Weed Control BMPs for Florida Nurseries

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Why are BMPs so important in Florida?

- Unique climate, sandy soils, high population
- Numerous lakes, streams, other water bodies (potential for serious pollution)
  - BMPs are tested and determined to be the best methods to protect environment and successfully grow your crops
- Everybody wants to live here (including weeds and other pests)

Importance of Weed Control BMPs

- Plants need to be weed free to be marketable
- Compete with nursery crops for:
  - Air
  - Water
  - Light
  - Nutrients
  - 1 large crabgrass plant can reduce holly growth up to 60% (Fretz, 1972)
- Can hinder workers (harvesting, pruning, etc.)
- Can harbor disease/insects
- Helps save money on other production inputs

How much does weed control cost?

- More than anything else (in most cases)
- Nurseries spend from $500 to $4,000 (or more) per acre for hand-weeding
- Economic losses due to weeds estimated at $7,000/acre (Case et al., 2005)

How much does weed control cost?

APPLICATION METHOD	MAN HOURS/ACRE (+/-)
High Clearance Boom	1.5
Orbit Air spreader	2
Hand-crank/belly grinder	4-6
Hand-weeding	100+

SLIGHTLY increased chemical/prevention cost *can* = **SIGNIFICANT** overall savings

Preventing weeds

- Top reasons for weed control problems:
  - Poor application/calibration practices
  - Weed seed are already germinating (you just don’t see them yet)
  - No rainfall/irrigation to activate herbicide
  - Poor sanitation practices
  - Destroying the chemical barrier
  - Bad timing

Weed Control Best Management Practices:

1. Improve Sanitation

- **The cost of prevention is lower than cost of management**
- Keep weed mats/ground cloth weed free
- Control escaped weeds before they spread

Keep bark piles and area weed free

- UF study: New shipments of pinebark and sand are usually not significant sources of weed seed (Norcini et al., 2006)
- But, if area is not kept weed free you can spread seeds around all parts of your nursery
- Use media ASAP after mixing
  - Reduce chance for seed introduction
  - Reduce chance of fertilizer leaching
- Keep bagged products in packaging until use

Control weeds in roadways, aisles, ditches

- Mow/weed-eat whenever possible – don’t let weeds seed
- Use dense, thick groundcovers, perennial grass species
  - Reduces erosion and nutrient/pesticide runoff
- Keep areas mulched, apply tank mix of PRE and POST for weed control

Use weed free liners

- Inspect new liners for weeds (especially regulated species)
- Visit liner sources during propagation seasons
- Consider using other sources if liners consistently contain weed seed

2. Maintain a good hand weeding program

- Scout for escaped weeds even when there doesn’t seem to be a problem
  - Stay ahead
- Stay on top of weeds during busy times
  - Potting seasons
  - Loading trucks
- Weed before applying PREs

3. Modify cultural practices

- Improve irrigation efficiency
  - Over-watering decreases weed control
  - Check uniformity
  - Group plants by water requirement
- Consider dibbling fertilizers
  - Reduces weed seed germination (Altland and Fain, 2003)
  - Can also improve N use efficiency
  - Reduce fertilizer loss due to blow-over

4. Use Non-Chemical Tools

- Replace ground cloth when needed
- Use mulches to reduce weed pressure
  - Pick mulch that dries out quickly
  - Needs to break down slowly
  - Aesthetically pleasing to customers
  - Available and cheap

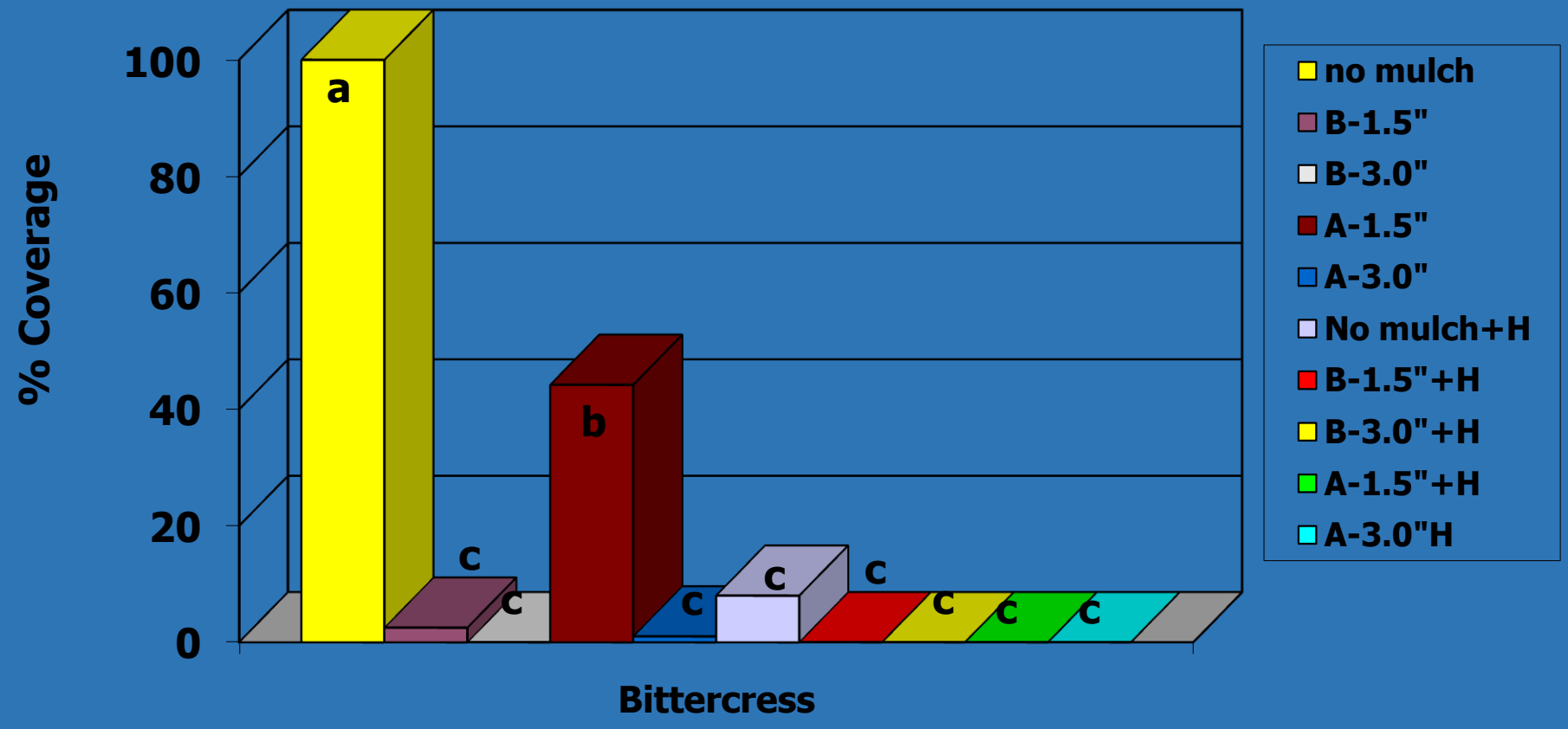
AU Study: Richardson et al., 2008; JEH 26:144-148

