

HERBICIDE & WEED CONTROL UPDATE

2016 SFNMC Contact Meeting
Lake Charles, LA
July 18, 2016

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HERBICIDE & WEED CONTROL UPDATE

- Results of studies conducted in 2015
- Studies in progress in 2016
- Shortcuts to herbicide-related research reports on SFNMC website

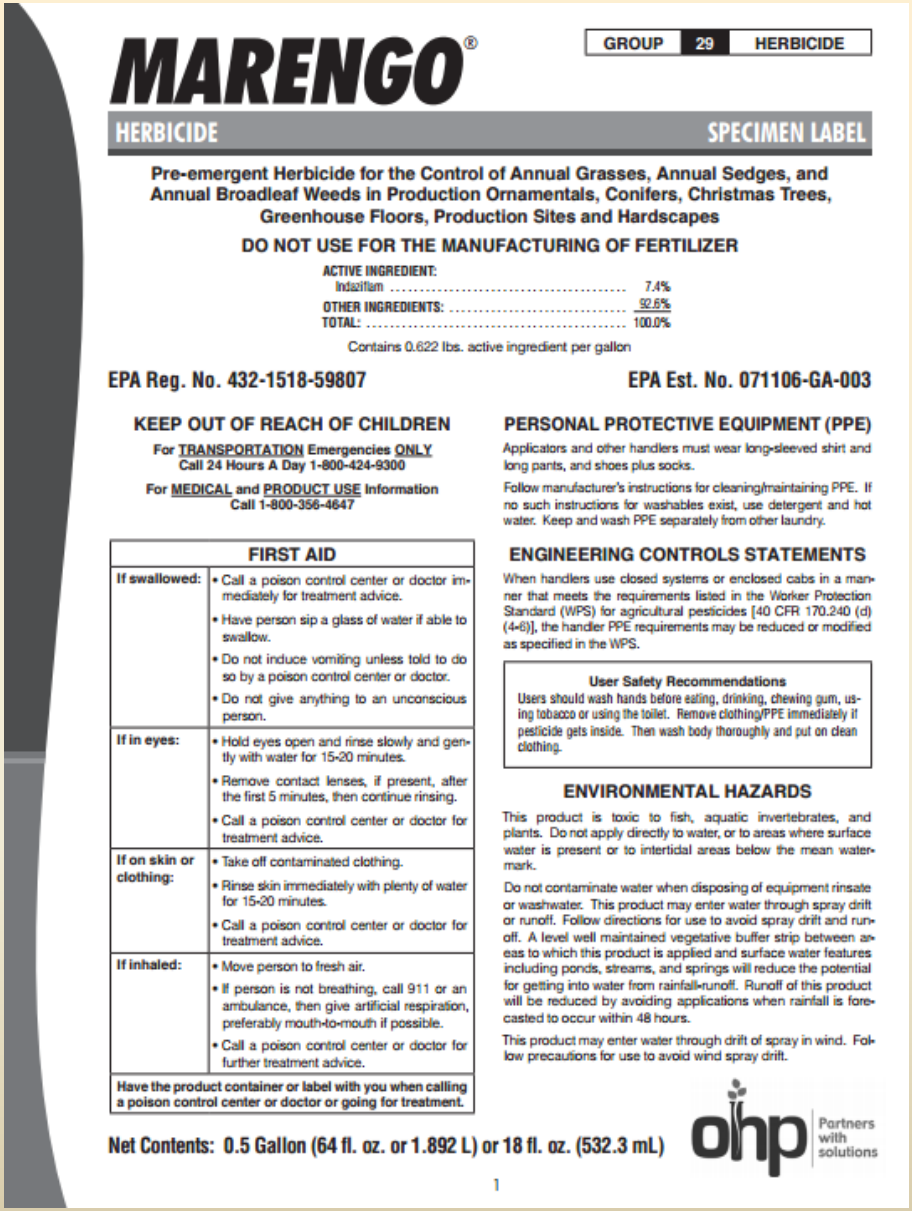
2015 STUDIES

- Marengo®
  - bareroot loblolly and slash pine, cedar
  - container loblolly, longleaf and slash pine
  - directed spray in pin oak
- Pendulum® AquaCap™
  - bareroot loblolly and slash pine, buttonbush
  - container loblolly and slash pine

2015 STUDY LOCATIONS

Nursery	# Marengo® installations	# Pendulum® AquaCap™ installations
East Tennessee Nursery (TDOF)	2	1
Flint River Nursery (GFC)	2	
IFCO Moultrie Nursery (GA)	4	6
IFCO DeRidder Nursery (LA)	1 outplanting	
Westervelt Eutaw Nursery (AL)	1 + 1 outplanting	3
Weyerhaeuser Jesup Nursery (GA)	2	2
Weyerhaeuser Pearl River Nursery (MS)	4	

Marengo®
indaziflam



MARENGO®

GROUP 29 HERBICIDE

HERBICIDE **SPECIMEN LABEL**

Pre-emergent Herbicide for the Control of Annual Grasses, Annual Sedges, and Annual Broadleaf Weeds in Production Ornamentals, Conifers, Christmas Trees, Greenhouse Floors, Production Sites and Hardscapes

DO NOT USE FOR THE MANUFACTURING OF FERTILIZER

ACTIVE INGREDIENT:	
Indaziflam	7.4%
OTHER INGREDIENTS:	92.6%
TOTAL:	100.0%

Contains 0.622 lbs. active ingredient per gallon

EPA Reg. No. 432-1518-59807 **EPA Est. No. 071106-GA-003**

KEEP OUT OF REACH OF CHILDREN

For TRANSPORTATION Emergencies ONLY
Call 24 Hours A Day 1-800-424-9300

For MEDICAL and PRODUCT USE Information
Call 1-800-356-4647

FIRST AID

If swallowed:	• Call a poison control center or doctor immediately for treatment advice. • Have person sip a glass of water if able to swallow. • Do not induce vomiting unless told to do so by a poison control center or doctor. • Do not give anything to an unconscious person.
If in eyes:	• Hold eyes open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing. • Call a poison control center or doctor for treatment advice.
If on skin or clothing:	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a poison control center or doctor for treatment advice.
If inhaled:	• Move person to fresh air. • If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth if possible. • Call a poison control center or doctor for further treatment advice.

Have the product container or label with you when calling a poison control center or doctor or going for treatment.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Applicators and other handlers must wear long-sleeved shirt and long pants, and shoes plus socks.

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry.

ENGINEERING CONTROLS STATEMENTS

When handlers use closed systems or enclosed cabs in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240 (d) (4-6)], the handler PPE requirements may be reduced or modified as specified in the WPS.

User Safety Recommendations

Users should wash hands before eating, drinking, chewing gum, using tobacco or using the toilet. Remove clothing/PPE immediately if pesticide gets inside. Then wash body thoroughly and put on clean clothing.

ENVIRONMENTAL HAZARDS

This product is toxic to fish, aquatic invertebrates, and plants. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean water-mark.

Do not contaminate water when disposing of equipment rinsate or washwater. This product may enter water through spray drift or runoff. Follow directions for use to avoid spray drift and runoff. A level well maintained vegetative buffer strip between areas to which this product is applied and surface water features including ponds, streams, and springs will reduce the potential for getting into water from rainfall-runoff. Runoff of this product will be reduced by avoiding applications when rainfall is forecasted to occur within 48 hours.

This product may enter water through drift of spray in wind. Follow precautions for use to avoid wind spray drift.

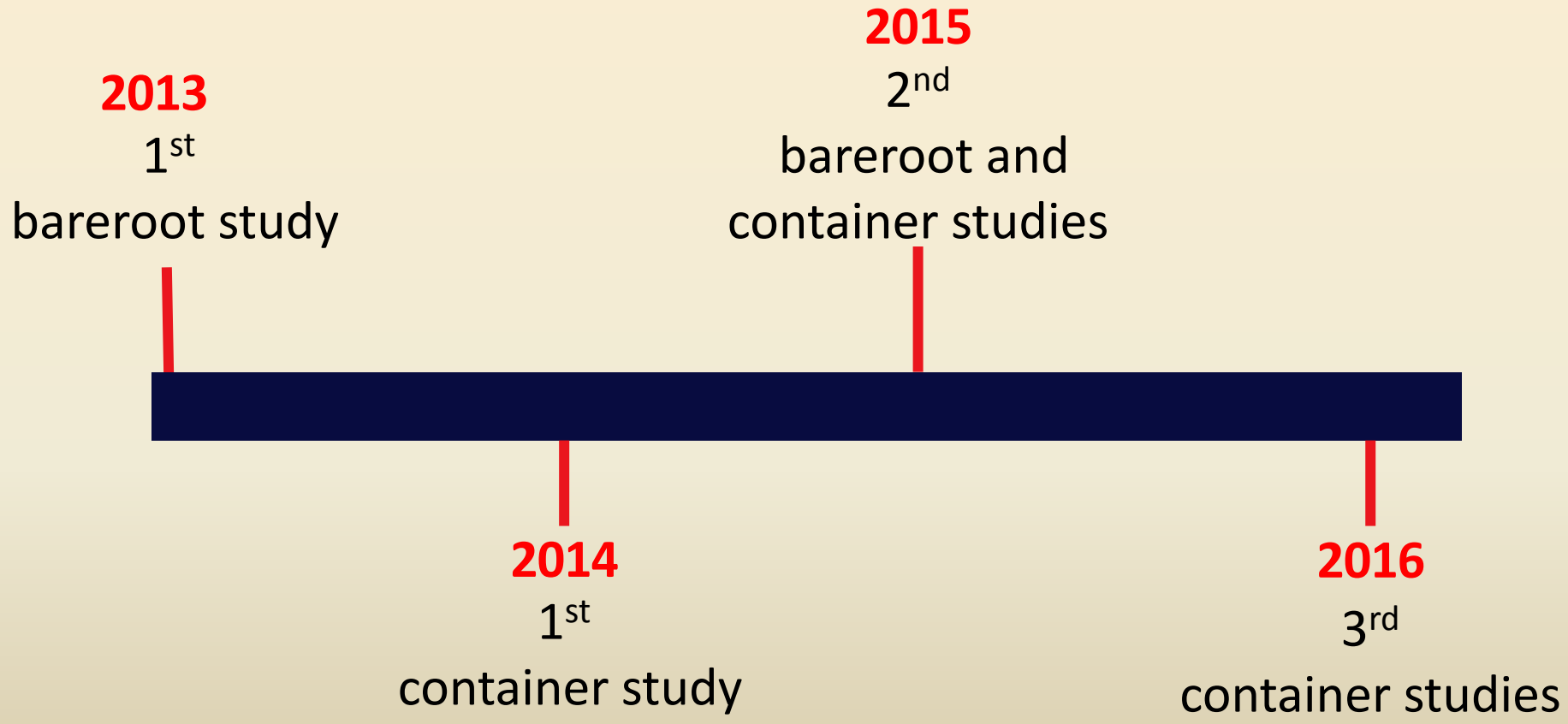
Net Contents: 0.5 Gallon (64 fl. oz. or 1.892 L) or 18 fl. oz. (532.3 mL)

