WHAT'S NEW IN NURSERY FIELD AND CONTAINER WEED CONTROL

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Rutgers University, August 11, 2014

THE OHIO STATE UNIVERSITY

BasicGreen Website

http://basicgreen.osu.edu

- ✓ **Publications**
  - **Archive: Out-and-about articles**
  - **Research Summaries – 2006 to 2013**
- ✓ **News**
  - **Video clips**


Efficacy – ↑ weed control
Phytotoxicity - ↓ injury
Beauty without the risk

HAND WEEDING

- Before each **“scheduled”** herbicide application - hand weeding is done.
- Hand weeding, not more than 1-2 days prior to scheduled applications.
- If for any reason weeds are ready to seed before scheduled application, weeds are pulled and **half rate** of preemergence herbicide applied.

PREEMERGENCE HERBICIDES

10,000 lb/ac = 400 hrs./ acre =
400 X 15.00 = $6,000

Mitosis Inhibitors (Root and Shoot) – *Sambucus* – NF, 2012

Mitosis Inhibitors - MoA

Root inhibitors

Group 3

Dinitroaniline	Barricade 65WG	Prodiamine
	Pendulum 2G,	Pendimethalin
	Pendulum 3.3 EC	Pendimethalin
	Pendulum Aqua Cap	Pendimethalin
	Prowl H_20 3.8 CS	Pendimethalin
	Pre-M 60DG	Pendimethalin
	Corral	Pendimethalin
	Surflan AS T/O	Oryzalin
	Treflan EC	Trifluralin
	Treflan QR5	Trifluralin
	OH II	Oxyfluorfen + Pendimethalin
	Rout	Oryzalin + Oxyfluorfen
	Snapshot 2.5TG	Isoxaben + Trifluralin
Pyridine	Dimension	Dithiopyr
Benzoic acid	Dacthal	DCPA

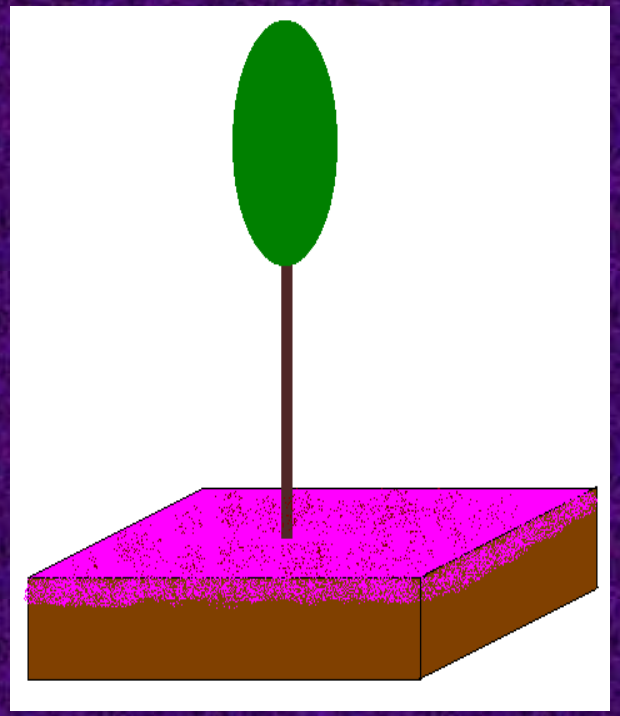
Mitosis Inhibitors - MoA

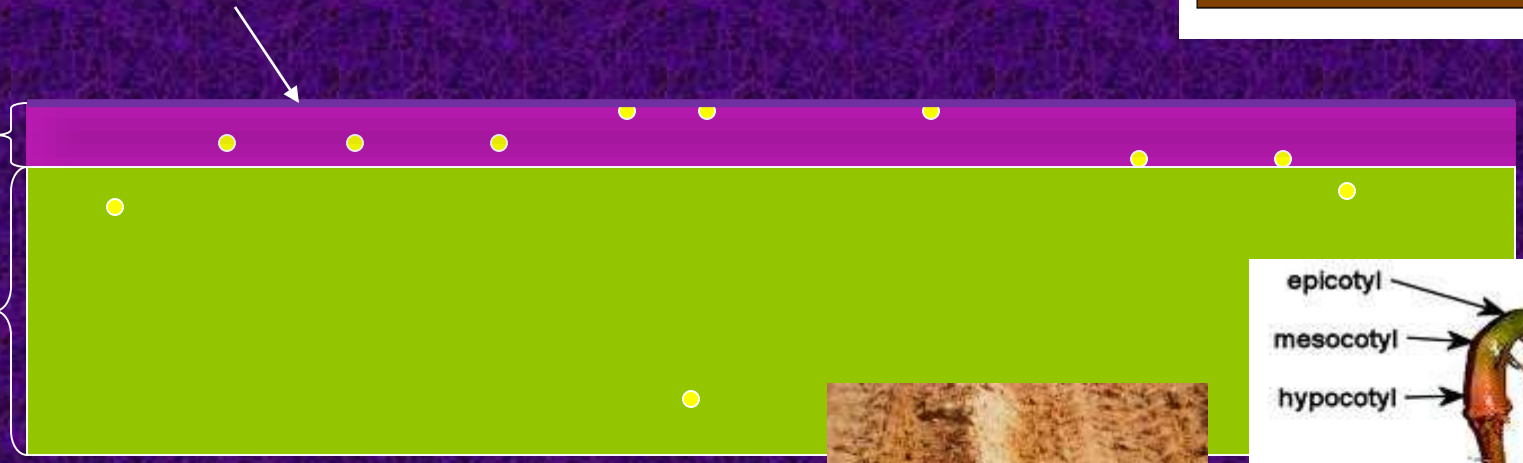
Shoot inhibitors (inhibits VLCFAs):

