Applied Weed Control Technology
Tropical Turf Grass Management
Research to develop improved control of grassy weeds in Bermuda sport turf.
10/20/2016

Dr. Joe DeFrank – UH-TPSS
Topics Covered – 2016

1. Grassy Weed ID for turf
2. Time of year and weed control
3. Wipers for applying turf pesticide
Grassy Weeds in Hawaiian Turf

- Australian Carpet Grass
- Hilo Grass
- Goose grass
- Dallisgrass
- Love grass
- Henry’s and India CG
- Star Grass
- Smut grass
- Pitted Beardgrass
Australian carpet grass

*Axonopus compressus*

Forest Starr & Kim Starr
Hilo grass
Paspalum conjugatum
Similar looking weedy grasses

Hilo grass

A. Carpet grass
Goose grass

Eleusine indica
Dallisgrass
*Paspalum dilatatum*
Love grass
Eragrostis amabilis
Eragrostis tenella

Carolina Love grass
Eragrostis pectinacea

Forest & Kim Starr
Henry’s Crabgrass

*Digitaria ciliaris*
India Crabgrass

*Digitaria longiflora*
Star Grass
Chloris divaricata
Smutgrass
*Sporobolus indicus*
Pitted beardgrass

Bothriochloa pertusa
What is selective weed control in ornamental turf?

In the summer of 2013, field research in HI, demonstrated the effectiveness of Tenacity + Sencor tank mix for the control of Goose grass and Love grass.

Prior to this time, a good “selective” chemical control in Bermuda grass was not available for these two large well established grassy weeds in Hawaii.

5oz Ten + 8oz Sen
102 DAS02
08/09 to 12/03/13

“Selective” weed control has new meaning:

“Selective” used to mean good weed control with little to no noticeable turf injury.

Now, “selective” control means: “is the turf injury, that is very noticeable, worth the weed control obtained”? 
Assumptions for **TIME OF YEAR** considerations for selective weed control based on case studies at the Waipio Soccer field (winter 2013 to summer 2014).

**Municipal sport turf is the case study model**

**Winter season protocol**

1. Nov.-March in Hawaii, Bermuda grass slow growing = semi dormant.
2. Weedy grass growth favored allowing for wider spread.
3. Cool wet weather reduces the effectiveness of certain herbicide with mode of action is based on “growing the weeds to death”. All of the herbicides within this mode of action act upon specific enzymes to prevent production of amino acids. Amino acids are the “building blocks” for proteins for plant growth and development of a plant.
5. More tolerance of significant turf injury = yellowing and turf burn out.

Tank mix of 5 oz/a Tenacity + 8 oz/a Sencor + 1% v/v MSO applied 2Xs

Provided near complete cleanup of Goose grass and Love grass with common Bermuda grass recovery in 75-80 days

Dec.-Feb. period in Hawaii.
Waipio Winter Season Case Study

2013-Dec. Honolulu City and County treats 8 acres at Waipio

4 oz Tenacity + 8 oz Sencor + 1% MSO - 2X’s
12/10 & 12/23/2013 = Start of Winter Program
22 DAS02 Ten (4 oz/a) + Sen (8 oz/a) – 01/06/14
Dallis grass = not controlled.
42 DAS02 Ten (4 oz/a) + Sen (8 oz/a) – 01/26/14
22 DAS02 Ten (4 oz/a) + Sen (8 oz/a) – 01/06/14
42 DAS02 Ten (4 oz/a) + Sen (8 oz/a) – 01/26/14
22 DAS02 Ten (4 oz/a) + Sen (8 oz/a) – 01/06/14
42 DAS02 Ten (4 oz/a) + Sen (8 oz/a) – 01/26/14
42 DAS02 Ten (4 oz/a) + Sen (8 oz/a) – 01/26/14
Dismiss (6 oz/a) + Barricade (10 oz/a) 2Xs for control of seedling Goose grass on

GG control w/Dismiss:  
pre-tiller = OK  
Post tiller = NOT CONTROLLED.