ohp Partners with solutions

1

- Primarily a **pre-emergent** herbicide.
- Apply to soil.
- One of 1st MOA Group 29 herbicides; useful in herbicide rotation.
- Conifer nurseries are listed on label with recommendation for *directed spray applications.*
- Weeds listed as controlled/ suppressed include spurge, eclipta, teaweed, doveweed, annual sedge, pigweed, horseweed, flatsedge, coffeeweed, crabgrass, goosegrass, dandelion.

Timeline of SFNMC Marengo® Studies



Objectives of Marengo® 2015 studies:

1. What is the tolerance of bareroot loblolly, slash pine and eastern red cedar to different rates of Marengo®?

2. What is the tolerance of pin oak to multiple directed spray applications of Marengo®?

3. What is the tolerance of loblolly, longleaf and slash pine in containers to different rates of Marengo®?

4. What is the effectiveness of Marengo® on willow and weed control in containers and bareroot seedling beds?

2015 Marengo® bareroot trial

- Follow-up to first bareroot trial in 2013 (*RR 14-04*).
- Installed at 4 nurseries on 3 species: loblolly and slash pine, eastern red cedar.
- Sprayed at 3 rates with single application made at 6 - 8 weeks post-sowing on pine & at 20 weeks post-sowing on cedar.

Results on bareroot pine and cedar tolerance

- **Loblolly** and **slash** pine were tolerant of the herbicide.
  Slash pine at 1 nursery had lower shoot weight.
  Loblolly at 1 nursery had slight stem swelling.

- **Eastern red cedar** exhibited *increased* density, shoot height, shoot weight and root weight when treated with the herbicide.

Results on weed control in bareroot studies

- **Weeds listed** as controlled or suppressed on Marengo® label include spurge, teaweed, doveweed, pigweed, horseweed, eclipta, coffeeweed, annual sedge, flatsedge, crabgrass, goosegrass, dandelion, Florida pusley.

- **No differences** in weed density were found at any nursery in any species.
  Spring/summer weeds counted at study installation are not naturally found at study conclusion in November.
  Some study plots were inadvertently hand-weeded.

2015 Marengo® container trial

- Follow-up to 2014 container trial (*RR 15-01*).
- Installed at 3 nurseries on 3 species in 2 container types.
- Each species sprayed at 3 rates with single application made between 6 - 8 weeks post-sowing.

Results on container pine tolerance

- Herbicide effect is species-dependent.
- **Loblolly** pine exhibited mixed results across the 3 nurseries and 2 container types when measuring effects of the herbicide on seedling quality. There was no consistent treatment effect with respect to % fill, shoot height, RCD, root weight, shoot weight, swelling, root growth potential.
- **Longleaf** pine showed no differences between treated and untreated seedlings in 2015. However, this contrasts the 2014 study that showed significant decreases in root weights.
- **Slash** pine exhibited increased stem swelling and decreased plug weights when compared to untreated seedlings.

Results on willow and weed control in container studies

- **Willow control** showed no differences between treated and untreated trays in 2015. This contrasts 2014 results that showed decreases in willow counts; *however*

- **2015 lack of Marengo® effect** is attributed to relative absence of willow in nurseries.

- **The number of weeds** (other than willow) were significantly decreased in 2 installations. However, the remaining 4 installations had no difference in weed counts between treated and untreated trays. Most of this lack of significance is due to so few weeds present in the control and treated trays. Weeds identified at the end of the study included spurge, annual sedge and crabgrass.


2015 Marengo® directed spray trial

- Follow-up to morning glory control trial in hardwoods using broadcast applications (*RR 13-05, RR 14-05*).
- Installed at East Tennessee Nursery (TN DOF) on pin oak at 20 weeks post-sowing when trees were at least 6" in height.
- Directed sprayer used to apply 1 rate at single and multiple applications.

Results in pin oak tolerance

- **5 oak species** are listed as tolerant to Marengo® on its label; pin oak not listed.

- **Compared to untreated plots:**

  Single application at 20 weeks resulted in no differences in seedling density or % culls.

  Multiple applications made at 20 and 23 weeks resulted in both higher seedling density and % culls.

  Across all treatments, no differences in **# plantable seedlings** recorded at end of study.

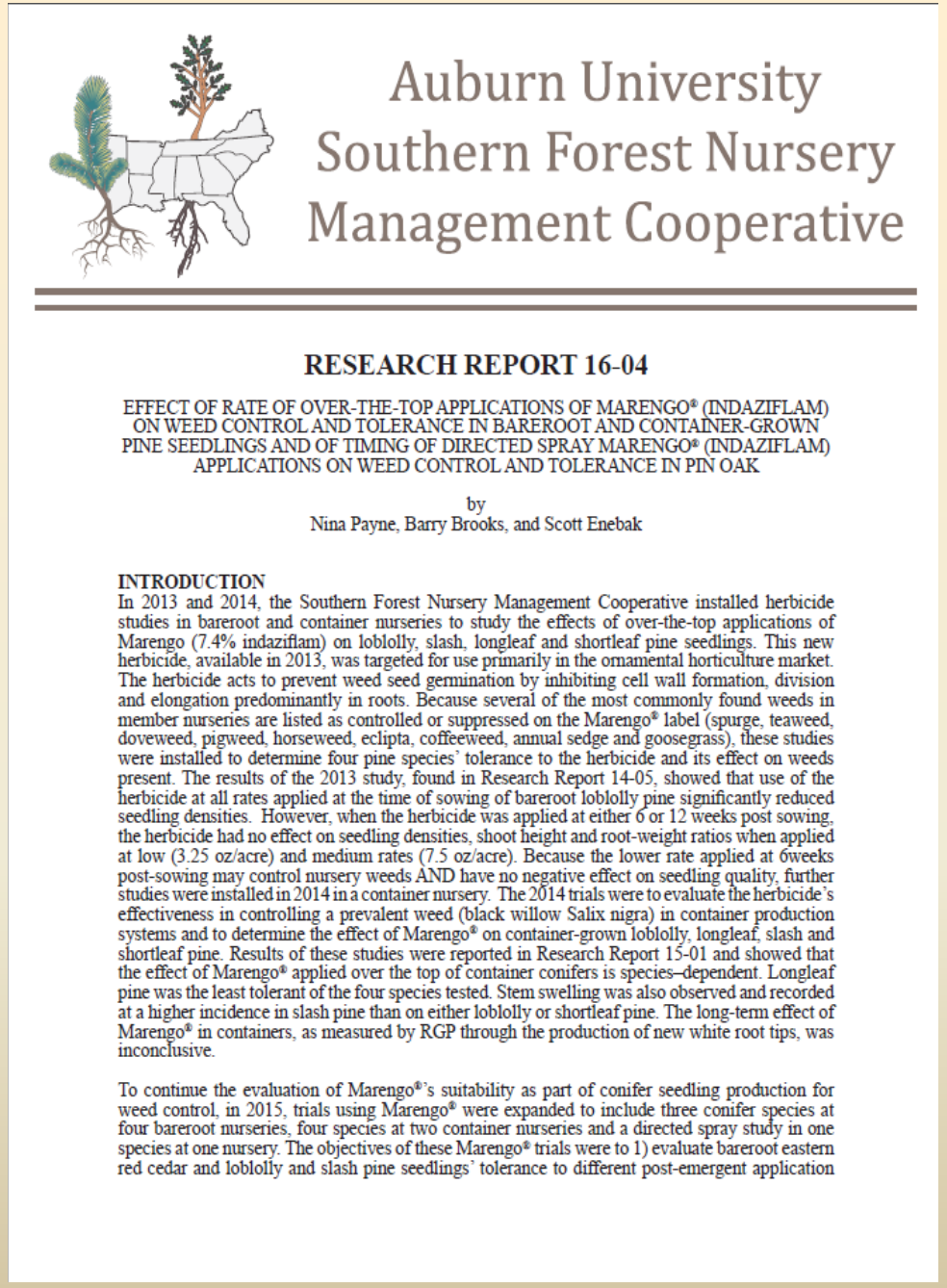
Results in morning glory and other weed control in directed spray study

- **No differences** in the number of weeds when comparing treated to untreated plots.

  Standard operational weed treatments were sufficient this year.

  Crown closure of pin oak seedlings limited weed development by date of third application.