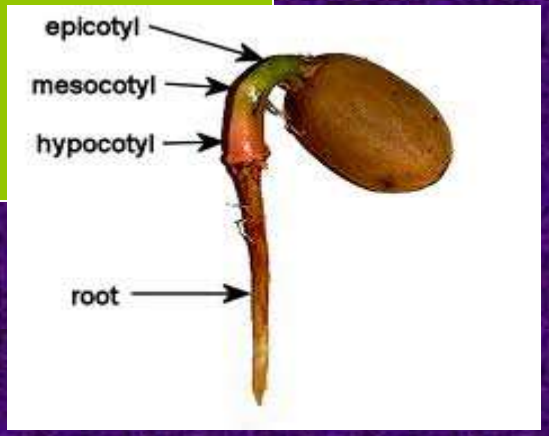
Chloroacetanilide	Pennant Magnum	Metolachlor
	Tower	Dimethamid -p
Group 15	FreeHand	Dimethenamid-p +pendimethalin
	Kerb 3.3 SC	Pronamide
	Kerb 50 W	Pronamide
Acetamide	Devrinol 50DF	Napropamide
	Devrinol 10G	Napropamide
Group 15		

Mitosis Inhibitors

- Emerging/germinating seedling has to come in contact with the herbicide







PPO Inhibitors (Group 14)

Diphenylether		
	Goal 2XL	**Oxyfluorfen**
	Goal Tender	**Oxyfluorfen**
	OH II	**Oxyfluorfen+pendimethalin**
	Rout	**Oxyzalin + Oxyfluororen**
	Biathalon	**Oxyfluorfen + prodiamine**
Oxadiazole		
	Ronstar 50 WSP	**Oxadiazon**
N-phenylphthalimide		
	BroadStar G	**Flumioxazin**
	SureGuard WDG	**Flumioxazin**
Triazolinone		
	F6875, Echelon	**Sulfentrazone + prodiamine**

Flumioxazin

- Flumioxazin 51WDG (sprayable) = SureGuard
- **Flumioxazin 0.25G (granular) = BroadStar®, Valent USA Corp.,** - Acquired (2014) by Nufarm Americas Inc., Alsip, IL) 0.25 (a.i.) lb./acre [0.28 (a.i.) $kg \cdot ha^{-1}$]
- Both products registered since 2003 / 2004.
- For use in many field & container-grown woody ornamentals.
- Broad spectrum - broadleaf weeds and grasses.
- In Ohio BroadStar is the nursery standard & most commonly used

Cellulose Inhibitors (Group 20 & 21)

Benzamide
Group 21

Gallery 75 DF
Snapshot 2.5 TG

Isoxaben

Isoxaben + trifluralin

Nitrile
Group 20

Casoron 4G

Dichlobenil

Alkylazine
Group 29

Alion -Orchard
Specticle -Landscape
Marengo G -Nursery containers

Indaziflam

Marengo G®

- ✓ OHP, Inc., Mainland, PA launched granular 9/2013 – Nursery containers
- ✓ Long-lasting - Soil degradation 150 days
- ✓ Less applications
- ✓ Low a.i./ac – 0.0224% Indaziflam
- ✓ 0.25” to activate within 21 days
- ✓ Non-volatile, does not move in soil once watered in

Standard Use Rates

			lb a.i. / A
Snapshot TG	150 lb/A	Isox + Trifl	3.75
OH-2	100 lb/A	Oxyfl + Pend	3.0
Rout	100 lb/A	Oxyfl + Oryz	3.0
Regal O-O	100 lb/A	Oxyfl + Oxad	3.0
Ronstar 2G	200 lb/A	Oxadiazon	4.0
Biathlon	100 lb/A	Oxyfl + Prodi	2.75
BroadStar 0.25G ®			
	150 lb/A	Flumioxazin	0.375
Marengo G ®	200 lb/A	Indaziflam	0.0448

Preemergence herbicides

- *Most* will not kill weeds present at time of application
  - **Exceptions (must be "small" weeds)**
  - ✓ Goal – oxyfluorfen –PPO inh.
  - ✓ SureGuard – flumioxazin – PPO inh.
  - ✓ Ronstar – Oxadiazon – PPO inh.
  - ➢ Gallery – isoxaben – cellulose inh.

Materials and Methods – Phyto.

Studebaker Nursery (New Carlisle, OH)	Willoway Nurseries (Huron, OH)
May 6, 2013 – 1, 2, 4 WAT and 8 WAT	May 1, 2013 – 1, 2, 4 and 8 WAT

Exposed Gravel Pads

3 subsamples/4 reps = 12 plants/treatment

7 species

Materials and Methods – Efficacy:

Ohio State University, Columbus, OH
Retractable roof greenhouse (Cravo Ltd., Brantford, Ontario, CA)

- ➢ June 9, 2013 – 30 seed/pot (then 2 d irrigation)
- ➢ June 11, 2013 – treatments applied to imbibed seed
- ✓ Large crabgrass (*Digitaria sanguinalis*)
- ✓ Common yellow woodsorrel (*Oxalis stricta*)
- ✓ Hairy Bittercress (*Cardamine hirsuta*)
- ➢ Applied to 1 gallon = (85% pine bark, 10% comtil (composted sewage sludge) and 5% pea gravel).
- ➢ 6 single plant reps/ species.

Weed counts - 2, 4, 8 and 13 WAT

Materials and Methods – Phyto. and Eff.:

- Marengo G ® – 0, 100, 150 and 400 lb/ac.
- BroadStar ® - 150 lb/ac
- Osmocote Pro 17-5-11, top-dress (14.8 g/#1 gallon)
- CRD within species
- Phytotoxicity (0-10, < 3 = commercially acceptable)
- SAS® Proc Mixed
- Phytotoxicity - treatment compared to untreated = Dunnett's t-test with $\alpha = 0.10$ and 0.05.
- Efficacy (LSmeans) - separate all possible comparisons.