Bittercress and oxalis control using PB mulch in #7 containers

Treatments:

Seeded	Mulch Depth (in)	Broadstar (150 lbs/A)
Before	No mulch	No
Before	1.5	No
Before	3.0	No
After	1.5	No
After	3.0	No
Before	No mulch	Yes
Before	1.5	Yes
Before	3.0	Yes
After	1.5	Yes
After	3.0	Yes

Results: Bittercress, 180 DAT



JEH 26:144-148

Other Non-chemical tools:

- Weed cloths/weed mats/discs
- Inorganic mulches
- Subirrigation/drip irrigation systems

Remember: No method will provide complete control – use multiple methods and hit weeds from all angles

5. Use Pre-emergent herbicides correctly

- **Read the label, follow the label**
  - Rate, timing, volume, weeds controlled, sensitive species, nozzle, weather…..
- **Calibrate**
  - Herbicides are effective in narrow range
  - Too much: waste money, injure plants, negative environmental impacts
  - Too little: waste **MORE** money (hand weeding, wasted chemical cost) and weeds thrive
  - “Safe” herbicides become dangerous, effective herbicides become useless
  - It’s the law

Calibrated vs. Not Calibrated

Calibrate for each new granular you use

- Different products will have different granule sizes
  - They will spread differently during application
  - When you are calibrated for one, doesn't mean you are calibrated for another

Apply herbicides correctly

- Apply during calm conditions
  - Morning usually the best time, cooler
- Irrigate immediately after application, at least 0.25”
- Field drip won’t properly activate herbicide

Know how long you have to activate your herbicide

Herbicide	Needs activation within:
Barricade (Prodiamine)	14 days
Pendulum 3.3 EC/AquaCap (Pendimethalin)	30 days
Pennant Magnum (metalochlor)	7 days
Surflan (Oryzalin)	21 days
Princep (Simizine)	10 days
SureGuard (Flumioxazin)	14 days
Gallery (Isoxoben)	21 days
Tower (Dimethenamid-p)	30 days

Will cumulative rainfall work?

- Common assumption: If 0.5” rain is received over course of 30 days, herbicide will work
- Intermittent wetting/drying cycles cause herbicides to bind to very top surface of soil
- Does not move down to create 1” herbicide barrier
- Weeds can germinate through thin layer

Apply at the correct timing

- Where we get into trouble:
  - Applying to sensitive species (READ THE LABEL)
  - Applying before media settles, right after potting
  - During bud break, tender new growth
  - Wet foliage (granular materials; Snapshot is the exception)

DO NOT apply **FreeHand 1.75G** to begonia or severe injury will occur.

Do not apply Gallery 75 Dry Flowable to newly transplanted ornamentals, nursery stock, groundcovers, ornamental bulbs, non-bearing fruit and nut trees or non-bearing vineyards until soil or potting media has been settled by packing and irrigation or rainfall and no cracks are present or plant injury may occur.

SENSITIVE ORNAMENTAL SPECIES

Injury has been reported after application of *BroadStar* Herbicide to the plants listed in Table 5, especially when applied to small, recently transplanted liners. In some cases, only specific cultivars are listed because injury has not been reported on other cultivars of this species (See Tables 6-8). It is recommended that *BroadStar* Herbicide not be applied to these plant species or cultivars.

- Do not use **MARENGO G** on ornamentals where granules may become trapped in developing leaves or in meristematic areas (e.g. whorls of grasses and perennials such as hosta).

- Best times to apply PREs
  - While dormant
  - Winter
  - Summer/fall (no new growth)
  - When pots are jammed can-tight
  - When pots are weed free

Apply at the correct timing

- Apply at potting (after media settles) and about every 60 days during season
  - Study: Neal (NCSU) most PREs only provide control for 4 – 6 weeks
- ASAP after supplemental hand-weeding

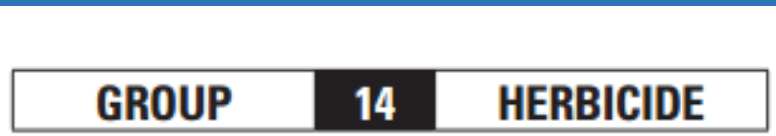
6. Avoid crop injury

- No applications in enclosed structures
- Don’t apply to overly stressed plants (fertilizer, water, disease, insects, etc)
- EC formulations (Pendulum EC, Pennant Mag, Tower) can cause injury during hot weather
- Treat small areas to test new chemistries
  - Note weather conditions/crop stage during application
  - Wait ~ 4 weeks before determining safety

7. Rotate your active ingredients/MOAs

- MOA group usually listed on top of label
  - Combinations usually have 2 groups
- Don’t rely too heavily on any one herbicide
- No herbicide controls all weeds
  - What’s not controlled will spread
- Use tank mixes/different chemistries to provide broad spectrum control