Marengo® results reported in RR 16-04



Auburn University
Southern Forest Nursery
Management Cooperative

RESEARCH REPORT 16-04

EFFECT OF RATE OF OVER-THE-TOP APPLICATIONS OF MARENGO® (INDAZIFLAM) ON WEED CONTROL AND TOLERANCE IN BAREROOT AND CONTAINER-GROWN PINE SEEDLINGS AND OF TIMING OF DIRECTED SPRAY MARENGO® (INDAZIFLAM) APPLICATIONS ON WEED CONTROL AND TOLERANCE IN PIN OAK

by
Nina Payne, Barry Brooks, and Scott Enebak

INTRODUCTION

In 2013 and 2014, the Southern Forest Nursery Management Cooperative installed herbicide studies in bareroot and container nurseries to study the effects of over-the-top applications of Marengo (7.4% indaziflam) on loblolly, slash, longleaf and shortleaf pine seedlings. This new herbicide, available in 2013, was targeted for use primarily in the ornamental horticulture market. The herbicide acts to prevent weed seed germination by inhibiting cell wall formation, division and elongation predominantly in roots. Because several of the most commonly found weeds in member nurseries are listed as controlled or suppressed on the Marengo® label (spurge, teaweed, doveweed, pigweed, horseweed, eclipta, coffeeweed, annual sedge and goosegrass), these studies were installed to determine four pine species' tolerance to the herbicide and its effect on weeds present. The results of the 2013 study, found in Research Report 14-05, showed that use of the herbicide at all rates applied at the time of sowing of bareroot loblolly pine significantly reduced seedling densities. However, when the herbicide was applied at either 6 or 12 weeks post sowing, the herbicide had no effect on seedling densities, shoot height and root-weight ratios when applied at low (3.25 oz/acre) and medium rates (7.5 oz/acre). Because the lower rate applied at 6weeks post-sowing may control nursery weeds AND have no negative effect on seedling quality, further studies were installed in 2014 in a container nursery. The 2014 trials were to evaluate the herbicide's effectiveness in controlling a prevalent weed (black willow Salix nigra) in container production systems and to determine the effect of Marengo® on container-grown loblolly, longleaf, slash and shortleaf pine. Results of these studies were reported in Research Report 15-01 and showed that the effect of Marengo® applied over the top of container conifers is species–dependent. Longleaf pine was the least tolerant of the four species tested. Stem swelling was also observed and recorded at a higher incidence in slash pine than on either loblolly or shortleaf pine. The long-term effect of Marengo® in containers, as measured by RGP through the production of new white root tips, was inconclusive.

To continue the evaluation of Marengo®'s suitability as part of conifer seedling production for weed control, in 2015, trials using Marengo® were expanded to include three conifer species at four bareroot nurseries, four species at two container nurseries and a directed spray study in one species at one nursery. The objectives of these Marengo® trials were to 1) evaluate bareroot eastern red cedar and loblolly and slash pine seedlings' tolerance to different post-emergent application

What we've learned from Marengo® studies:

- Bareroot pine:

  Apply at least 6 weeks post-sowing (but Marengo® is primarily a pre-emergent herbicide).

  No negative results on seedling quality are reported at low and medium rates on loblolly and slash pine.

  Because of its **MOA**, Marengo® can be an option to consider in herbicide rotation with more frequently used herbicides to diminish shifting of weed species composition.

Summary of Herbicide Mechanism of Action According to the Weed Science Society of America (WSSA)

1

Acetyl CoA Carboxylase (ACCase) Inhibitors

Aryloxyphenoxypropionate (FOPs) cyclohexanedione (DIMs) and phenylpyrazolin (DENs) herbicides inhibit the enzyme acetyl-CoA carboxylase (ACCase), the enzyme catalyzing the first committed step in *de novo* fatty acid synthesis (Burton 1989; Focke and Lichtenthaler 1987). Inhibition of fatty acid synthesis presumably blocks the production of phospholipids used in building new membranes required for cell growth. Broadleaf species are naturally resistant to cyclohexanedione and aryloxyphenoxy propionate herbicides because of an insensitive ACCase enzyme. Similarly, natural tolerance of some grasses appears to be due to a less sensitive ACCase (Stoltenberg 1989). An alternative mechanism of action has been proposed involving destruction of the electrochemical potential of the cell membrane, but the contribution of this hypothesis remains in question.

2

Acetolactate Synthase (ALS) or Acetohydroxy Acid Synthase (AHAS) Inhibitors

Imidazolinones, pyrimidinylthiobenzoates, sulfonylaminocarbonyltriazolinones, sulfonylureas, and triazolopyrimidines are herbicides that inhibit acetolactate synthase (ALS), also called acetohydroxyacid synthase (AHAS), a key enzyme in the biosynthesis of the branched-chain amino acids isoleucine, leucine, and valine (LaRossa and Schloss 1984). Plant death results from events occurring in response to ALS inhibition and low branched-chain amino acid production, but the actual sequence of phytotoxic processes is unclear.

3 **15** **23**

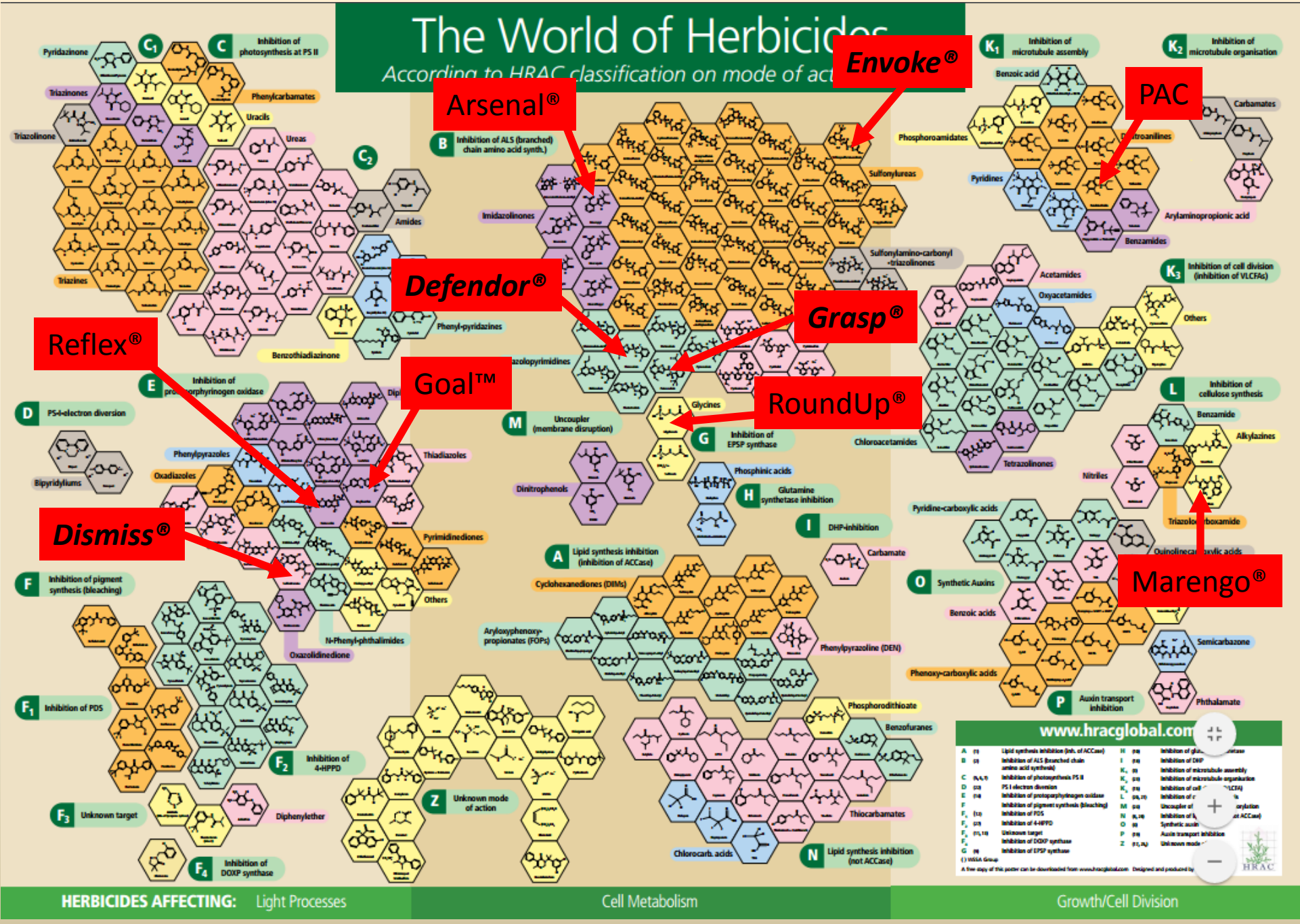
Mitosis Inhibitors

Benzamide, benzoic acid (DCPA), dinitroaniline, phosphoramidate, and pyridine herbicides (Group 3) are examples of herbicides that bind to tubulin, the major microtubule protein. The herbicide-tubulin complex inhibits polymerization of microtubules at the assembly end of the protein-based microtubule but has no effect on depolymerization of the tubule on the other end (Vaughn and Lehnen 1991), leading to a loss of microtubule structure and function. As a result, the spindle apparatus is absent, thus preventing the alignment and separation of chromosomes during mitosis. In addition, the cell plate can not be formed. Microtubules also function in cell wall formation. Herbicide-induced microtubule loss may cause the observed swelling of root tips as cells in this region neither divide nor elongate.

The carbamate herbicides, carbetamide, chlorpropham, and propham (23), are examples of herbicides that inhibit cell division and microtubule organization and polymerization.

Acetamide, chloroacetamide, oxyacetamide, and tetrazolinone herbicides (Group 15) are examples of herbicides that are currently thought to inhibit very long chain fatty acid (VLCFA) synthesis (Husted et al. 1966; Böger et al. 2000). These compounds typically affect susceptible weeds before emergence, but do not inhibit seed germination.