Results - Willoway

0-0-62 – solution mined with NaCl

- 2013 on-going nutritional problems - causing bleaching of foliage at Willoway
- Masked treatment effects
- Data non-useable

Results - Studebaker

< 3 = commercially acceptable

2WAT M 100# (2.7)

2WAT M 150# (2.7)

2WAT M 400# (3.1)

Hemerocallis 'Stella d'oro'								
Treatment	Rate	1 WAT		**2 WAT**		4 WAT		8 WAT	
Marengo G	100 lb	2.6		**2.7**	**	2.8	**	1.5	*
Marengo G	150 lb	1.4		**2.7**	**	2.6	**	0.8	
Marengo G	400 lb	0.5		**3.1**	**	2.5	**	1.2	
BroadStar	150 lb	4.0	**	**5.1**	**	4.8	**	3.3	**
Untreated	--	1.1		**0.8**		0.5		0.1	

*, ** are significantly different from the control based on Dunnett's t-test (α = 0.10 and 0.05)

2WAT B 150# (5.1)

2WAT Control (0.8)

PPO (Protoporphyrinogen oxidase) Inhibitors (Group 14)

- Inhibit the synthesis of a precursor of chlorophyll and heme; however, formation of triplet oxygen = rapid destruction of contacted tissue.
- Injury = severe crinkling and malformation of leaves
- Tolerance determined plants metabolizing the herbicide rapidly = prevent herbicide accumulation to toxic concentrations.

Indaziflam Vs. Ronstar – 2 WAT

"Hydrangea is very susceptible to Indaziflam, showing stunting, whitening, and brittle stems. The *paniculata* species are more tolerant than the *macrophylla* species based on our data, but it is still inadvisable to apply Indaziflam to any *Hydrangea* cultivars." (Mathers et al., 2012).

< 3 = commercially acceptable

Results - Studebaker

Viburnum x'Juddi'								
Treatment	Rate	1 WAT		2 WAT		4 WAT		8 WAT	
Marengo G	100 lb	0.7		0.2		0.3		1.3	
Marengo G	150 lb	1.6		1.3	*	1.7		2.9	**
Marengo G	400 lb	1.9		1.7	**	2.3	**	3.1	**
BroadStar	150 lb	1.7		1.5	**	2.5	**	4.5	**
Untreated	--	0.9		0.2		0.2		1.7	

*, ** are significantly different from the control based on Dunnett's t-test (α = 0.10 and 0.05)

Efficacy Results - OSU

- Marengo® 100, 150, 1nd 400 lb/ac and the BroadStar® 150 lb/ac – excellent control of *Cardamine* and *Digitaria* (data not shown).
- *Oxalis* = good emergence
- At 4 WAT, all treatments = significantly lower counts for *Oxalis* vs untreated
- 8 WAT = residual control ↓ all treatments – 200 and 400 lb/ac better
- 13 WAT – 400 lb/ac residual control - *Oxalis* was re-seeding

Efficacy Results

*> 7 = commercially acceptable, 0 no control

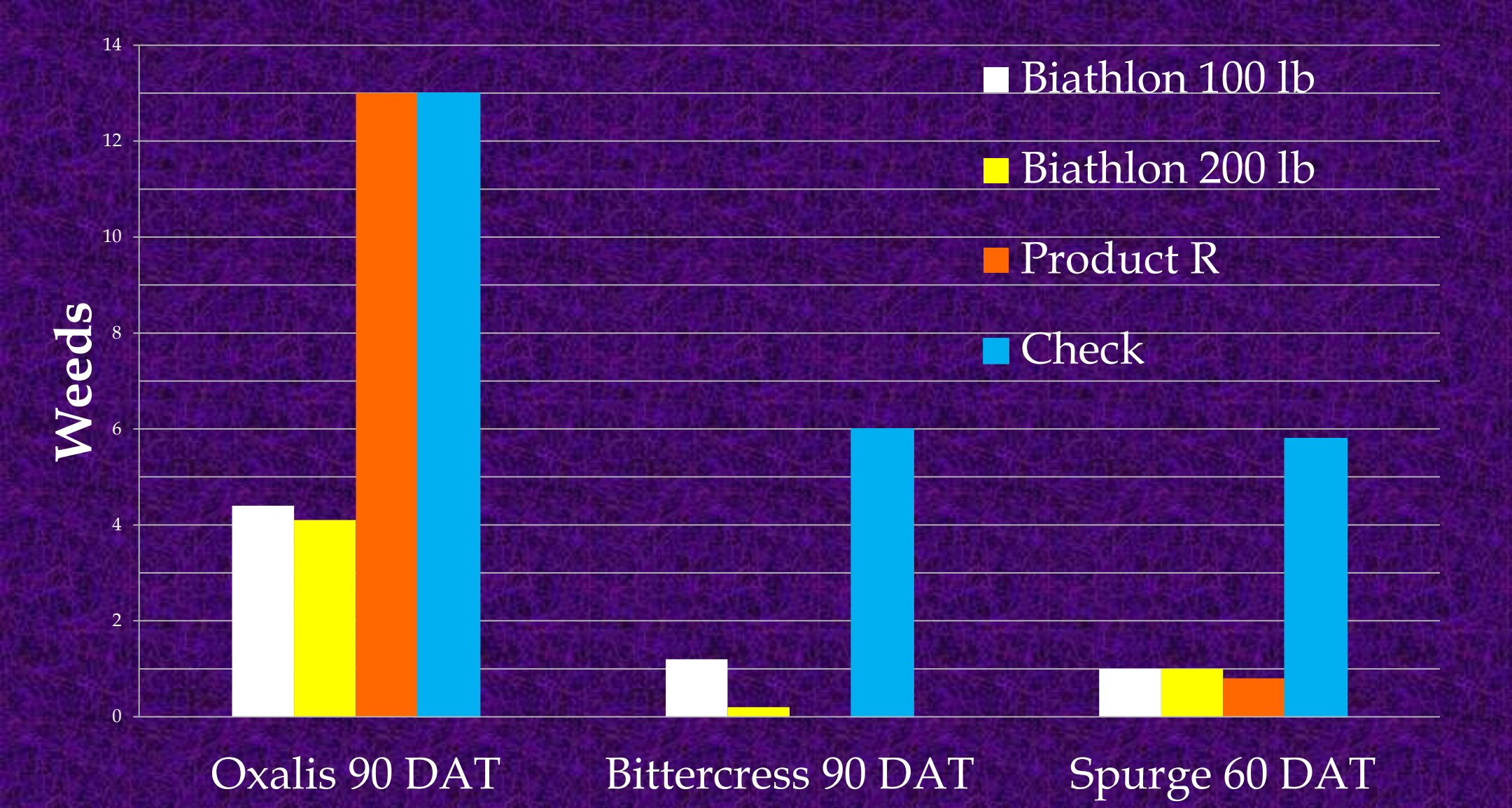
Oxalis stricta		2 WAT		4 WAT		8 WAT		13 WAT	
Treatment	Rate	Weed counts						Visual Ratings*	
Marengo	100 lb	5.8	bc	4.2	a	8.8	b	0.0	c
Marengo	150 lb	7.8	c	4.4	a	13.7	bc	0.0	c
Marengo	200 lb	4.0	abc	3.5	a	**4.3**	**a**	**3.8**	**b**
Marengo	400 lb	1.3	a	0.6	a	**2.5**	**a**	**6.0**	**a**
BroadStar	150 lb	3.2	ab	3.3	a	9.2	b	0.7	c
Untreated	--	18.3	d	20.2	b	20.0	c	0.0	c