Photos  
8 DAS 1st Dism+Barr
Optimum Goose grass size for Dismiss activity is “pre-tiller” stage

6-leaf pre-tiller  
3-tiller goose grass

Timing isn’t everything, it’s the only thing!
Winter Protocol
70 Days after T+S 2X’s
Common Bermuda grass turf has filled in

Seedling goose grass control needed soon after larger weeds die and leave openings for weed seed germination.
Assumptions for TIME OF YEAR consideration for selective weed control based on case studies at the Waipio Soccer field (winter 2013 to summer 2014).

Municipal sport turf is the case study model

**Summer season protocol**

1. May-Aug. in Hawaii, Bermuda grass fast growing, fast recovery.
2. Weed growth faster too.
3. Hot sunny weather improves the effectiveness of certain herbicide who’s mode of action is based on “growing the weeds to death”.
4. June-Aug. main soccer tournament season, sport tourism an important economic consideration.
5. Less tolerance of significant turf injury due to high use pattern.

*To reduce turf injury with lower use rate of T+S tank mix and get good weed control weeds must be setup to enhance kill with post herbicides.*
HC& C summer 2014 Waipio clean up
Experimental setup to evaluate reduced rates
Tenacity + Sencor Tank mix experiment.

Summer 2014 protocol

- May 8, 2014: apply CN9 (10 gal/a) + Specticle (3.5 dry-oz/a).
- Enhances T+S herbicide mode of action by:
  1. Activating weed growth
  2. Prevent re-rooting of grassy weeds = improved kill w/post herbicides
  3. Priming turf growth to reduce recovery time and rapid fill in of gaps in turf.

<table>
<thead>
<tr>
<th>Fertilizer Analysis</th>
<th>Product Description</th>
<th>Nitrogen Form</th>
<th>Weight per Gallon</th>
<th>Nutrients Supplied/Gal</th>
<th>Gallons to Apply/1000 ft²*</th>
<th>Gallons to Apply/Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>9-0-0 11Ca</td>
<td>Contains nitrogen in fast, available form with calcium</td>
<td>9.0% Nitrate</td>
<td>12.20</td>
<td>1.10 lbs. N</td>
<td>.91 gallons</td>
<td>39.6 gallons</td>
</tr>
<tr>
<td>CN-9</td>
<td></td>
<td></td>
<td></td>
<td>1.34 lbs. Ca</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Root pruning of seedlings w/Specticle

Unt.
Pre emergence for
Broadleaf & certain grass weed control

Specticle

• Use on Bermuda with preemergence activity only
• Control of important broadleaf weed HI: horseweed, broadleaf plantain, prostrate spurge and oxalis.
• Control of grassy weeds include: Henry’s crab grass, Goose grass, Guineegrass, Green Kyllinga.
• 4-5 months of Goose grass control with 3.7 oz/a.
• Irrigation required for activation.
• Pruning of new roots of grassy weeds and spreading turf to be expected.
Summer 2014 protocol

- May 8, 2014 apply CN9 (10 gal/a) + Specticle (3.5 dry-oz/a)
- 26 DAYS
- June 3, 2014 apply Revolver 26 liq-oz/a + Celsius 3 dry-oz/a + Liberate surfactant .25%.
- 17 DAYS
- June 20, 2014, 2nd app Rev. + Cel.
- Visual cue for 2nd R+C application is 1-2 nodes of new growth on Goose grass
Commonly used post emergence for Goose grass weed control

**Revolver**

- Single AI product, post in turf.
- Use on Bermuda
- Control for Goose grass in HI,
- Systemic uptake, plant grows without essential components and dies. = ALS inhibitor
- Active plant growth needed for uptake and activation

Herbicides that inhibit acetolactate synthase (ALS), the enzyme common to the biosynthesis of the branch-chain amino acids (valine, leucine, and isoleucine)
Celsius

- 3 A.I. mix, includes: thiencarbazone-m, iodosulfuron (ALS) & dicamba
- Use on Bermuda, zoysia & centipede
- Control of important broadleaf weeds in HI: creeping beggars tic, broadleaf plantain, prostrate spurge, horse weed and oxalis.
- Control of grassy weeds include Love grass relative, Sandbur, Australian Carpet grass.
- Systemic uptake, multiple modes of actions.
- Active plant growth needed for uptake and activation.
Celsius: Control of important broadleaf weed in HI: creeping beggarstic, horse weed, broadleaf plantain, prostrate spurge, and oxalis.
Celsius: Control of important grassy weeds: Sandbur, carpet grass & Love Grass relative = Eragrostis ciliaris