Herbicide Mode of Action *Refresher 101*


The World of Herbicides
According to HRAC classification on mode of act
Envoke®
Arsenal®
PAC
Defendor®
Grasp®
Reflex®
Goal™
RoundUp®
Dismiss®
Marengo®
C1 Inhibition of photosynthesis at PS II
Pyridazinone
Triazinones
Triazolinone
Phenylcarbamates
Uracils
Ureas
Amides
Triazines
Phenyl-pyridazines
Benzothiadiazinone
C2
B Inhibition of ALS (branched) chain amino acid synth.)
Sulfonylureas
Imidazolinones
Sulfonylamino-carbonyl -triazolinones
K1 Inhibition of microtubule assembly
Benzoic acid
Phosphoroamidates
Pyridines
K2 Inhibition of microtubule organisation
Carbamates
Arylaminopropionic acid
Benzamides
K3 Inhibition of cell division (inhibition of VLCFAs)
Acetamides
Oxyacetamides
Others
Chloroacetamides
Tetrazolinones
L Inhibition of cellulose synthesis
Benzamide
Alkylazines
Nitriles
E Inhibition of protoporphyrinogen oxidase
D PS-I-electron diversion
Bipyridyliums
Phenylpyrazoles
Oxadiazoles
Thiadiazoles
Pyrimidinediones
Others
N-Phenyl-phthalimides
Oxazolidinedione
M Uncoupler (membrane disruption)
Dinitrophenols
G Inhibition of EPSP synthase
Glycines
Phosphinic acids
H Glutamine synthetase inhibition
I DHP-inhibition
Carbamate
A Lipid synthesis inhibition (inhibition of ACCase)
Cyclohexanediones (DIMs)
Aryloxyphenoxy-propionates (FOPs)
Phenylpyrazoline (DEN)
F Inhibition of pigment synthesis (bleaching)
F1 Inhibition of PDS
F2 Inhibition of 4-HPPD
F3 Unknown target
Diphenylether
F4 Inhibition of DOXP synthase
Z Unknown mode of action
Phosphorodithioate
Benzofuranes
Thiocarbamates
Chlorocarb. acids
N Lipid synthesis inhibition (not ACCase)
Pyridine-carboxylic acids
O Synthetic Auxins
Benzoic acids
Phenoxy-carboxylic acids
P Auxin transport inhibition
Semicarbazone
Phthalamate
www.hracglobal.com
HRAC
HERBICIDES AFFECTING: Light Processes
Cell Metabolism
Growth/Cell Division

What we've learned from Marengo® studies:

- Bareroot eastern red cedar:

  Tested at 20 weeks post-sowing for one growing season only.

  Increased seedling density and size reported in treated plots, but herbicides generally not expected to *increase* growth unless severe weed pressure is removed.

  Additional testing needed to clarify results in this species.

  Plans for 2016 study shelved due to low germination.

What we've learned from Marengo® studies:

- Container conifers:

  Loblolly, slash and longleaf pine tested.

  Herbicide tends to lower root/plug weights in 3 species.

  Longleaf is most sensitive to Marengo® in all measures of seedling quality when compared to untreated seedlings.

  Outplanting studies have been established to determine carryover effects.

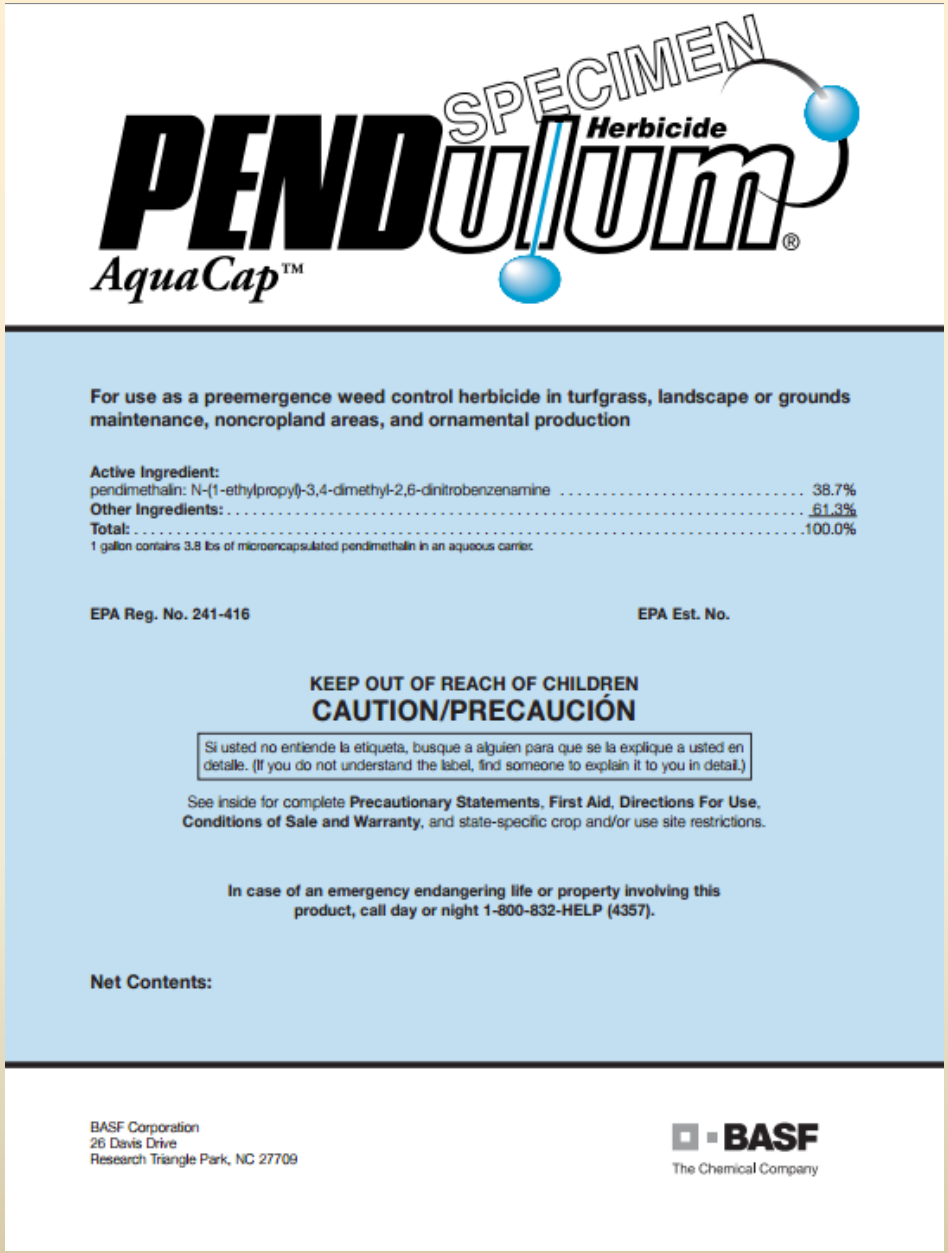
What we've learned from Marengo® studies:

- Directed spray application in pin oak:

  Tested at 20, 23 and 26 weeks post-sowing for one growing season only, with initial treatment delayed until seedlings were 6" in height.

  No negative results on number of plantable seedlings are reported in single and multiple applications in pin oak.

  Because of its MOA, Marengo® can be an option to consider in herbicide rotation with more frequently used herbicides to diminish shifting of weed species composition.


SPECIMEN

PENDULUM® AquaCap™

Herbicide

For use as a preemergence weed control herbicide in turfgrass, landscape or grounds maintenance, noncropland areas, and ornamental production

Active Ingredient:
pendimethalin: N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine 38.7%
Other Ingredients: 61.3%
Total: 100.0%
1 gallon contains 3.8 lbs of microencapsulated pendimethalin in an aqueous carrier.

EPA Reg. No. 241-416 **EPA Est. No.**

KEEP OUT OF REACH OF CHILDREN
CAUTION/PRECAUCIÓN

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

See inside for complete **Precautionary Statements**, **First Aid**, **Directions For Use**, **Conditions of Sale and Warranty**, and state-specific crop and/or use site restrictions.

In case of an emergency endangering life or property involving this product, call day or night 1-800-832-HELP (4357).

Net Contents:

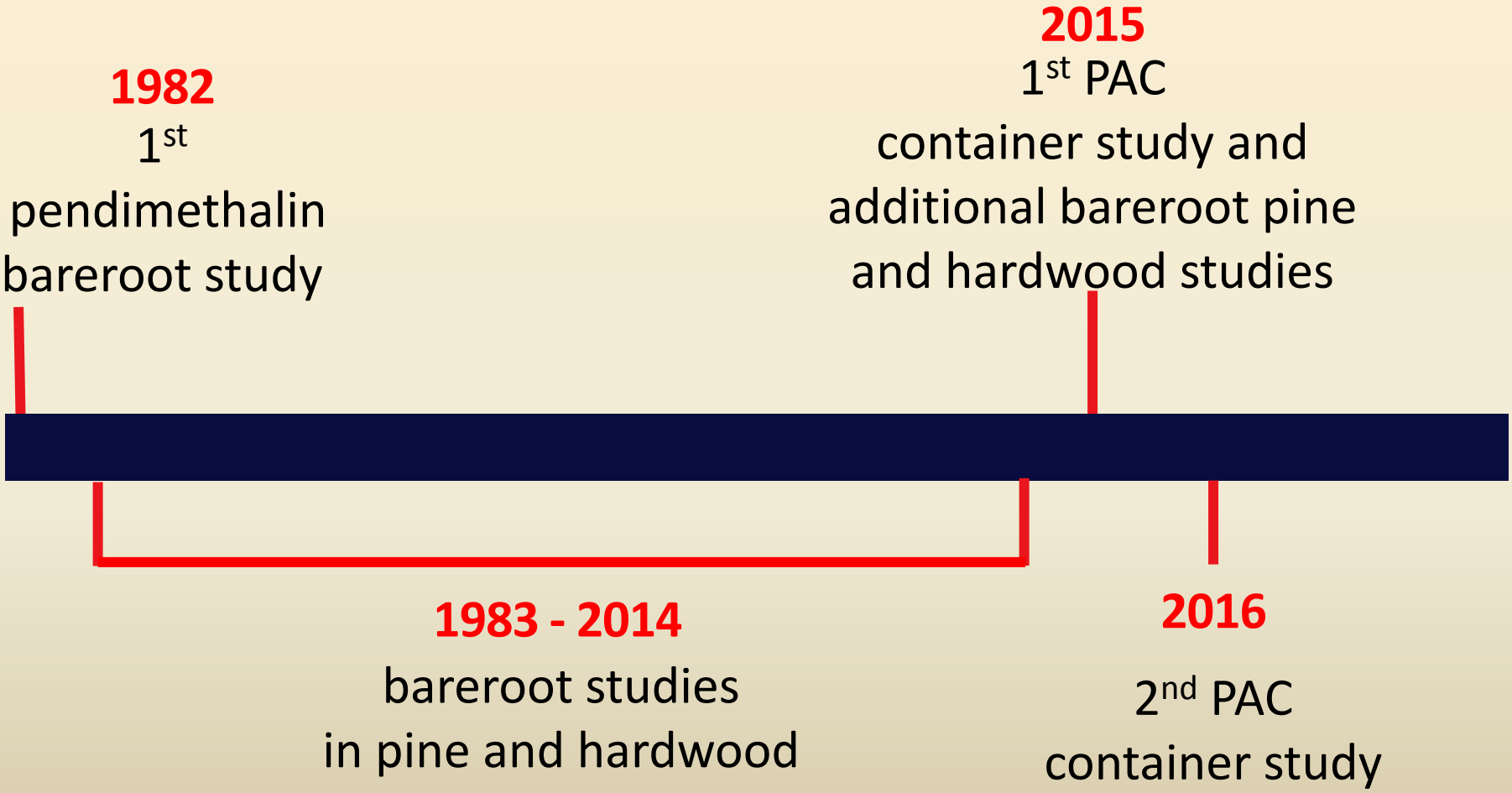
BASF Corporation
26 Davis Drive
Research Triangle Park, NC 27709