Conclusions

- Marengo safer on *Hemerocallis* and *Viburnum*
- *Hemerocallis* - Marengo all rates OK
- *Viburnum* – Marengo 100 lb/ac OK
- Both phytotoxic on *Hydrangea*
- Marengo comparable to BroadStar for efficacy at 100 or 150 lb/ac
- 200 and 400 lb/ac better than BroadStar – at 8 WAT
- BroadStar and Ronstar formerly best on Oxalis at 7 WAT (previous studies)
- Marengo 400#/ac still near comm. acceptable at 13 WAT
- Phytotoxicity could be reduced by better granular formulation – 2014 - now

Biathlon - oxyfluorfen and prodiamine

- Biathlon new - Verge granule technology
- Granule - low dust and **uniform-sized** granule for greater accuracy.
- The rate is 100 lbs. per acre with a maximum of two applications per acre per year.
- Controls grass and broadleaf weeds in field and container ornamentals, ground maintenance and other non-crop areas.



Weed counts days after treatment (DAT) C. Gilliam 2011, Auburn Univ.

Biathlon

	Azalea ‘Karen’
	Pieris ‘Red Mill’
	Ilex × *meserveae* ‘Blue Maid’
	Rhododendron ‘Nova Zembla’
	Hydrangea paniculata ‘Little Lamb’
	Viburnum ‘Juddi’

Biathlon	**Rosa ‘Knockout’**	**(North Branch and Studebaker)**
	Hydrangea macrophylla ‘Endless Summer’	1 application only Wash off immediately
	Hydrangea arborescens ‘Invincibelle spirit’	
	Azalea viscosum	
	Hemerocallis ‘Stella d oro’	OK at Klyn, not at Studebaker’s not at BFN 2011

Biathlon

Hydrangea macrophylla
'Endless Summer'

2WA2T chlorosis **200 lb./ac – 2X**


(2+1 transplant 2-3 wk before appl. May 22, 2013)
3
43
1
Biathlon 150#/ac

- **Granular combo preemergence**
  - ✓ Rout - Oxyflourfen (Goal) + Oryzalin (Surflan)
  - ✓ Regal 0-0 (Oxadiazon + Oxyflurofen)
  - ✓ Showcase (Snapshot + Goal)
  - ✓ Jewel (Oxadiazon + Pendimethalin) – Scotts
  - ✓ Harrell's 75 (Oxyfluorfen + Trifluralin) – HGH75, HGH63
  - ✓ Snapshot 2.5 TG (Isoxaben + Trifluralin)
  - ✓ Regal Star G (Oxadiazon + Prodiamine)
  - OH2 (Oxyflourfen + pendimethalin)
  - **Biathlon (Oxyfluorfen and prodiamine)**
  - **Freehand 1.75G = 150 lb/A - Dimethenamid- p + pendimethalin**