DNA is needed here to pick up grassy weeds

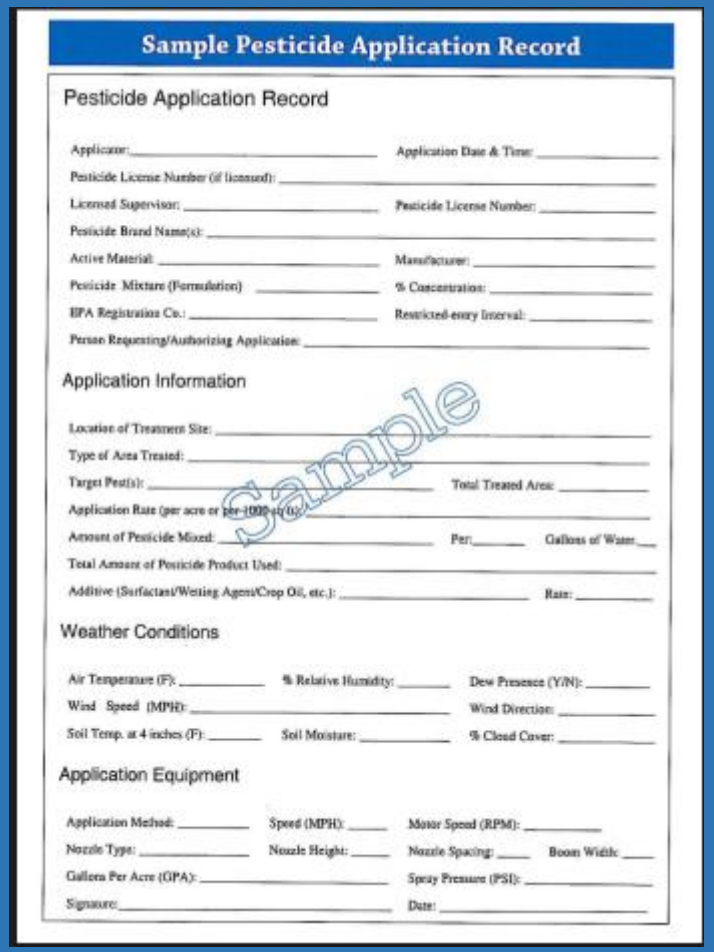


8. Identify your weeds

- Know what weeds are your problem
- Determine which herbicide works best on each weed
  - Information on label and note taking

9. Keep good records of all applications

- Mandatory records (restricted use)
  - Name/license # of licensed applicator and who applied
  - Date, start/end time and location
  - Crop or target site treated and size of area
  - Brand name and EPA number of product applied
  - Total amount applied and method of application
- Other good records for all pesticides
  - Weather conditions during application
  - Plant growth stage
  - Injury observed in the weeks following treatment
  - Escaped weeds



Sample Pesticide Application Record

Pesticide Application Record

Applicator: _____ Application Date & Time: _____

Pesticide License Number (if licensed): _____

Licensed Supervisor: _____ Pesticide License Number: _____

Pesticide Brand Name(s): _____

Active Material: _____ Manufacturer: _____

Pesticide Mixture (Formulation) _____ % Concentration: _____

IPA Registration Co.: _____ Restricted-entry Interval: _____

Person Requesting/Authorizing Application: _____

Application Information

Location of Treatment Site: _____

Type of Area Treated: _____

Target Pest(s): _____ Total Treated Area: _____

Application Rate (per acre or per 1000 sq ft): _____

Amount of Pesticide Mixed: _____ Per: _____ Gallons of Water: _____

Total Amount of Pesticide Product Used: _____

Additive (Surfactant/Wetting Agent/Crop Oil, etc.): _____ Rate: _____

Weather Conditions

Air Temperature (F): _____ % Relative Humidity: _____ Dew Presence (Y/N): _____

Wind Speed (MPH): _____ Wind Direction: _____

Soil Temp. at 4 inches (F): _____ Soil Moisture: _____ % Cloud Cover: _____

Application Equipment

Application Method: _____ Speed (MPH): _____ Motor Speed (RPM): _____

Nozzle Type: _____ Nozzle Height: _____ Nozzle Spacing: _____ Boom Width: _____

Gallons Per Acre (GPA): _____ Spray Pressure (PSI): _____

Signature: _____ Date: _____

Sample

10. Continually work to increase efficiency, reduce costs

- Designate someone to be in charge of weed control
  - Increases organization, reduces confusion, ensures strategies and schedules are maintained
- Consider adding more sprays to your program

Granular	***Considerations:***	**Spray**
More	**Cost of Chemicals**	**Less**
Less	**Cost of Application Equipment**	**More**
More	**Non-Target Losses**	**Less**
Less	**Applicator Skill Level**	**More**

How much are granulars really costing you?

- AU study (JEH 10:175-176)
  - Can-tight container spacing – **23% non-target loss**
  - 8 inch spacing – **51% non-target loss**
  - 12 in. spacing – **80% non-target loss**
  - Negative impact on environment and your wallet
- If 50 lbs. cost $100, and you applied to 8” spaced containers…
  - You would be wasting $50 per bag
  - Say you needed 4 bags/acre and had 10 acres
  - Loss of $200 per acre/$2,000 per application
  - 5 applications/year = $10,000 loss

Should you use granular products?

“The sprays are too expensive”

- Check the label for the amount of product needed to treat an acre

Specifications:	RONSTAR 2G (Oxadiazon)	RONSTAR 50 WSP (Oxadiazon)
Active Ingredient %	2	50
Cost per package:	$100/50 lbs	$60/2 lbs
Cost per pound product:	$2	$30
Cost per pound a.i.	$100	$60

- Base cost on price/acre and efficacy
  - If it costs more but is much more effective (reducing hand-weeding, less apps per year), it may be a bargain
- Sprays can be applied faster/cheaper

Field weed control considerations

- Crunch the numbers:
- Determine how much it costs to make repeated glyphosate applications
  - Labor
  - Equipment costs
  - Fuel
  - Chemical costs
- Could costs be reduced by using more effective (expensive) PRE herbicide in a tank mix?
  - 10 - 15+ applications glyphosate vs. 2 – 3 applications glyphosate + SureGuard or other PRE

Tom Landis, USDAFS, bugwood.org

11. Use PREs that provide early POST control

- Biggest problem with PREs:
  - Weeds are hard to see when small – missed during hand-weeding
  - If only a few weeds are missed, thousands of seeds could be produced
  - Few post options, bleak future for new products: Ornamental production is low acreage and high value = LIABILITY
  - Solution: Find PRE herbicides that provide early POST control

Herbicides evaluated: 2009 - 2012

- **Broadstar®** (Flumioxazin); new safety coating – PPO inhibitor
- **V-10142 G®** (Imazosulfuron) - Acetolactate synthase (ALS) inhibitor, blocks synthesis of amino acids (Celero WDG in turf)
- **Tower®** (Dimethenamid-P) – long chain fatty acid inhibitor, disrupts cell division
- **FreeHand®** (Pendimethalin + Dimethenamid-P) – mitosis + LCFA inhibitor
- **Pendulum** (Pendimethalin) – mitosis inhibitor
- **Casaron®** (Dichlobenil) – inhibits cellulose synthesis, disrupts cell division
- **Certainty®** (Sulfosulfuron) – ALS inhibitor
- **Gallery®** (Isoxoben) – cell wall synthesis inhibitor
- **Surflan®** (Oryzalin) – mitosis inhibitor
- **Dimension®** (Dithiopyr) – mitosis inhibitor
- **Marengo®** (Indaziflam) – inhibits cell wall biosynthesis
- **Showcase®** (Trifluralin + Isoxaben + Oxyfluorfen) - cell wall synthesis + mitosis inhibition