BASF
The Chemical Company

Pendulum®AquaCap™ *pendimethalin*

- Pre-emergent herbicide.
- Group 3 herbicide.
- Apply to soil; weeds generally die before emerging from soil.
- Will not control established weeds.
- Conifer and hardwood seedling nurseries listed on label.
- Weeds listed as controlled on label include crabgrass, goosegrass, Johnsongrass, carpetweed, evening primrose, pigweed, spurge, woodsorrel.

Timeline of SFNMC PAC Studies



Objectives of PAC 2015 studies:

1. What is the tolerance of loblolly and slash pine in **containers** to different rates of PAC?

2. What is the effectiveness of PAC on willow and other weeds control in container production systems?

2015 Pendulum®AquaCap™ container trials

- First container trials.
- Installed at 2 nurseries on 2 pine species.
- Sprayed at 2 rates with weekly applications made at sowing over capping material.

Results on container pine tolerance

- **Loblolly** and **slash** pine seedling characteristics were unaffected by PAC applications EXCEPT

Loblolly – slightly smaller RCD at high rate in 1 of 2 trials (0.2 mm)
control = 4.19, low = 4.08, high = 4.01

Slash – slightly lower plug weights at both rates in only trial (0.2 g)
control = 10.0, low = 9.8, high = 9.8

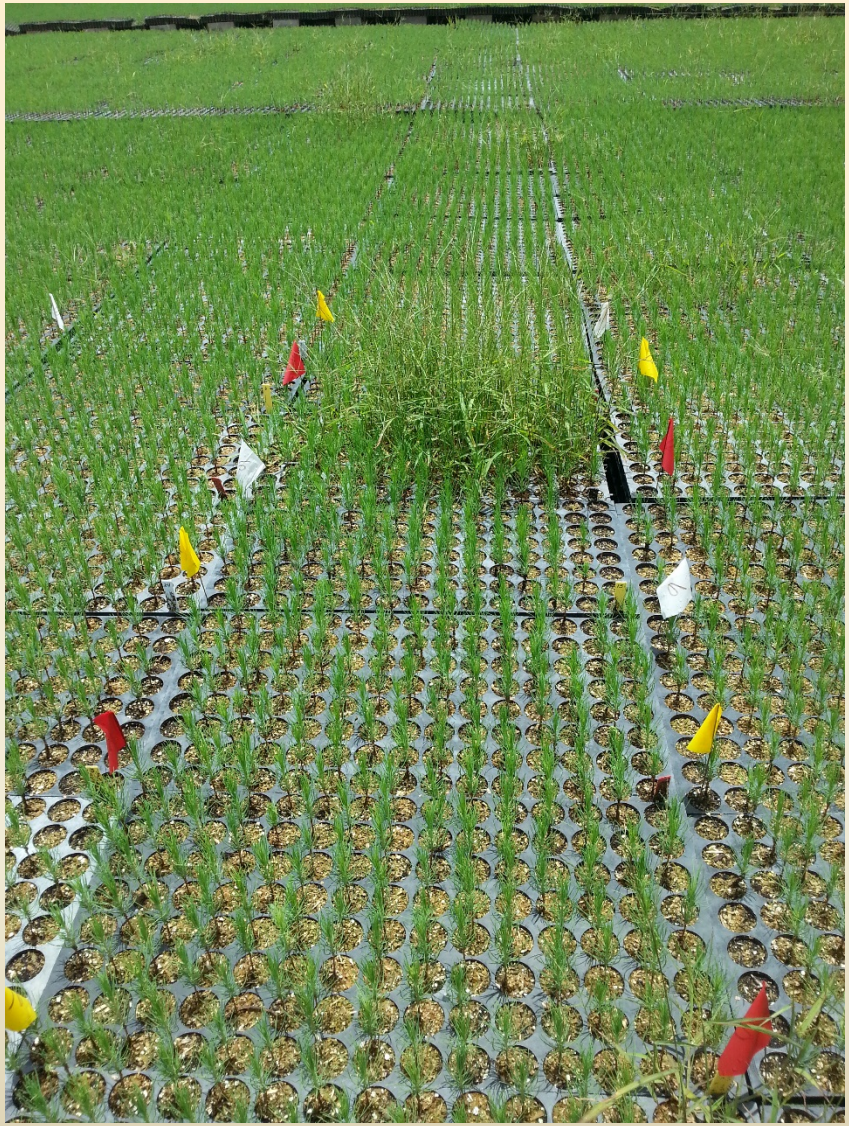
Results on willow and weed control in container studies

- **Willow control** - lack of willows in 2015

  At one nursery, PAC treated trays had statistically significant fewer number of willow seedlings.

  At second nursery, PAC treated trays showed no difference when compared to untreated trays.

- **The number of weeds** (other than willow) were significantly less in treated vs. untreated trays. Weeds identified at the end of the study included spurge, annual sedge and crabgrass.



5 weeks after PAC application

Pendulum®AquaCap™ results reported in RR 16-03

Auburn University
Southern Forest Nursery
Management Cooperative

RESEARCH REPORT 16-03

PENDULUM® AQUACAP™ (PENDIMETHALIN) APPLICATIONS ON WEED AND WILLOW CONTROL AND TOLERANCE TO BAREROOT AND CONTAINER-GROWN LOBLOLLY AND SLASH PINE AND BUTTONBUSH

by
Nina Payne, Barry Brooks and Scott Enebak

INTRODUCTION

The use of Pendulum® AquaCap™ (PAC) in bareroot forest tree nurseries has been examined since 2007 by the Southern Forest Nursey Management Cooperative for control of prostrate spurge (Chamaesyce maculate). Field trials that began on one species at one nursery have been expanded to nurseries in Alabama, Georgia, South Carolina and Tennessee in pine and hardwood. Results have shown that the herbicide can be safely used over loblolly and slash pine when applied **at the time of sowing** to provide good spurge control AND to prevent gall formation that can sometimes occur. In hardwood production systems, the tolerance of seedlings to PAC is species-dependent (Research Reports 13-03; 13-05). Care should be taken if one wants to use this material over an untested hardwood species. With any new herbicide, adoption of the treatment into the standard operating procedures takes time as each organization becomes familiar with the compound. A recent survey of SFNMC cooperating nurseries reported that approximately half of bareroot nurseries are using Pendulum® AquaCap™ in their weed control regimen.

While considerable effort was put into bareroot systems, little is known about the interaction of Pendulum® AquaCap™ with the organic media commonly used in containerized forest tree nurseries. In one of the few studies conducted with pendimethalin and organic matter, Lithuanian researchers reported in 2007 that peat acted to bind the herbicide so that the pendimethalin had a slow decomposition rate and half-life of 63 days (Lubytė et al, 2007). Most bareroot studies included soil types from clay to sandy soil rather than organic soils. Because some SFNMC nurseries have successfully used PAC for weed control in nursery beds, the use of the herbicide in containerized systems to target black willow (*Salix nigra*) is considered a logical next step. Willow is one of the more annoying weeds, as seed production and dispersal is difficult to predict in its timing, quantity and coverage over a nursery. Applications of PAC must be timed to coincide with estimated time of willow seed dispersal AND sowing dates of trays.

In order to further develop the potential use of Pendulum® AquaCap™, trials were installed at two nurseries in container-grown pine. In addition, two other bareroot trials were installed on conifer and hardwood species. The objectives of these trials were to 1) assess the effectiveness of PAC on control of weeds, notably black willow, at different pre-emergent application rates, 2) evaluate containerized loblolly and slash pine tolerance to pre-emergent application rates of Pendulum® AquaCap™ made at sowing and 3) follow-up results of previous trials by evaluating bareroot

What we've learned from Pendulum® AquaCap™ studies:

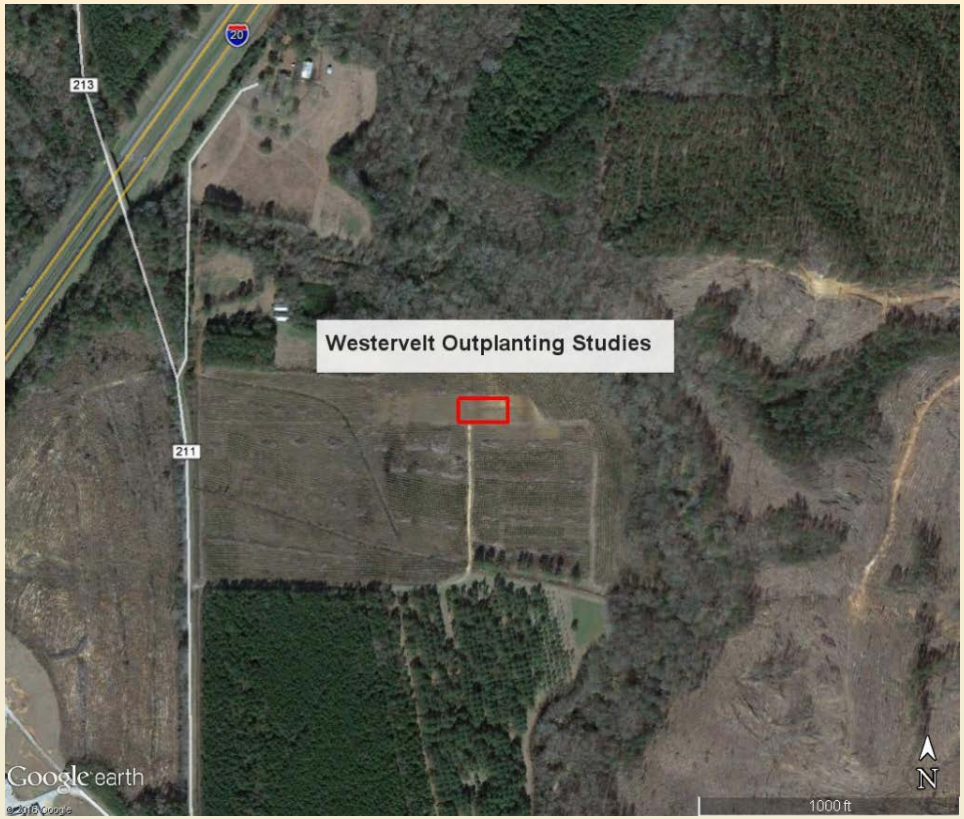
- Container conifers

  Loblolly and slash pine tested, sprayed at sowing.