⊡ Granular single preemergence

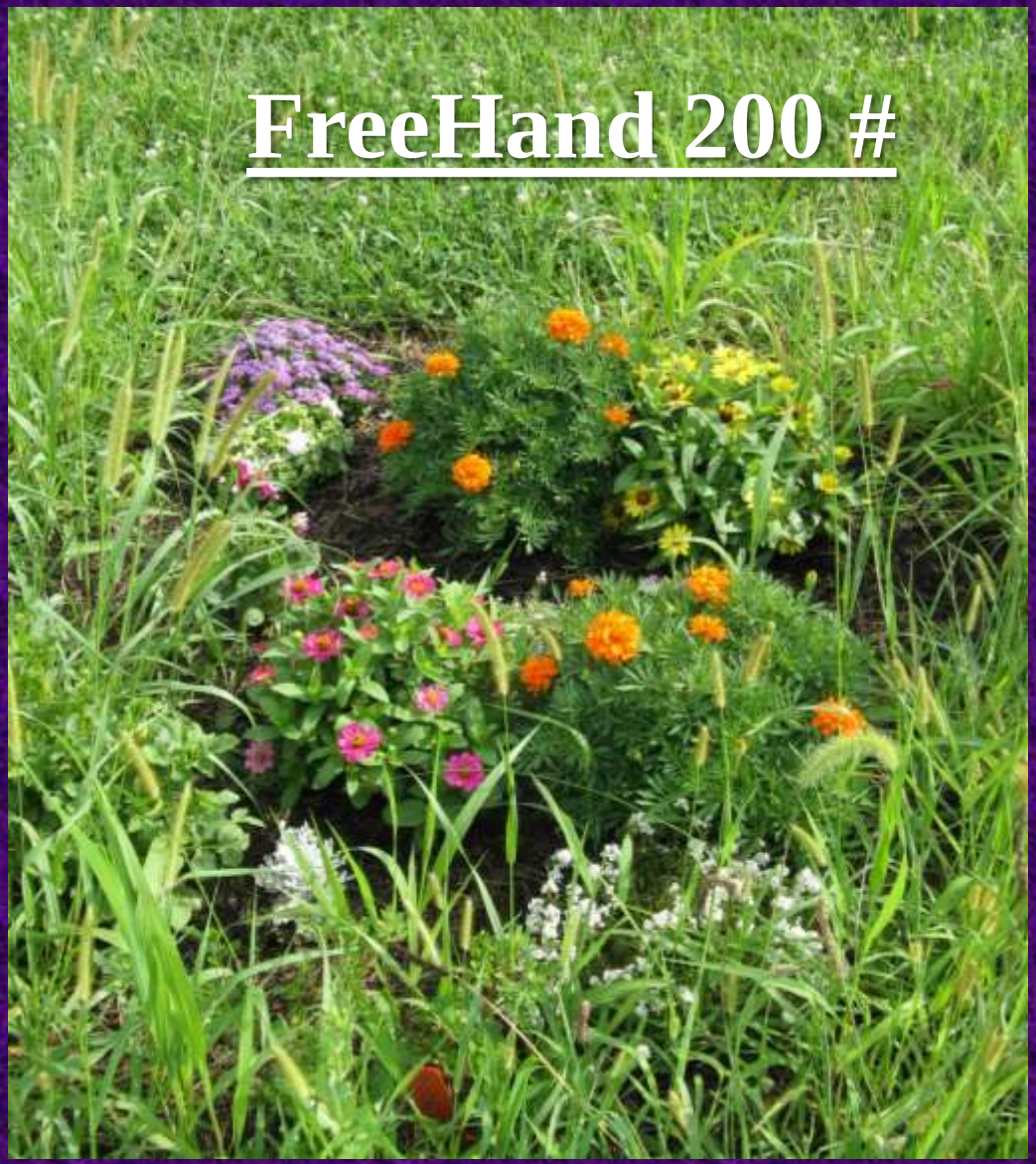
- ✓ **Pendulum 2G** - Pendimethalin
- ✓ Treflan 5G (TR10) - Trifluralin
- ✓ Ronstar G - Oxadiazon
- ✓ Devrinol 2G – Napropamide
- ✓ Corral (Pendimethalin 2.68G)
- ✓ XL 2G – Oryzalin
- ✓ BroadStar G
- ✓ Marengo G

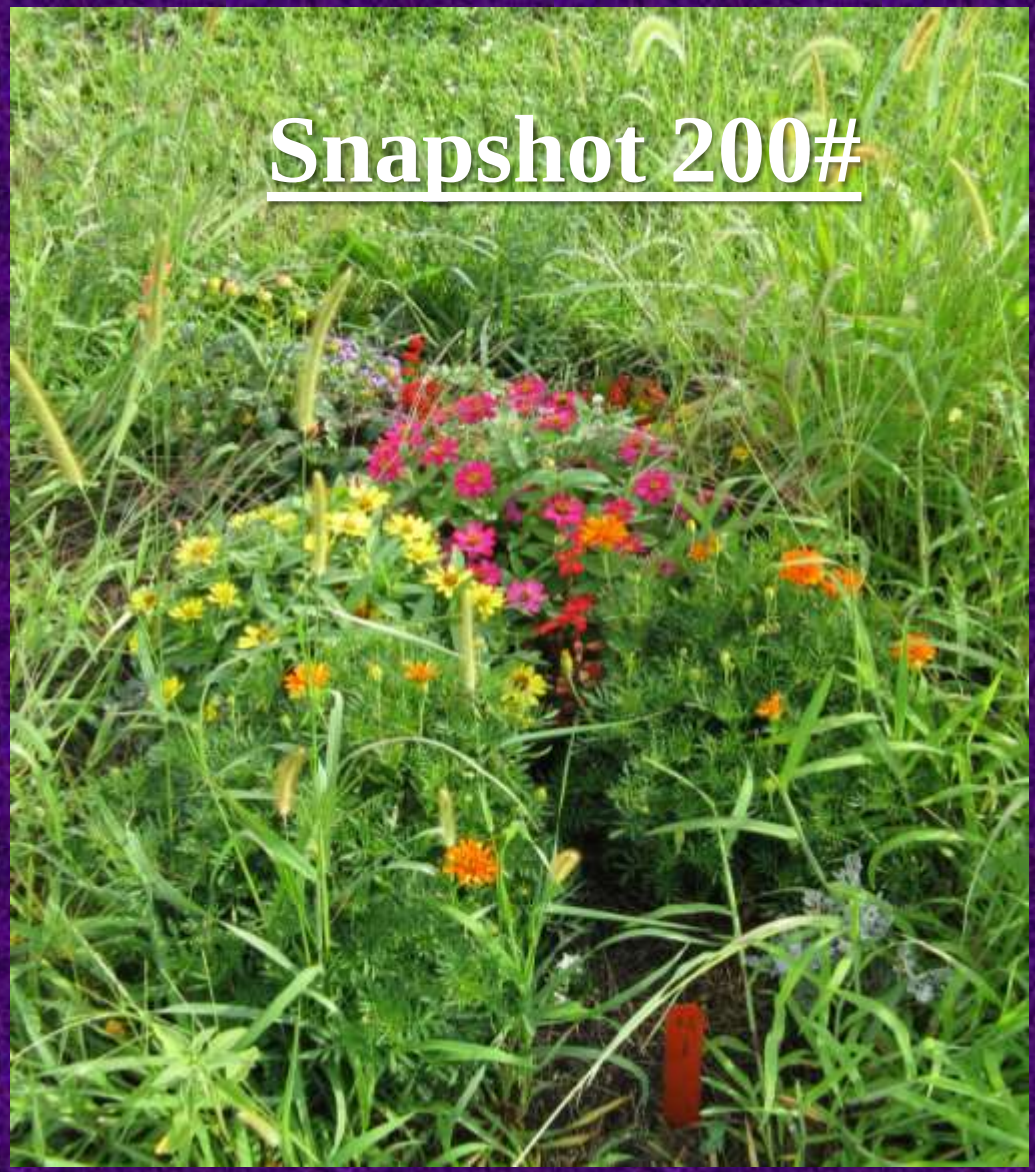
FreeHand Vs. Snapshot

Treatment	Rate	2 wat	4 wat	8 wat	12 wat	
FreeHand	200 #/ac	9.3	8.7	8.7a	7.0b	
Snapshot	200# /ac	9.0	8.0	6.8b	6.0c	

Phytotoxicity

		Salvia	Geranium	Snapdragon	Impatiens	Ageratum
FreeHand	FreeHand	1.9	2.1	2.9	5.8*	0.8
Snapshot	Snapshot	1.3	3.6*	2.0	3.7*	0.8





2/9/2017

A. FreeHand with mulch,
B. Snapshot and mulch
C. Weedy Check with no mulch at 3MAT.

Bayer landscape trial 2013 - Waterman Farm, Columbus, OH.