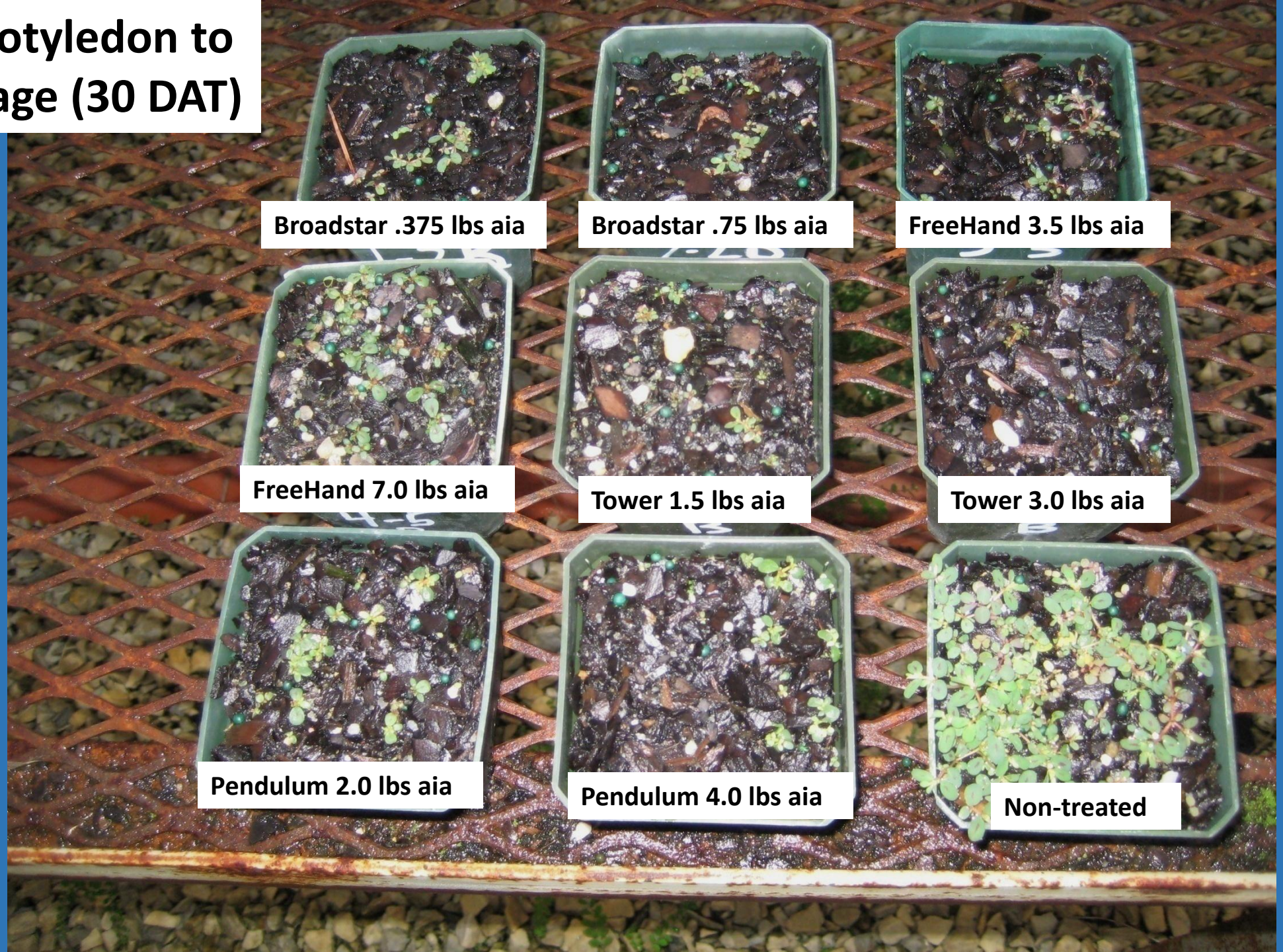
Example of Trial Set-up: Spurge

Cotyledon to 1 Leaf

2 to 4 Leaf

Growth Stage	Pots Filled/Seeded	Treated
2 to 4 Leaf	July 31, 2008	August 14, 2008
Cotyledon to 1 Leaf	August 7, 2008	

Exp. 1. Cotyledon to 1 Leaf Stage (30 DAT)



Exp. 1. 2 to 4 Leaf Stage (30 DAT)