  Seedling quality attributes not affected. Small effects seen in RCD and plug weights.

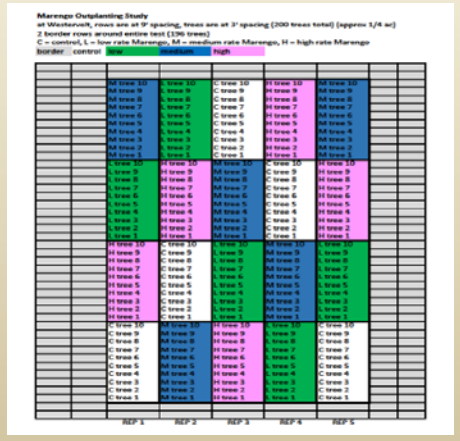

2015 Pendulum®AquaCap™ and Marengo® container outplanting studies

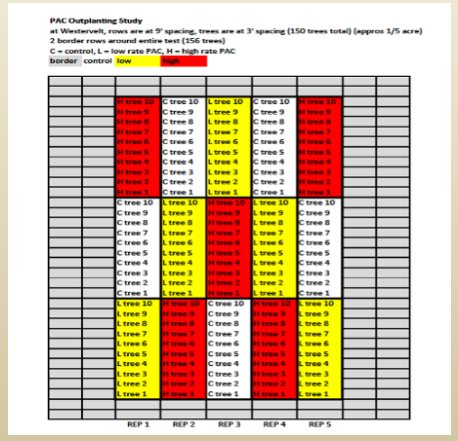
- Purpose is to determine any carryover effect of herbicides in containers one year after planting.
- Established 2 independent studies at each of 2 nurseries.
- Planted seedlings from Westervelt 2015 PAC and Marengo® studies.



Eutaw, AL site near Westervelt nursery

DeRidder, LA site near IFCO nursery





PAC and Marengo® field layouts

2016 STUDIES in progress

- Marengo®
  - Container loblolly, longleaf, slash and shortleaf pine
- Pendulum® AquaCap™
  - Container loblolly, longleaf, slash and shortleaf pine
- 3 ‘new’ herbicides
  - Bareroot loblolly and slash pine
- Targeted goosegrass study
  - Bareroot loblolly and slash pine

2016 STUDY LOCATIONS

Nursery	# Marengo® installations	# Pendulum® AquaCap™ installations	# Defendor™, Grasp®, and Envoke® installations	# Dismiss® installations
ArborGen Selma Nursery (AL)			1	
GFC Flint River Nursery (GA)			2	
IFCO Moultrie Nursery (GA)	4	6		
K & L Nursery (GA)		1 watch trial	1	
Weyerhaeuser Pine Hill Nursery (AL)			2	1

2016 Marengo® container trial

- Follow-up to 2014 and 2015 container trials (*RR 15-01, 16-04*).
- Installed at 1 nursery on 4 species.
- Each species sprayed at 3 rates with single application made between 6 - 8 weeks post-sowing.

Objectives of Marengo® 2016 studies:

1. What is the tolerance of container-grown loblolly, slash, longleaf and shortleaf pine to different rates of Marengo®?

2. What is the effectiveness of Marengo® on willow and weed control in container production systems?

At study installation

- Sprayed each species with 3 rates of Marengo® when seedlings were at least 6 weeks post-sowing.
- Recorded percent fill and # willows and other weeds by tray.

At study conclusion

- Will record percent fill and # willows and other weeds by tray.
- Take sample seedlings from each tray to lab for seedling measurements and root growth potential (RGP) studies.


LONGLEAF


LOBLOLLY


SLASH


SHORTLEAF

Pendulum®AquaCap™ container trials

- Follow-up to first container trials.
- Installed at 1 nursery on 4 pine species.
- Sprayed at 2 rates with 6 weekly applications made at sowing over topping material.

Objectives of PAC 2016 studies:

1. What is the tolerance of container-grown loblolly, slash, longleaf and shortleaf pine to different rates of PAC?

2. What is the effectiveness of PAC on willow and weed control in container production systems?

At study installation (at sowing)

- Sprayed 2 rates of PAC once a week for 6 weeks, including each of 4 species at least once.
- Timing of sprays to coincide with willow seed flight.

At study conclusion

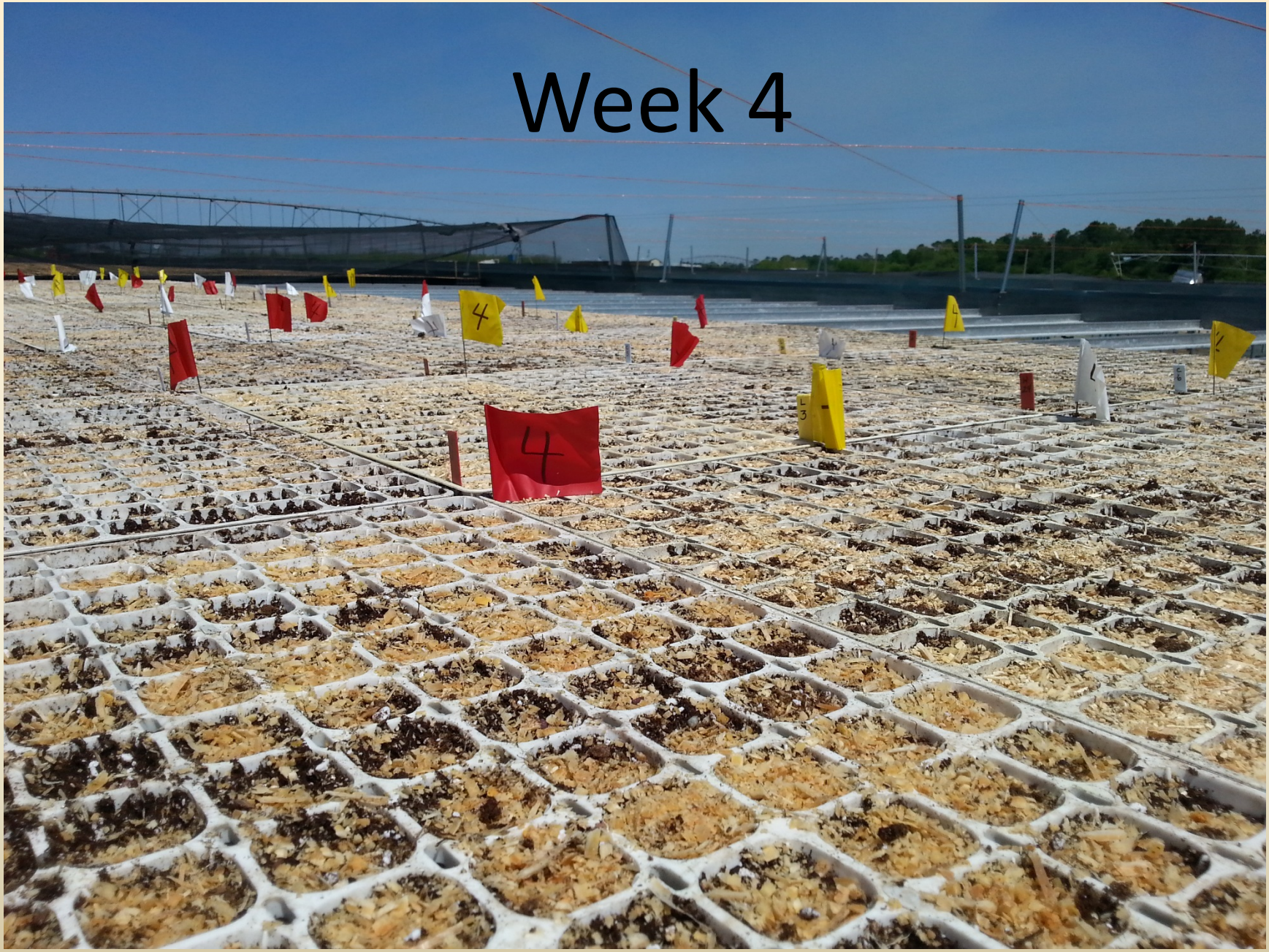
- Will record percent fill and # willows and other weeds by tray.
- Take sample seedlings from each tray to laboratory for seedling characteristics measurements.