- Sandbur-C. echinatus
- Carpet grass-A. affinis
- Gopher LG-E. ciliaris
Summer 2014 protocol

- May 8, 2014 apply CN9 (10 gal/a) + Specticle (3.5 dry-oz/a)
- 26 DAYS
- June 3, 2014 apply Revolver 26 liq-oz/a + Celsius 3 dry-oz/a + Liberat surfactant .25%.
- 17 DAYS
- June 20, 2014, 2\textsuperscript{nd} app Rev. + Cel.
- Visual cue for 2\textsuperscript{nd} R+C application is 1-2 nodes of new growth on Goose grass
See 2-nodes of new GG stem growth as visual cue for Revolver/Celsius 2\textsuperscript{nd} app.
Summer 2014 protocol

• May 8, 2014 apply CN9 (10 gal/a) + Specticle (3.5 dry-oz/a)
• 26 DAYS
• June 3, 2014 apply Revolver 26 liq-oz/a + Celsius 3 dry-oz/a + Liberate surfactant .25%.
• 17 DAYS
• June 20, 2014, 2nd app Rev. + Cel.
• 40 DAYS
• Old roots dead & New root growth from Goose and Love grass stem nodes, CUE to start next spray with different mode of action, 83 DA-Spec.
Weedy grasses survive Rev/Cel Injury by rooting at stem node.
Specticle stops roots from entering soil and makes the easier to kill.
Weed pressure in foreground = area not sprayed with Revolver & Celsius shows large Goose grass

Revolver & Celsius treatment above yellow line
Weed pressure in foreground = not sprayed with Revolver & Celsius shows large Goose grass
40 DAS2 Rev. & Cel. mostly Love grass some GG
at start of low dose T+S on 08/01/14
40 DAS2 Rev+Cel =
Easy extraction of **NORMAL**
looking Love grass due to
Specticle root pruning
Compromised main roots allows flush of new roots. **Specticle** in place to prevent root penetration into soil, provides wider window for post herbicide application and preemergence control of weed seed germination. Low dose Tenacity + Sencor to complete weed control process after **setup** with Rev + Cel.
Low dose Tenacity + Sencor Tank mix study 42 Days after 2\textsuperscript{nd} Rev. + Cel. Application-Started 08/01/2014, 2\textsuperscript{nd} “low dose app. 11 days later.

<table>
<thead>
<tr>
<th>Treatment #</th>
<th>Herbicides</th>
<th>Amount/a</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tenacity + Sencor + NIS (Excel 90) 0.25%</td>
<td>5 liq-oz/a + 1 dry-oz/a</td>
</tr>
<tr>
<td>2</td>
<td>Tenacity + Sencor + NIS (Excel 90) 0.25%</td>
<td>5 liq-oz/a + 2 dry-oz/a</td>
</tr>
<tr>
<td>3</td>
<td>Tenacity + Sencor + NIS (Excel 90) 0.25%</td>
<td>5 liq-oz/a + 4 dry-oz/a</td>
</tr>
<tr>
<td>4</td>
<td>NIS (Excel 90) 0.25%</td>
<td></td>
</tr>
</tbody>
</table>

“High Dose treatments”
4 oz Tenacity + 8 oz Sencor + 1% MSO - 2X’s 12/10 & 12/23/2013 = Start of Winter Program
7 days after 1st spray application 08/08/14

01 = T-5 oz/a + S-1 oz/a
02 = T-5 oz/a + S-2 oz/a
03 = T-5 oz/a + S-4 oz/a
04 = NIS 0.25% v/v
7 DAS
Trt-01
5 OZ/A-T
1 OZ/A-S
Pre-spray LG roots
8 days after 2\textsuperscript{nd} spray application 08/20/14