A. Specticle 100 lb./ac with mulch,

B. Control at 3 MAT.

3 MAT

Treatment	Rate/ac	Eff no mulch		Eff w/mulch	
Specticle	100	0.6	e	5.8	bc
Specticle	150	6.3	bcd	5.9	bc
Specticle	200	5.8	cd	**7.8**	**ab**
Snapshot	150	6.8	abc	**8.3**	**a**
FreeHand	150	5.3	cd	**8.7**	**a**
Unt. Weedy	--	1.0	e	4.0	d

FreeHand

- **Dimethenamid- p + pendimethalin (*Freehand G) – BASF***
- Freehand 1.75G, 150 lb/ A= 1X, 450 lb/ A = 3X
- Excellent, broad-spectrum weed control
- One of the longest-lasting preemergence herbicides in container nurseries – Joe Neal
- **Landscape and nursery** control weeds other products not controlling

Pennisetum alopecuroides ‘Hameln’ - Dwarf Fountain Grass

Control

FreeHand – stunting at 2 WAT

FreeHand – less flowers - 12 WAT

FreeHand 2011 IR-4 Trials

Echinacea Untreated

Echinacea 2X Rate

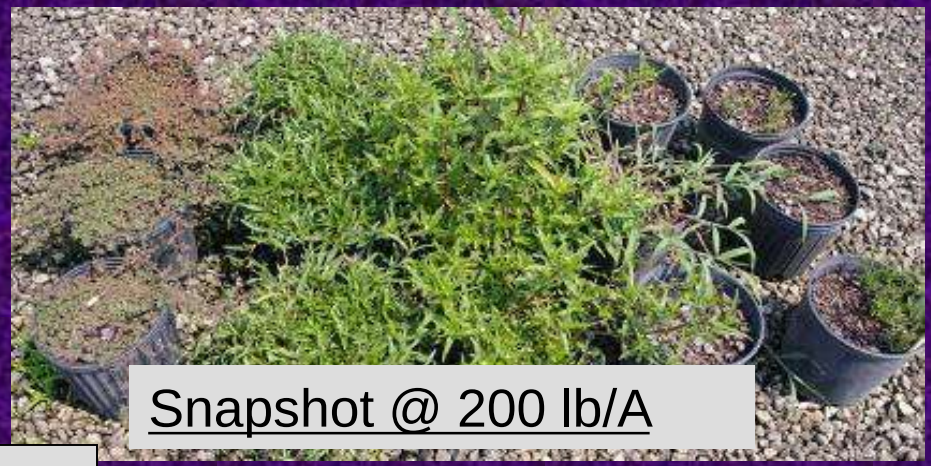
Echinacea 4X Rate

FreeHand 1.75G Control

Dr. Joe Neal, North Carolina State Univ.

[redacted]

FreeHand 150 lb/A



Snapshot @ 200 lb/A

10 WAT

OH2 @ 100 lb/A

BroadStar @ 150 lb/ A

2007 Trial, Wilmington, NC

Freehand – Echinacea – BFN, 2012

- Watch root inhibition – 2nd appl.
- I application per season

Liquid Preemergence Ornamental Herbicides

Barricade 65 WG
Surflan AS T/0
Pendulum Aqua Cap, Pendulum 3.3EC
Gallery 75 DG
Goal 2 XL, Goal Tender
Pennant Magnum
Dimension Ultra 40 WP
Tower EC
Ronstar 50 WSP
SureGuard 51 WDG

COST OF LIQUID APPLICATIONS VS. GRANULAR APPLICATIONS

Herbicide	Applic. method	Rate per acre	$ per acre
OH-2	Granular	120 lb	208
Ronstar G + Devrinol 2G	Granular	150 lb + 200 lb	487
Snapshot 2.5 TG	Granular	150 lb	260
Gallery + Treflan	Liquid	1 lb + 21 oz	160
Gallery + Surflan	Liquid	1 lb + 2 qt	156
SureGuard	Liquid	10 oz	59

LABOR FOR GRANULAR AND LIQUID APPLICATIONS

Methods	Man-hours per acre	*% savings*
Hand crank granules	5.58	*0*
Orbit-Air spreader	2.19	*61*
Backpack sprayer	3.46	*38*
High clearance boom	1.35	*76*

50 Gal Tank:

For mixing herbicide solution for backpack applications.

Hydraulic agitator.

When the solution inside, the pump is on.

50 gal – Tank Mix

Pressure regulator

Spray swath
14-ft.