Week 1

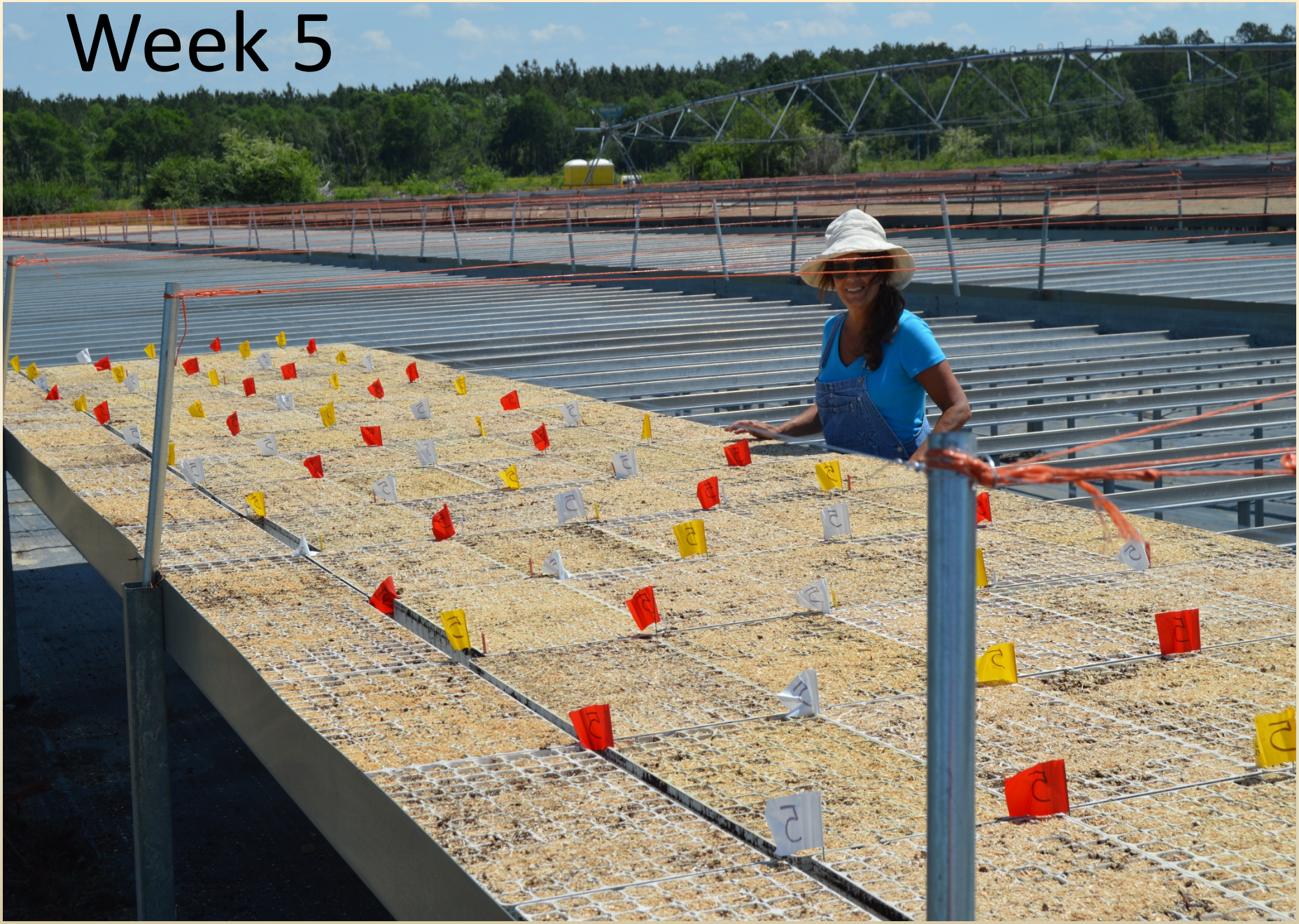
Week 2


Week 3

Week 4



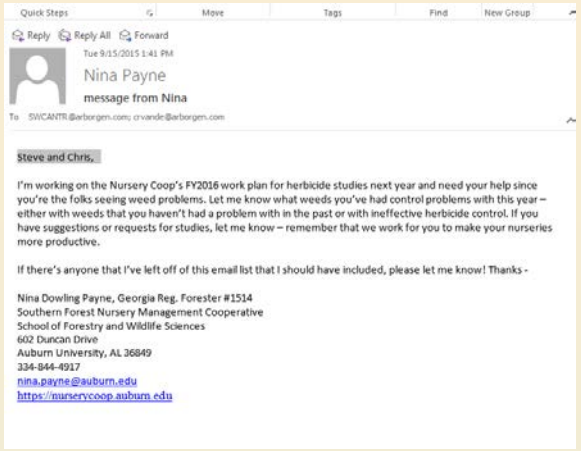
Week 5




Week 6

2016 3 ‘new’ herbicide trials

Started with email/phone survey of nurseries’ weed problems



Quick Steps | Move | Tags | Find | New Group

Reply | Reply All | Forward

Tue 9/15/2015 1:41 PM

Nina Payne

message from Nina

To SWCANTR@arborgen.com; crvande@arborgen.com

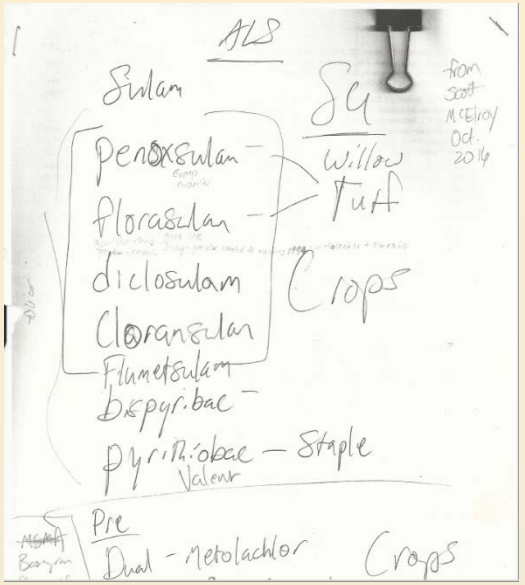
Steve and Chris,

I’m working on the Nursery Coop’s FY2016 work plan for herbicide studies next year and need your help since you’re the folks seeing weed problems. Let me know what weeds you’ve had control problems with this year – either with weeds that you haven’t had a problem with in the past or with ineffective herbicide control. If you have suggestions or requests for studies, let me know – remember that we work for you to make your nurseries more productive.

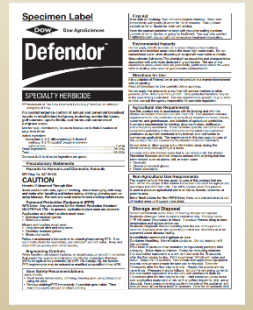
If there’s anyone that I’ve left off of this email list that I should have included, please let me know! Thanks -

Nina Dowling Payne, Georgia Reg. Forester #1514
Southern Forest Nursery Management Cooperative
School of Forestry and Wildlife Sciences
602 Duncan Drive
Auburn University, AL 36849
334-844-4917
nina.payne@auburn.edu
https://nurserycoop.auburn.edu

Took resulting list of problem weeds to AU agronomist/weed scientist for recommendations



Selected 3 from list of 15+, contacted manufacturers for information and samples



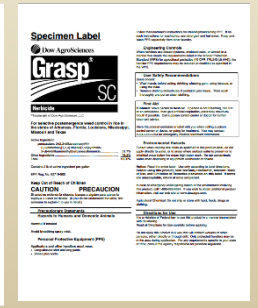
Specimen Label

Dow AgroSciences

Defendor

SPECIALTY HERBICIDE

CAUTION



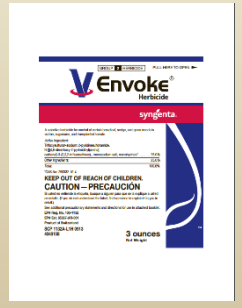
Specimen Label

Dow AgroSciences

Grasp SC

Herbicide

CAUTION PRECAUCION



Envoke Herbicide

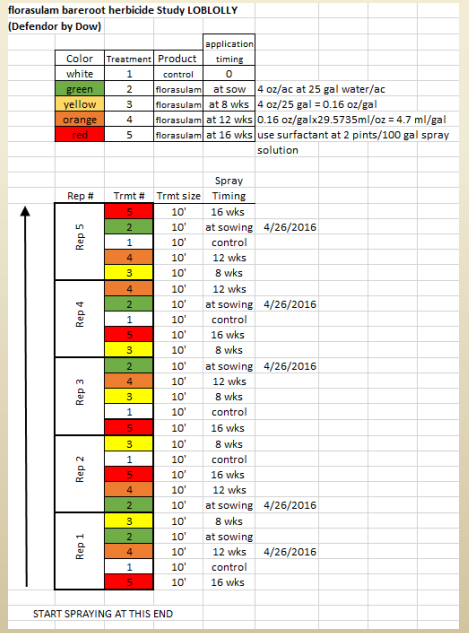
syngenta

KEEP OUT OF REACH OF CHILDREN.

CAUTION – PRECAUCION

3 ounces

Designed studies, requested bed space in 4 nurseries



florasulam bareroot herbicide Study LOBLOLLY (Defendor by Dow)

Color	Treatment	Product	application timing	
white	1	control	0	
green	2	florasulam	at sow	4 oz/ac at 25 gal water/ac
yellow	3	florasulam	at 8 wks	4 oz/25 gal = 0.16 oz/gal
orange	4	florasulam	at 12 wks	0.16 oz/galx29.5735ml/oz = 4.7 ml/gal
red	5	florasulam	at 16 wks	use surfactant at 2 pints/100 gal spray solution

Rep #	Trmt #	Trmt size	Spray Timing	
Rep 5	5	10’	16 wks	
	2	10’	at sowing	4/26/2016
	1	10’	control	
	4	10’	12 wks	
	3	10’	8 wks	
Rep 4	4	10’	12 wks	
	2	10’	at sowing	4/26/2016
	1	10’	control	
	5	10’	16 wks	
	3	10’	8 wks	
Rep 3	2	10’	at sowing	4/26/2016
	4	10’	12 wks	
	3	10’	8 wks	
	1	10’	control	
	5	10’	16 wks	
Rep 2	3	10’	8 wks	
	1	10’	control	
	5	10’	16 wks	
	4	10’	12 wks	
	2	10’	at sowing	4/26/2016
Rep 1	3	10’	8 wks	
	2	10’	at sowing	
	4	10’	12 wks	4/26/2016
	1	10’	control	
	5	10’	16 wks	

START SPRAYING AT THIS END

2016 3 'new' herbicide trials

- In response to need for safe post-emergent herbicides to control sedges, grasses and broadleaf weeds.
- Installed at 4 nurseries on bareroot loblolly and slash seedlings.
- Sprayed at lowest recommended rate at sowing and at 8, 12 and 16 weeks post-sowing.