Note frosting in areas where turf was scalped

01 = T-5 oz/a + S-1 oz/a
02 = T-5 oz/a + S-2 oz/a
03 = T-5 oz/a + S-4 oz/a
04 = NIS 0.25% v/v
0 Day
5 OZ/A-T
2 OZ/A-S

54 days from start of T+S spray

38 DAS
5 OZ/A-T
2 OZ/A-S

Start

End
Comparison of time of year impact on:
Herbicide type, sequence and rates for Love and Goose grass control in Bermuda Grass sport turf in Hawaii

<table>
<thead>
<tr>
<th>Spray treatment</th>
<th>Winter* Dec.-Jan 2013</th>
<th># of Apps W</th>
<th>Summer June-Aug 2014</th>
<th># of Apps S</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN-9 +</td>
<td></td>
<td></td>
<td>10 GPA</td>
<td>1</td>
</tr>
<tr>
<td>Specticle</td>
<td>-</td>
<td>-</td>
<td>3.5 oz/a</td>
<td>1</td>
</tr>
<tr>
<td>Rev. + Cel.</td>
<td>-</td>
<td>-</td>
<td>26 L-oz R + 3 D-oz/a Cel.</td>
<td>2</td>
</tr>
<tr>
<td>Tenacity +</td>
<td>4 L-oz/a</td>
<td>2</td>
<td>5 L-oz/ for LG only +</td>
<td>2</td>
</tr>
<tr>
<td>Sencor</td>
<td>8 D-oz/a</td>
<td>2</td>
<td>4 D-oz/a-GG &amp; 2 D oz/a-LG</td>
<td>2</td>
</tr>
<tr>
<td>Surfactant</td>
<td>1% MSO</td>
<td>2</td>
<td>.25% NIS</td>
<td>2</td>
</tr>
<tr>
<td>Dismiss +</td>
<td>6 L-oz/a</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brricade</td>
<td>10 oz/a</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Days to recover</td>
<td>75-80</td>
<td></td>
<td>14-20</td>
<td></td>
</tr>
</tbody>
</table>

Tropical Plant & Soil Sciences Department
University of Hawaii at Manoa
Mottled turf texture in greens cut due to goose grass
For broadcast use in residential turfgrass

This supplemental label expires May 31, 2018, and must not be used or distributed after this date.

Active Ingredient:
Topramezone: [3-(4,5-dihydro-isoxazoly]-2-methyl-4-(methylsulfonyl)phenyl][5-hydroxy-1-methyl-1H-pyrazol-4-yl]methanone .......................................................... 29.7%
Other Ingredients: ........................................................................................................... 70.3%
Total: .................................................................................................................................. 100.0%

1 gallon contains 2.8 pounds of topramezone free acid.

EPA Reg. No. 7969-327

Use Information

Pylex may be applied as a postemergence broadcast spray to residential and nonresidential turfgrass.
Pylex – uses and precautions

Main herbicide & Supplemental label

* Except for control or suppression of the following, DO NOT apply to Bahiagrass, Bermudagrass, buffalograss, carpetgrass, St. Augustinegrass, seashore paspalum, zoysiagrass, dichondra, or desirable clover.

1. No more that 2.0 fl oz./a per application
2. No more that 4.0 fl oz./a per year
3. No more that 3 applications/year
4. Not for greens or aprons.
5. Crop oil recommended as spray enhancer
Pylex – uses and precautions

Main herbicide & Supplemental label

6. Weed listed for control 1.0 to 1.5 fl oz/a
7. Reduced rates are OK by HRS 0149A-0031


PART III. PESTICIDE USE

§149A-31 Prohibited acts. No person shall:

(1) Use any pesticide in a manner inconsistent with its label, except that it shall not be unlawful to:

(A) Apply a pesticide at any dosage, concentration, or frequency less than that specified on the label or labeling; provided that the efficacy of the pesticide is maintained and further provided that, when a pesticide is applied by a commercial applicator, the deviation from the label recommendations must be with the consent of the purchaser of the pesticide application services;
### Treatments applied across 3-cuts: Rough, apron & green. 40 GPA, plots 6’ x 15’ w/4 replications of each treatment