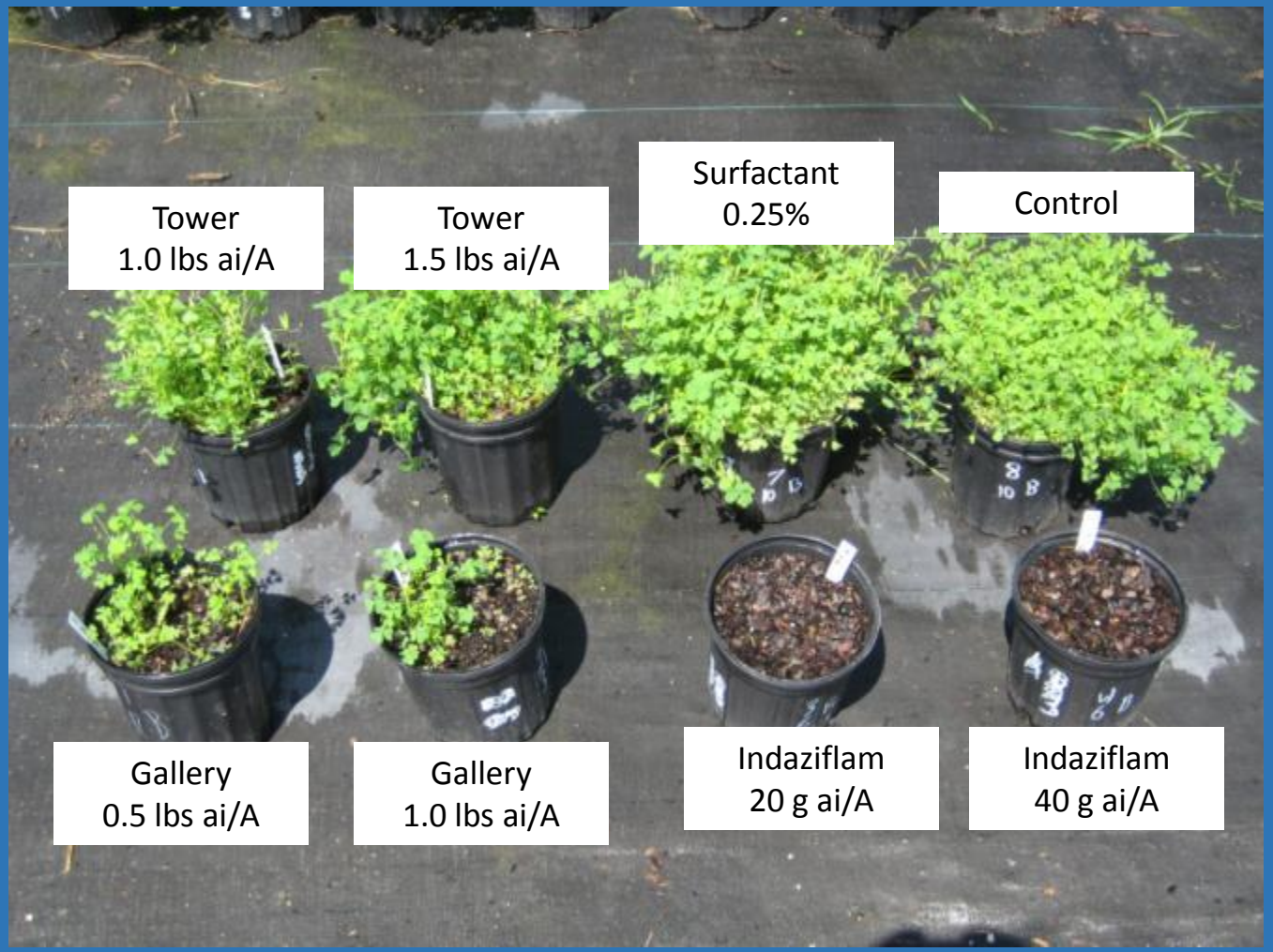
Example of Trial Set-up: Oxalis

Cotyledon to 1 Leaf

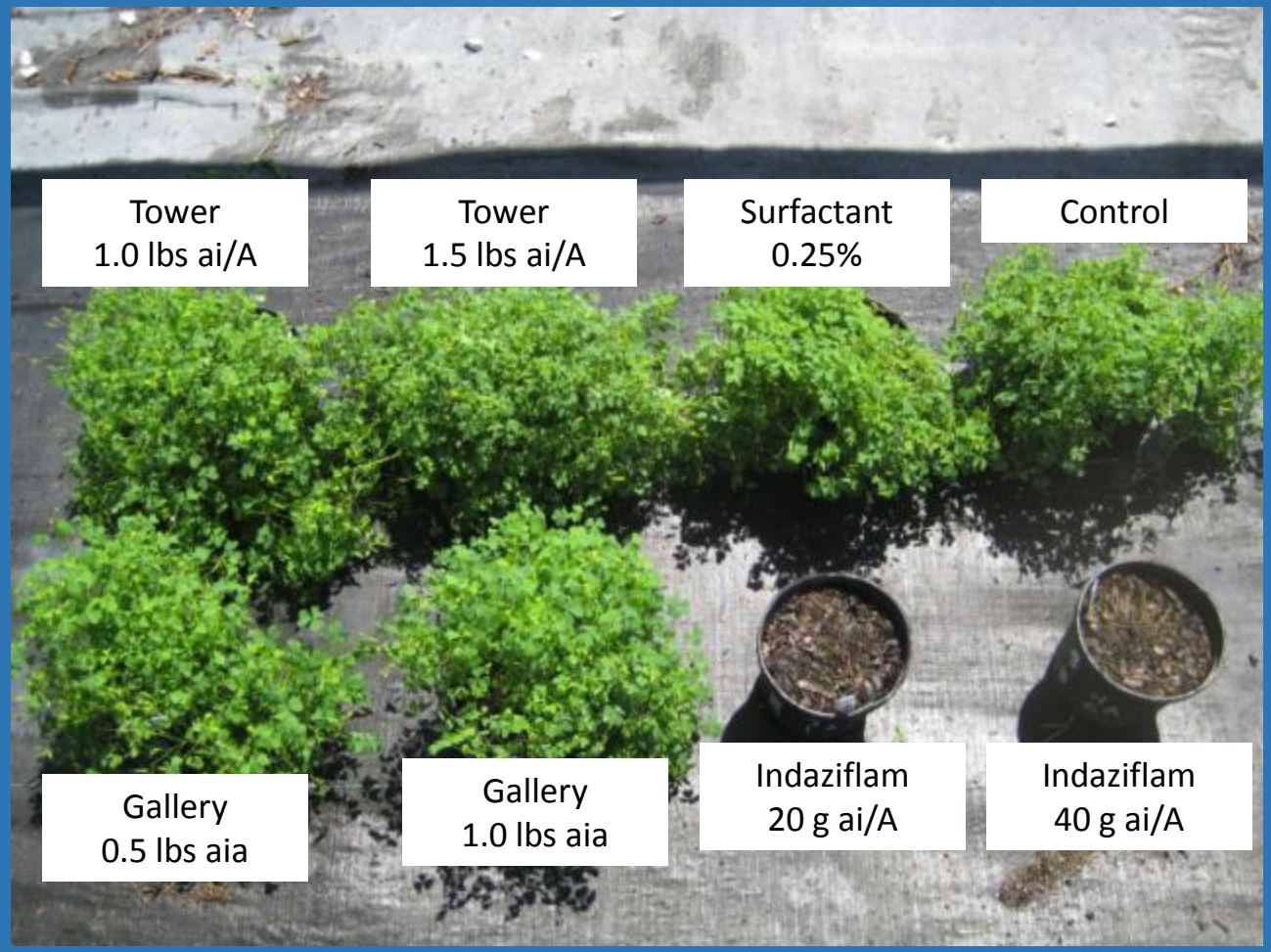
2 to 4 Leaf

Growth Stage	Pots Filled/Seeded	Treated
2 to 4 Leaf	May 31, 2011	June 18, 2011
Cotyledon to 1 Leaf	June 7, 2011	