FIELDJET NOZ, BRASS

Product Description:

Item number: S1/4KLC-5

$25.34

Chemical Containers, Inc.
413 ABC Road
Lake Wales, FL 33859-6849
Phone - 863-638-1407

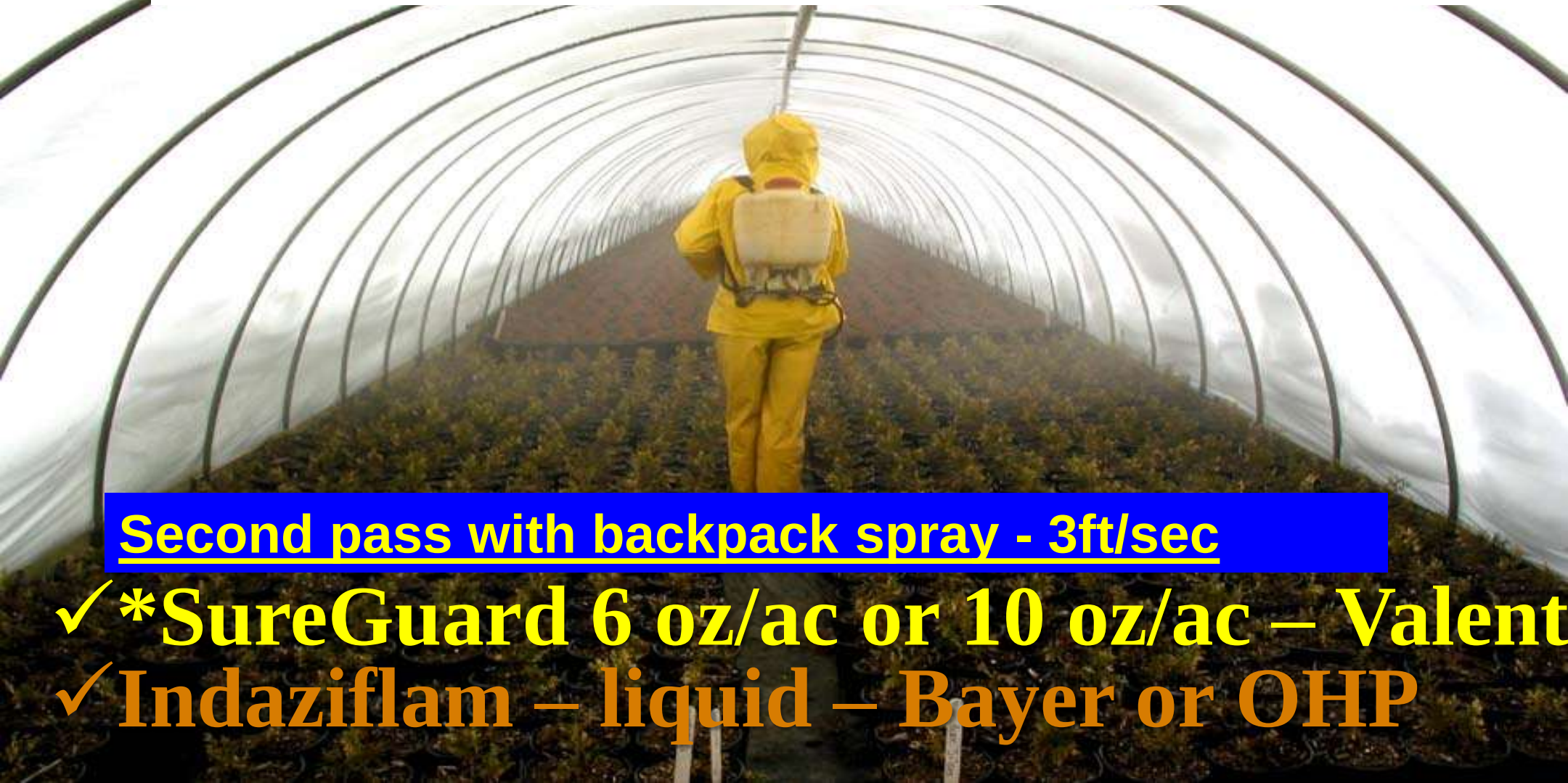
KLC-5 nozzle - for backpack spray

Dormant Application – spring before the plastic covers are removed -hoop houses vented.

First pass with backpack spray – 3ft/sec

Imperial Nursery

- ✓Gallery (1.33 #/ac)/ Surflan (2 qtrs./ac)
- ✓Gallery/Barricade (each 1#/ac)



Second pass with backpack spray - 3ft/sec

- ✓*SureGuard 6 oz/ac or 10 oz/ac – Valent
- ✓Indaziflam – liquid – Bayer or OHP

Sprayables/ Tank mixes

- ✓ Gallery (1.33 #/ac)/ Surflan (2 qts/ac); no prob. Hemerocalis (2012 trials)
- ✓ Gallery/ Barricade (1#/ac) (no more than 2-3 lbs/season) or Pendulum WDG (5 #/ac)
- ✓ Gallery sensitive = Snapshot (200 #/ac) then Corral (114#/ac)
- ✓ Many herbaceous = **Gallery (1#/ac)/ Barricade (1#/ac)** or **Pendulum (4#/ac)**
- ✓ Gailardia, Lavenula, Lobelia, sedum (Barricade (1#/ac) or Pendulum (4#/ac); Winter - Corral (114#/ac)

Gallery Injury

- Sedum
- Yucca
- Snow on the Mountain Euphorbia


Chlorosis or leaf discoloration - randomly on the leaf
Parts of the leaf remain green - others parts chlorotic
131
Buddleia - Gallery

Gallery+ Barricade

Rhododendron ‘Nova Zembla’

Ronstar

Ronstar

Huron, 05/03/12
4WAT

Gallery+ Barricade

Rhododendron ‘Nova Zembla’

Control
Yes - Bittercress
No - Groundsel

Huron, 07/11/12

2X, 1X, Control

Tower EC

- New active ingredient dimethenamid-p
- Safe directed-spray preemergence in nurseries and landscapes.
- Combine with **Pendulum Aqua Cap® herbicide for** prevention on graveled areas in containers prod.
- Tower 6.6 EC, 21 oz/ A = 1X, 64 oz/ A = 3X

Tower EC

- Annual Bluegrass – partial control
- Barnyardgrass
- Bittercress (Hairy)
- Carpetweed
- Crabgrass
- Fall Panicum
- Annual Sedges
- Spurge spp.
- Foxtails
- Goosegrass
- Nightshade spp.
- Nutsedge (Yellow) - partial
- Pigweed spp.
- Ryegrass (Italian)
- Sandbur (Field)
- Shepherds purse
- Willowherb

Tower and Pendulum

21 fl oz
+ 2 qt

No Injury with BFN Field Liners:

- ✓ Forsythia ‘Lynwood Gold’
- ✓ Lilac ‘ Common Purple’
- ✓ Flowering Almond
- ✓ Potentilla ‘McKays White’

FreeHand applied at (200 lbs. /ac) (left), control (right) at 2 WAT. Bindweed and Marestail - control

Tower + pendulum

Hydrangea ‘Endless Summer’

Hydrangea paniculata 'Unique' left (control), Tower + pendulum (21 oz. + 48 oz., respectively) (right).