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Formulated product oz / acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tenacity + MSO(1.0% v/v)</td>
</tr>
<tr>
<td>2</td>
<td>Tenacity + Sencor (75WG)+ MSO(1.0% v/v)</td>
</tr>
<tr>
<td>3</td>
<td>Tenacity + Sencor (75WG)+ MSO(1.0% v/v)</td>
</tr>
<tr>
<td>4</td>
<td>Pylex + MSO(1.0% v/v)</td>
</tr>
<tr>
<td>5</td>
<td>Pylex + Sencor (75WG)+ MSO(1.0% v/v)</td>
</tr>
<tr>
<td>6</td>
<td>Pylex + Sencor (75WG)+ MSO(1.0% v/v)</td>
</tr>
<tr>
<td>7</td>
<td>MSO(1.0% v/v)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Application Date</th>
<th>Interval between applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>03/10/16 1&lt;sup&gt;st&lt;/sup&gt; application</td>
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</tr>
<tr>
<td>03/29/16 2&lt;sup&gt;nd&lt;/sup&gt; application</td>
<td>19 DAS-01</td>
</tr>
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</table>
Treatments applied across 3-cuts: Rough, apron & green.

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</tr>
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<td>2.0 oz + 1.0 oz +</td>
</tr>
<tr>
<td>3 Tenacity + Sencor (75WG)+ MSO(1.0% v/v)</td>
<td>2.0 oz + 2.0 oz +</td>
</tr>
<tr>
<td>4 Pylex + MSO(1.0% v/v)</td>
<td>0.5 oz</td>
</tr>
<tr>
<td>5 Pylex + Sencor (75WG)+ MSO(1.0% v/v)</td>
<td>0.5 oz + 1.0 oz +</td>
</tr>
<tr>
<td>6 Pylex + Sencor (75WG)+ MSO(1.0% v/v)</td>
<td>0.5 oz + 2.0 oz +</td>
</tr>
<tr>
<td>7 MSO(1.0% v/v)</td>
<td></td>
</tr>
</tbody>
</table>

2013-Dec. Honolulu City and County treats 8 acres at Waipio

4 oz Tenacity + 8 oz Sencor + 1% MSO - 2X’s

12/10 & 12/23/2013 = Start of Winter Program

Low dose Tenacity + Sencor Tank mix study

Started: 08/01/14

01 = T-5 oz/a + S-1 oz/a
02 = T-5 oz/a + S-2 oz/a
03 = T-5 oz/a + S-4 oz/a
04 = NIS 0.25% v/v
1% MSO  7 DAS01 03/17/16

1
Tenacity +
MSO(1.0% v/v)

2.0 oz
1% MSO  7 DAS01 03/17/16

<table>
<thead>
<tr>
<th>2</th>
<th>2.0 oz +</th>
</tr>
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<tbody>
<tr>
<td>Tenacity +</td>
<td>1.0 oz +</td>
</tr>
<tr>
<td>Sencor (75WG)+</td>
<td>MSO (1.0% v/v)</td>
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</table>
1% MSO

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<tr>
<th>3</th>
<th>Tenacity +</th>
<th>2.0 oz +</th>
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</thead>
<tbody>
<tr>
<td>Sencor (75WG)</td>
<td>MSO (1.0% v/v)</td>
<td>2.0 oz +</td>
</tr>
<tr>
<td>4</td>
<td>Pylex + MSO(1.0% v/v)</td>
<td>0.5 oz</td>
</tr>
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</table>
7 DAS01 03/17/16

1% MSO

<table>
<thead>
<tr>
<th>5</th>
<th>Pylex +</th>
<th>0.5 oz +</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Sencor (75WG)+</td>
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1% MSO

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</table>
GG RESPONSE
IN APRON CUT
05/15/16

#7-CO

#6-P+S2

#3-T+S2
Conclusion for Pylex & Tenacity on T328 Greens and Aprons-2016

1. P & T bleaching reduced with Sen-1.0 & 2.0 d oz./a
2. P & T alone: P-25-40% & T-40-60% red. GG size in greens
3. P&T + Sen 2.0 oz/a best for exc. GG control in green
4. P&T + Sen 2.0 oz/a not effective for GG in aprons