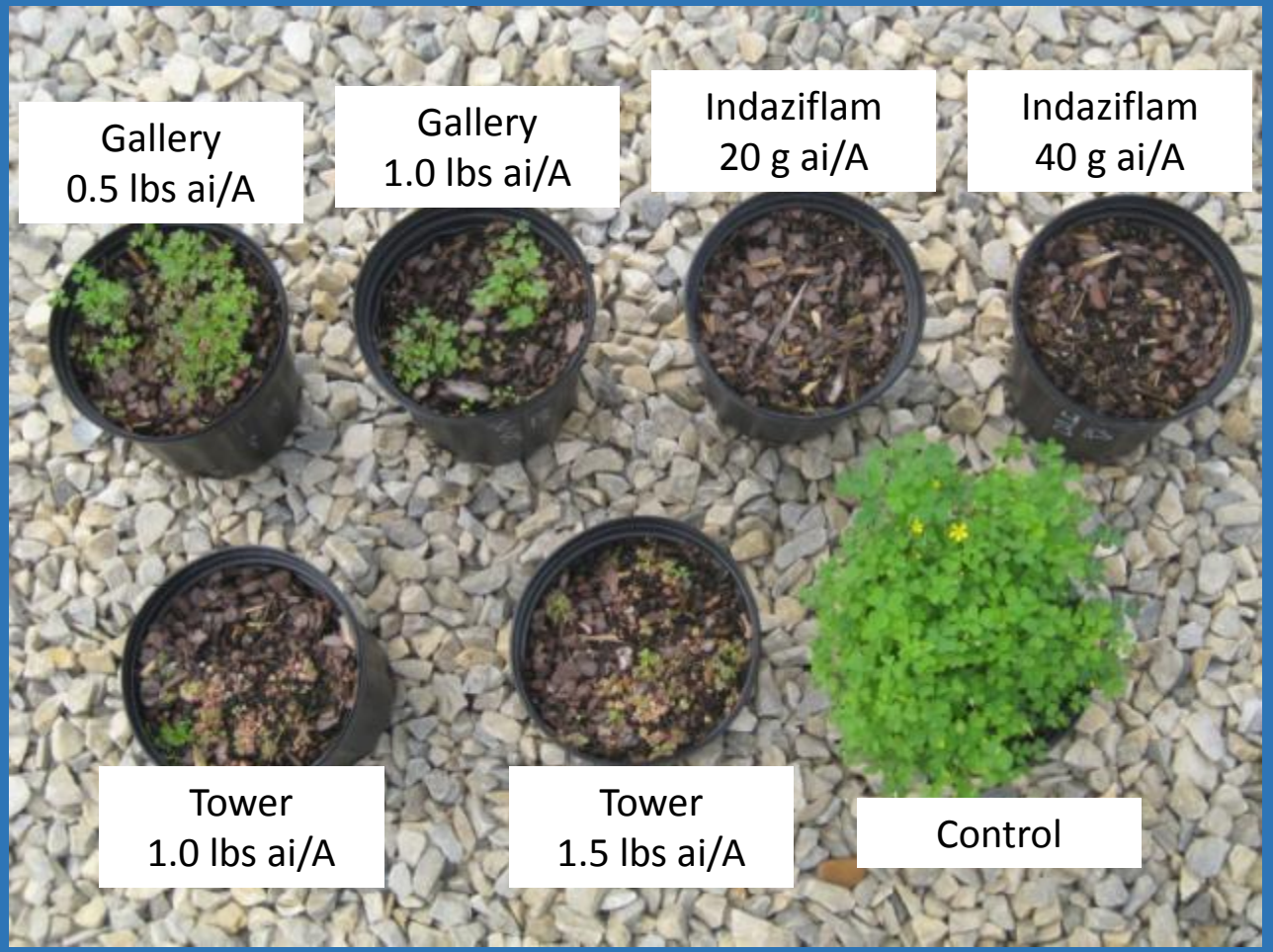
Exp. 1: Cotyledon to 1 Leaf at 8 WAT



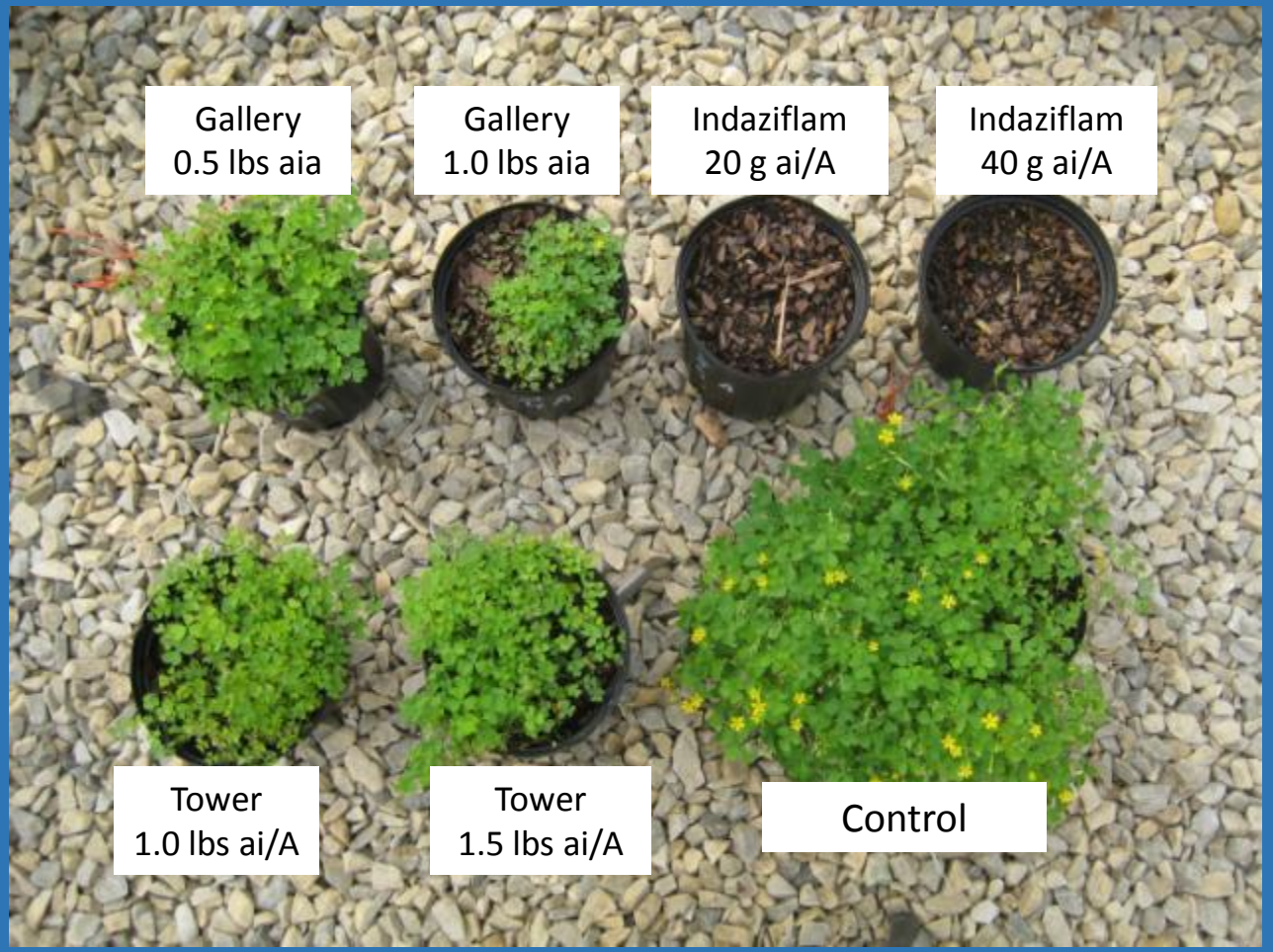
Exp. 1: 2 to 4 Leaf Stage at 8 WAT



Exp. 2: Cotyledon to 1 Leaf at 8 WAT



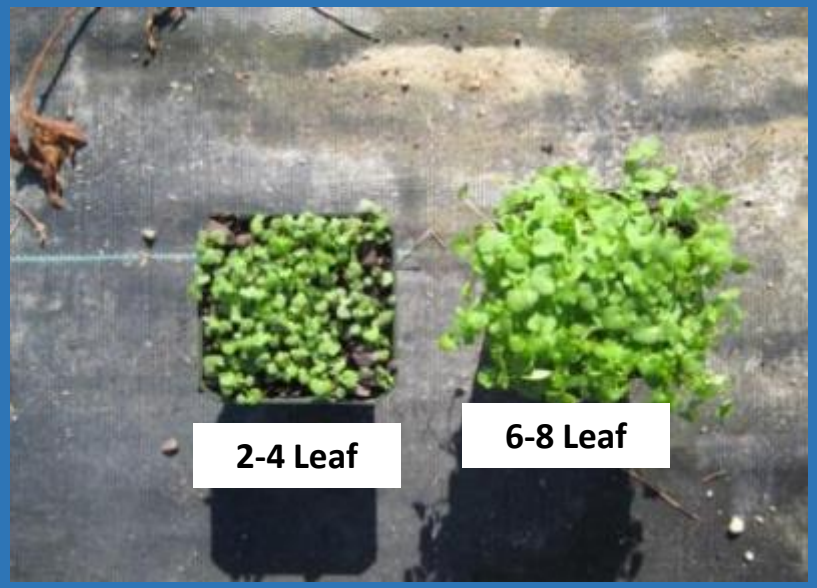
Exp. 2: 2 – 4 Leaf at 8 WAT



Methods: Bittercress

Herbicides and Rates:

1. Gallery – 0.66 and 1.0 lbs ai/A
2. Dow XR – 0.66 and 1.0 lbs ai/A
3. Showcase – 5 lbs ai/A
4. Dimension – 0.5 lbs ai/A



Example of Trial Set-up: Bittercress

2 to 4 Leaf

6 to 8 Leaf

10 to 12 Leaf

Growth Stage	Pots Filled/Seeded	Treated
2 to 4 Leaf	April 18, 2011	April 28, 2011
6 to 8 Leaf	April 6, 2011	
10 to 12 Leaf	April 18, 2011	May 11, 2011

Bittercress: 2 to 4 leaf – 30 DAT

Bittercress: 6 to 8 leaf at 30 DAT

Bittercress: 10 to 12 Leaf – 30 DAT

Benefits of Early Post Herbicides:

- All products provide effective PRE control – added benefit of controlling small emerged weeds
- Most herbicides reduced F.W., delayed flowering – provides more opportunities for hand weeding before seeds develop

12. Test new products

- Newest product on the market: Indaziflam (Marengo)
  - Very low volatility, great control of annual broadleaves/grasses
- Rate: 7.5 to 18 fl. oz/A – Liquid (directed apps only)

  100 to 200* lbs/A - Granular

1. Marengo (Indaziflam) – 7.4 oz/A

2. Marengo (Indaziflam) – 14.8 oz/A

3. Marengo (Indaziflam) – 29.6 oz/A

4. SureGuard 10 oz/acre

5. Non-treated control

% Weed Control at 100 DAT (no injury)				
97%	100%	100%	100%	12.5%

Indaziflam SC Field Trials: 2010 - 2012

- 30 tree/shrub species tested in commercial field nurseries in Alabama.
- Three rates of indaziflam 7.4, 14.8, and 29.6 oz/A.
- SureGuard control (10 oz/acre) and non-treated control.
- Directed application with 2% RoundUp – all treatments.
- Crop Tolerance – No injury at any date (directed applications)
- 14.8 oz rate provided 98% weed control 8 months after application

