed control.
- *H. contortus* seed was not safened by the rates of charcoal used.
- *H. contortus* seed exhibits tolerance to oxadiazon. Application rate of 1.4 kg ai ha⁻¹ provides complete weed control and highest seed germination and vigor.



Akiaki practical application

Practical installation protocol. US specs

- **Vigorous stock plant material**
- **18 – 24 inch cut stems**
- **24 hour rooting hormone soaking period (1:35)
Dip n Grow®**
- **Ensure contact of cut stems and soil (2.5 lb/100ft²)**
- **Light hydromulch covering (~20 gal / 100ft²), with
Ronstar® G at 100 lbs acre⁻¹**
- **60 DAP hand weed, apply fertilizer, re-apply
Ronstar® G at same rate.**



Pili grass practical application

Practical installation protocol. US Specs

- **Hand distribute seed on drip lines (0.57 lb/100ft)**
- **Hydromulch over entire area (15 gal/100ft²)**
- **In hydromulch mixture add 2.50 lb / acre rate of Ronstar[®] 50 WP (oxadiazon)**
- **Along with drip line irrigation, provide overhead irrigation for 30 minutes daily, for a collected volume of 18.8 ounces collected in a 5 gallon bucket.**



Questions?

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Mahalo