P 0.5 oz/a + S 2.0 d-oz/a   P= 5g ai/a
T 2.0 oz/a + S 2.0 d-oz/a   T = 28g ai/a
Improved weed wick for fast growing weeds in new turf plantings
Factors for wiper applications

1. Pre application growth activation of weeds and turf.

2. Sufficient height difference between weeds & turf.

3. Glyphosate at 15-20% (20-25 oz/gal) for wiping weeds.

4. 2-3 day delay mowing and irrigation after app.
Hoakalei wiper cleanup of 8 acres
Hoakalei wiper cleanup of 8 acres
Hoakalei wiper cleanup of 8 acres
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Hoakalei wiper cleanup of 8 acres
Why use wiper application?

1. Eliminates drifts

Spraying near sensitive area getting increased attention from media, regulatory agencies & lawyers
Why use wiper application?

1. Eliminates drifts
2. Application OK on windy days, quick dry
3. Visually less obvious as pesticide app.
4. Applications during active play
Selective post herbicides applied with contact to both weeds and turf. Compare spray to wiping

Topical Application of Selective Postemergence Herbicides to Warm Season Turf in Hawaii
Pre-spray/wipe weeds 04/29/16

40 ft. x 40 ft. perpendicular wipe pattern

<table>
<thead>
<tr>
<th>Treatment</th>
<th>oz / acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pylex + Tenacity + Sencor (75WG) + MSO(1.0% v/v)</td>
<td>1.0 oz + 2.0 oz 4.0 oz +</td>
</tr>
</tbody>
</table>
Pre-spray/wipe weeds 04/29/16

15 ft. x 100 ft parallel wipe pattern

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<tr>
<td>Pylex +</td>
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</table>

Pre-spray/wipe weeds 04/29/16

15 ft. x 100 ft. spray application
Pre-spray/wipe weeds 04/29/16
10-DAW-S 05/09/16

40 ft. x 40 ft. perpendicular wipe pattern

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### Treatment 

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<tr>
<td>MSO (1.0% v/v)</td>
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**40 ft. x 40 ft. perpendicular wipe pattern**
10-DAW-S 05/09/16

15 ft. x 100 ft parallel wipe pattern

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10-DAW-S 05/09/16

15 ft. x 100 ft. spray application
### Treatment | oz / acre
---|---
Pylex + | 1.0 oz +
Tenacity + | 2.0 oz
Sencor (75WG)+ | 4.0 oz +
MSO(1.0% v/v) |
Front brush to tease up turf and weeds

Back brush wet w/herbicide spray under shield to apply
Systemic herbicides applied to brush bristles and then rolled across treatment area for no-drift weed control.
Can mixed stands of adapted weedy species be used for safe use on Hawaii’s sport turf venues?
Sport turf management is very challenging for venues managed by State and county agencies - $$, trained staff & heavy usage.
Waipio Soccer complex demonstrated mixed stands of grass and Broadleaf plants that form a playing surface is currently used by many athletes.
Research Goal: define sustainable mix of species that can be managed
to provide a safe and acceptable playing surface with minimum inputs
Ideas for research into Normal Grass Sport turf

1. **What are the current inputs to Waipio soccer fields**
   a. Fertilization
   b. Irrigation amounts and frequency
   c. Mowing methods and frequency

2. **What is the species mix for Normal Sport turf**
   a. Henry’s & blaket crab grass, Austrailian carpet, Hilo grass, Bermuda, seashore paspalum, zoysia
   b. Sedges = green kyllinga
   c. Any broadleaf weeds that make sense
   d. Soil conditions, Ph, salts, compaction, drainage & irrigation source (brackish, fresh, stream or R2-waster water.

3. **Can a Normal Grass turf be optimized for sport turf use**
   a. % of species mix
   b. Nursery production for blended plantings
   c. Mix of vegetative and seed plantings
   d. Site prep for establishing Normal Grass
   e. Stop trying so hard = good irrigation, regular close cutting, minimal fertilization and don’t look too close

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On line video and slideshow:
http://www.ctahr.hawaii.edu/deFrankJ/index.htm