Indaziflam Trials: Directed spray in large containers

1. Marengo (Indaziflam) – 7.4 oz/A

92.5% weed control

2. Marengo (Indaziflam) 14.8 oz/A

90.5% weed control

3. Marengo (Indaziflam) – 29.6 oz/A

100% weed control

4. SureGuard 10 oz/acre

98.3% weed control

5. Non-treated control

0% weed control

Pictures taken at 90 DAT – no injury

Indaziflam SC trials: Over-the-top applications

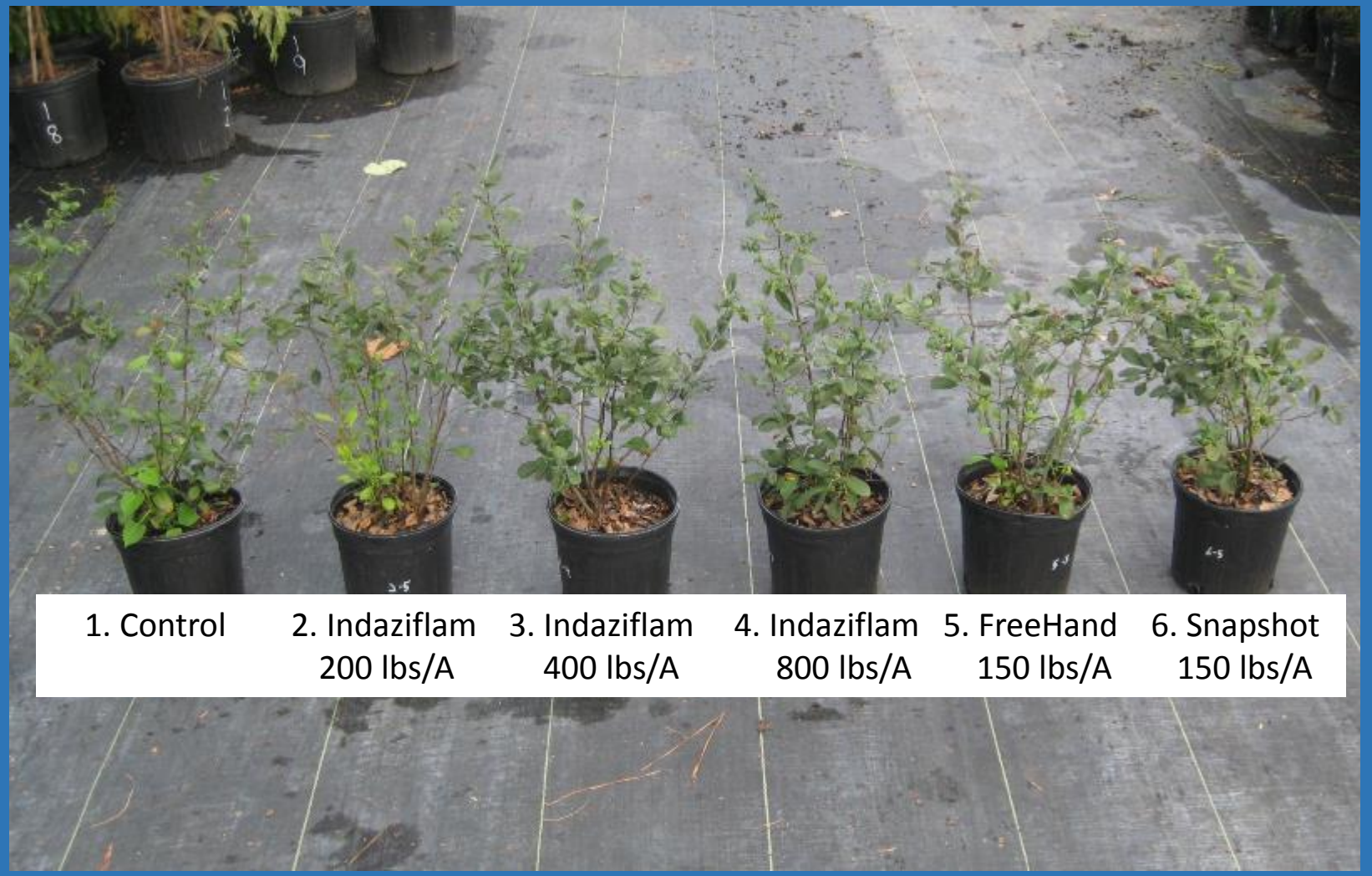
Marengo 3.7 oz/A	Marengo 7.4 oz/A	Marengo 14.8 oz/A	Control

Marengo 3.7 oz/A	Marengo 7.4 oz/A	Marengo 14.8 oz/A	Control

Indaziflam SC trials: Over the top applications:

SC Formulation must be used as directed spray; multiple species were injured by OTT application

Indaziflam G: Flowering Quince



1. Control	2. Indaziflam 200 lbs/A	3. Indaziflam 400 lbs/A	4. Indaziflam 800 lbs/A	5. FreeHand 150 lbs/A	6. Snapshot 150 lbs/A

Indaziflam G: Tuscarora Crapemyrtle

Indaziflam G Trials

- 9 woody shrub/tree species treated @ 800 lbs 2 with no injury/growth reduction
- Slight stunting noticed on ‘Bigfoot’ cleyera and Carolina jasmine @ 800 lbs – plants were still marketable
- **In the landscape:**
  - Caused injury on pansies, dianthus, snapdragons; no injury on gardenia, Chinese holly, little zebra grass

Snapdragon (Control Treatment)

Snapdragon (treated at 800 lbs/A)

13. Protect the chemical barrier

- PREs form a chemical barrier on container surface
  - Controls weeds emerging through the barrier
  - When barrier is disrupted, weeds will grow
- Common ways to break barrier:
  - Poking holes in containers when moving pots
  - Dropping pots
  - Staking
  - Blow-over
  - Pulling uncontrolled weeds
- Protect the barrier
  - Carry pots correctly, don't fill to top
  - Stabilize plants to prevent blow-over (big labor, media, fertilizer savings)
  - Re-apply PREs soon after hand-weeding

14. Stagger herbicide applications

- Most herbicide runoff occurs within first 6 irrigation after application
- Staggering over small areas reduces negative environmental impacts
- Benefits to you:
  - Less phytotoxicity concern when recycling water
    - Certain herbicides (oxyfluorfen) can burn tender foliage if allowed to accumulate in retention ponds
  - Allows workers to weed areas and re-apply before weeds begin germinating again
- Divide production areas that drain into same collection ponds into sections
- Gravel impedes herbicide movement more than plastic or fabric

Other considerations

- Don’t pre-fill/stack pots
- Group plants to make herbicide applications more efficient
  - Group according to tolerances/label recommendations
  - Example: Snapshot can’t be applied to *Hydrangea spp.*

Other considerations

- Only mix amount of pesticide needed for that day
- Know the half-life (how long for 50% to degrade) of your herbicide
  - Flumioxazin: pH 5 – 3.4 to 5.1 days
    pH 7 – 21.4 to 24.6 hours
    pH 9 – 14.6 to 22.0 minutes
- Consider using lower spray volumes to save time (depending on label)
  - More efficient to apply 20 gpa compared with 50 gpa – can use smaller spray tanks
  - AU Study: no injury on hydrangea or gardenia treated with Tower @ 25, 50, or 100 gpa app. vol.; no difference in weed control

James H. Miller, USDAFS, bugwood.org

Other considerations

- Clean sprayers after each use
  - SureGuard label:
    1. Drain spray tank, rinse sprayer and all screens
    2. Fill tank up with water and flush hoses, screens, nozzles
    3. Top off tank with water and ammonia (1 gal. 3% ammonia/100 gals)
    4. Circulate through sprayer 5 minutes
    5. Flush all hoses, booms, screens, nozzles for 15 min.
    6. Drain tank
    7. Add clean water to flush for 2 more min.
    8. Remove all nozzles, screens flush with clean water

I didn’t rinse properly! First plant treated OTT following a high SureGuard directed-app treatment

Other considerations

- Don’t use glyphosate for sucker removal
- Avoid applications to freshly cut suckers
  - Decreases trees resistance to disease
  - Weakens bark structure, making them more prone to cracking and splitting
  - Products with high adjuvant load are worst offenders
  - Use a contact herbicide

Mathers 2009 (Landscape Trades 31 (4):34-35)

Final thoughts:

- Always focus on eradication and prevention/sanitation
- Use a variety of methods to control weeds
  - Fabrics, mats, mulch, cover crops (field), herbicides (new and old), hand-weeding, directed sprays for larger crops
  - Change cultural practices to improve weed control
    - Work to increase water efficiency, change fertilizer placement
- Make chemical applications more efficient and accurate
  - Mechanize where possible
  - **Make calibration #1 priority** – guaranteed to **save money** and improve weed control

Questions

“An ounce of prevention is worth a pound of the cure.”

- Ben Franklin