Irrigate prior to - EC and after appl.
Spray in the rain or while irrigating

Liverwort (*Marchantia polymorpha*)

- Divi
- Very
  - No
  - No
  - No
  - No
- Repr
  vege
  spor

10 g/sq. ft. /flat

MilStop2.5 Tbsp. /flat

C. Base – K Bicarbonate 85%, BioWorks®, Victor, NY)

Program

1. **Dormant** – Dec., Jan. – SureGuard – must be dormant*
2. Spring – after covers come off (March) (Feb) - Rout or OH2 , Snapshot
3. Summer – Biathlon, Indaziflam Liquid
4. Fall – FreeHand, Tower + Pendulum Aqua Cap

Acknowledgements

- **Technical Assistance – Luke Case and Randy Zondag**
- **MNLA – MDA/USDA – SCBG**

1. Northland Farms LLC, West Olive, MI
2. Berry Family Nurseries, Grand Haven, MI
3. Spring Meadow Nursery, Inc, Grand Haven, MI

- **ONLA - ODA/ USDA – SCBG**

1. Klyn Nurseries, Inc., Perry, OH
2. Sunleaf Nurseries, LLP, Madison, OH
3. Herman Losely & Son, Inc., Perry, OH
4. Willoway Nurseries, Inc., Huron
5. Willoway Nurseries, Inc. ,Avon, OH
6. North Branch Nursery, Inc., Pemberville, OH
7. Studebaker Nurseries, Inc., New Carlisle, OH

Acknowledgements

- IR-4 Minor Use Program
- OHP
- Bayer Chemical
- BASF
- Dow AgroSciences
- Valent/ Nufarm

Questions?

Mugwort 2012 BFN

Treatment	Rate/ac	Buxus		Efficacy	
Basagran	2 pt.	0.1[z]		1.5[x]	cd
V-10233	Expt.	3.8	**	5.3	b
Pennant Magnum	2 pt.	0.3		0.8	d
Lontrel	1 pt.	1.9	**	8.0	a
Certainty	0.06 lb. ai	2.3	**	7.5	a
F6875	0.375 lb. ai	2.9	**	3.8	bc
Corsair	**5.5 oz.**	**1.8**	****	**8.3**	**a**
SedgeHammer	**0.125 lb. ai**	**1.2**	*****	**7.8**	**a**
Untreated	--	0.0		0.0	d

z = Ratings are based on a 0-10 scale with 0 being no phytotoxicity and 10 death, with ≤3 commercially acceptable. Ratings are averaged over 3 dates of evaluation.

Treatment means followed by *, ** are significantly different from the control, based on Dunnett's t-test (α = 0.10 and 0.05, respectively).

x = Efficacy ratings are based on a 0-10 scale with 0 being no weed control and 10 perfect weed control with ≥7 commercially acceptable. Ratings are averaged over all evaluations.

Table 1. Phytotoxicity to Syringa vulgaris from selected preemergence applications at Berry Family Nurseries, Grand Haven, MI.

Phytotoxicity										
Treatment	Rate/ac	4 WAT[z]		5 WAT		6 WAT		8 WAT		11 WAT	
Corsair	5.3 oz	7.5[yx]		8.3	**	9.0	**	9.3	**	10.0	**
Certainty	1 oz	4.5		4.5		5.5		6.5		5.0	
SedgeHammer	2 oz	5.3		5.3		6.3	*	6.0		4.8	
Lontrel	**1 pt**	**3.3**		**3.5**		**4.8**		**4.5**		**4.3**	
V-10336	15 oz	3.8		4.3		5.0		7.3		7.0	**
Diuron	3 lb	2.0		3.0		4.5		5.8		5.8	
Casoron + PN	3 gal	3.5		4.8		5.3		6.3		8.0	**
Untreated	--	2.3		1.5		2.5		3.5		2.5	

Table 2. Efficacy in Syringa vulgaris fields for **Rorippa sylvestris (creeping yellow cress)** from selected preemergence applications at Berry Family Nurseries, Grand Haven, MI.
Creeping yellow field cress control

Treatment	Rate/ac	4 WAT		5 WAT		6 WAT		8 WAT		11 WAT	
Corsair	5.3 oz	9.0[wv]	a	9.3	a	10.0	a	10.0	a	**9.8**	**a**
Certainty	1 oz	10.0	a	9.5	a	10.0	a	10.0	a	8.8	ab
SedgeHammer	2 oz	10.0	a	9.8	a	10.0	a	9.8	a	8.5	abc
Lontrel	**1 pt**	**2.8**	**c**	**3.3**	**d**	**6.8**	**bcd**	**7.0**	**bc**	**6.8**	**bc**
V-10336	15 oz	9.5	a	7.5	ab	5.5	cd	2.5	d	5.8	c
Diuron	3 lb	4.3	bc	6.3	bc	7.5	bc	7.8	ab	8.3	abc
Casoron + PN	3 gal	6.3	b	8.0	a	7.8	ab	7.0	bc	9.0	ab
Untreated	--	3.5	c	4.0	cd	5.0	d	4.8	cd	6.0	bc

z = weeks after treatment

y = Phytotoxicity ratings based on a 0-10 scale with 0 being no phytotoxicity and 10 death with ≤3 commercially acceptable

x = Treatment ratings followed by *,** are significantly different from the control, based on Dunnett's t-test (α = 0.10 and 0.05, respectively)

w = Control ratings are based on a 0-10 scale with 0 being no control and 10 perfect control with ≥7 commercially acceptable

v = Treatment ratings followed by the same letter in the same column are not significantly different based on lsmeans (α = 0.05)