Objectives of 3 ‘new’ herbicides 2016 studies:

1. What is the tolerance of bareroot loblolly and slash pine to florasulam, penoxsulam, and trifloxysulfuron at different application times?

2. What is the effectiveness of florasulam, penoxsulam and trifloxysulfuron on sedges, grasses and broadleaf weeds at different application times?

Nina with Ken and Lucas Singleton and
Dr. Steve Li, AU Extension Agronomist

Specimen Label

Dow AgroSciences

Defendor™

SPECIALTY HERBICIDE

®™Trademark of The Dow Chemical Company ("Dow") or an affiliated company of Dow

For postemergence control of annual and perennial broadleaf weeds in established turfgrass, including residential lawns, golf courses, sports fields, sod farms and commercial turfgrass areas

Not for sale, distribution, or use in Nassau or Suffolk Counties of New York State

Active Ingredient:

florasulam: N-(2,6-difluorophenyl)-8-fluoro-5-methoxy (1,2,4)triazolo(1,5-c)pyrimidine-2-sulfonamide	4.84%
Other Ingredients	95.16%
Total	100.00%

Contains 0.42 lb of active ingredient per gallon.

Precautionary Statements

Hazards to Humans and Domestic Animals

EPA Reg. No. 62719-560

CAUTION

Harmful If Absorbed Through Skin

Avoid contact with skin, eyes or clothing. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, or using tobacco. Remove and wash contaminated clothing before reuse.

Personal Protective Equipment (PPE)

WPS Uses: Any use covered by the Worker Protection Standard (40 CFR Part 170) – in general, agricultural plant uses are covered-

Applicators and other handlers must wear:
- Chemical-resistant gloves
- Shoes plus socks

Mixers and loaders must wear:
- Long-sleeved shirt and long pants
- Chemical-resistant gloves
- Shoes plus socks

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

Engineering Controls

When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240(d)(4-6)], the handler PPE requirements may be reduced or modified as specified in the WPS.

User Safety Recommendations

Users should:
- Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet.
- Remove clothing/PPE immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.

First Aid

If on skin or clothing: Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice.

Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-992-5994 day or night, for emergency treatment information.

Environmental Hazards

Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwater or rinsate.

Groundwater Advisory: This chemical has properties and characteristics associated with chemicals detected in groundwater. The use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in groundwater contamination.

Directions for Use

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.
Read all Directions for Use carefully before applying.

Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application. For any requirements specific to your state or tribe, consult the agency responsible for pesticide regulation.

Agricultural Use Requirements

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR Part 170. This standard contains requirements for the protection of agricultural workers on farms, forests, nurseries, and greenhouses, and handlers of agricultural pesticides. It contains requirements for training, decontamination, notification, and emergency assistance. It also contains specific instructions and exceptions pertaining to the statements on the label about personal protective equipment, restricted-entry interval, and notification to workers (as applicable). The requirements in this box apply to uses of this product that are covered by the Worker Protection Standard.

Do not enter or allow worker entry into treated areas during the restricted entry interval (REI) of 4 hours.

For early entry into treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil, or water, wear:
- Coveralls
- Chemical-resistant gloves
- Shoes plus socks

Non-Agricultural Use Requirements

The requirements of this box apply to uses of this product that are NOT within the scope of the Worker Protection Standard for agricultural pesticides (40 CFR Part 170). The WPS applies when this product is used to produce agricultural plants on farms, forests, nurseries, or greenhouses.

Entry Restrictions for Non-WPS Uses: Keep unprotected persons out of treated areas until sprays have dried.

Storage and Disposal

Do not contaminate water, food, or feed by storage or disposal.
Pesticide Storage: Store in original container only. Storage below 14°F will cause the product to freeze. If product freezes, bring to room temperature and agitate before use.
Pesticide Disposal: Wastes resulting from the use of this product must be disposed of on site according to label use directions or at an approved waste disposal facility.

Nonrefillable containers 5 gallons or less:
Container Handling: Nonrefillable container. Do not reuse or refill this container.
Triple rinse or pressure rinse container (or equivalent) promptly after emptying. **Triple rinse** as follows: Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container 1/4 full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times. **Pressure rinse** as follows: Empty the remaining contents into application equipment or a mix tank and continue to drain for 10 seconds after the flow begins to drip. Hold container upside down over application equipment or mix tank or collect rinsate for later use or disposal. Insert pressure rinsing nozzle in the side of the container, and rinse at about 40 psi for at least 30 seconds. Drain for 10 seconds after

Defendor™
florasulam

- **Post-emergent** herbicide.
- Herbicide used in turf.
- Group 2 herbicide.
- Apply to small, actively growing weeds; absorbed by foliage and roots; systemic.
- Conifer nurseries NOT on label.
- For broadleaf weed control.
- Also labeled as Orion® for ag applications.

Specimen Label

Dow AgroSciences

Grasp®

SC

Herbicide

®Trademark of Dow AgroSciences LLC

For selective postemergence weed control in rice in the states of Arkansas, Florida, Louisiana, Mississippi, Missouri and Texas

Active Ingredient:	
penoxsulam: 2-(2,2-difluoroethoxy)-N-(5,8-dimethoxy[1,2,4] triazolo[1,5c]pyrimidin-2-yl)-6-(trifluoromethyl)benzenesulfonamide	21.7%
Other Ingredients	78.3%
Total	100.0%

Contains 2 lb of active ingredient per gallon

EPA Reg. No. 62719-500

Keep Out of Reach of Children

CAUTION PRECAUCION

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

Precautionary Statements

Hazards to Humans and Domestic Animals

Harmful if inhaled

Avoid breathing spray mist.

Personal Protective Equipment (PPE)

Applicators and other handlers must wear:

- Long-sleeved shirt and long pants
- Shoes plus socks

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

Engineering Controls

When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240 (d) (4-6)], the handler PPE requirements may be reduced or modified as specified in the WPS.

User Safety Recommendations

Users should:

- Wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.
- Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.

First Aid

If inhaled: Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth if possible. Call a poison control center or doctor for further treatment advice.

Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may contact 1-800-992-5994 for emergency medical treatment information.

Environmental Hazards

Except when treating rice fields as specified in this product label, do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwater or rinsate.

Notice: Read the entire label. Use only according to label directions. **Before using this product, read Warranty Disclaimer, Inherent Risks of Use, and Limitation of Remedies elsewhere on this label. If terms are unacceptable, return at once unopened.**

In case of emergency endangering health or the environment involving this product, call 1-800-992-5994. If you wish to obtain additional product information, visit our web site at www.dowagro.com.

Agricultural Chemical: Do not ship or store with food, feeds, drugs or clothing.

Directions for Use

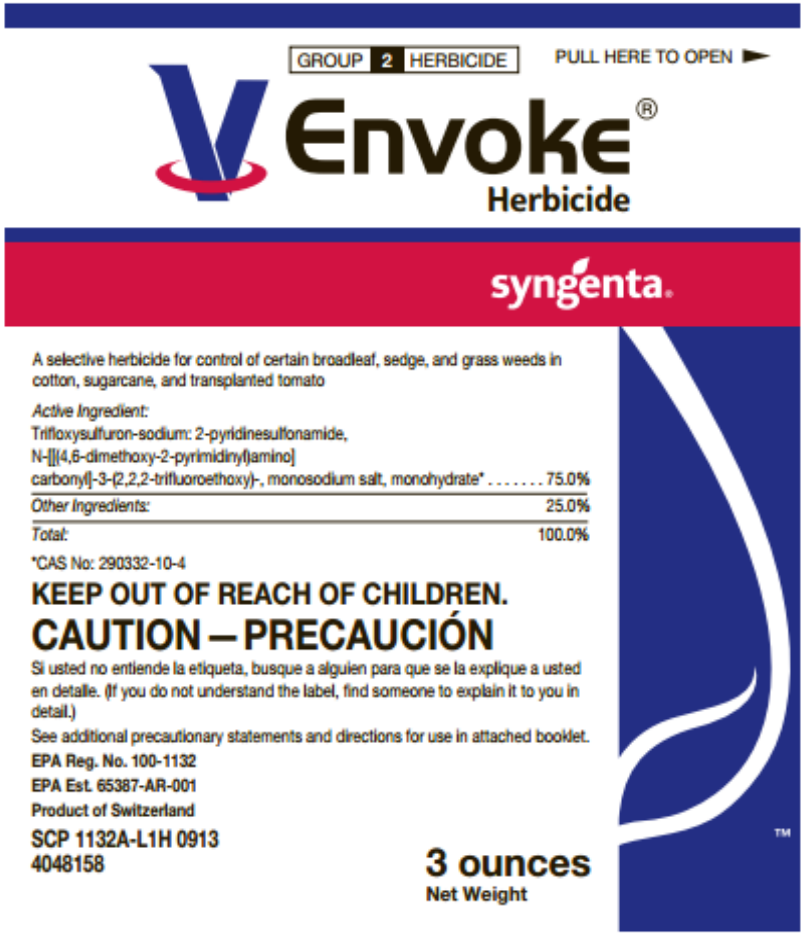
It is a violation of Federal law to use this product in a manner inconsistent with its labeling.
Read all Directions for Use carefully before applying.

Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application. For any requirements specific to your state or tribe, consult the agency responsible for pesticide regulation.

Grasp®

penoxsulam

- **Post-emergent** herbicide.
- Herbicide used in rice.
- Group 2 herbicide.
- Apply to small, actively growing weeds; absorbed by foliage and roots; systemic.
- Conifer nurseries NOT on label.
- For grass, broadleaf and annual sedge weed control.
- Also labeled as Sapphire™ and LockUp™ for turf applications.



Envoke®

trifloxysulfuron

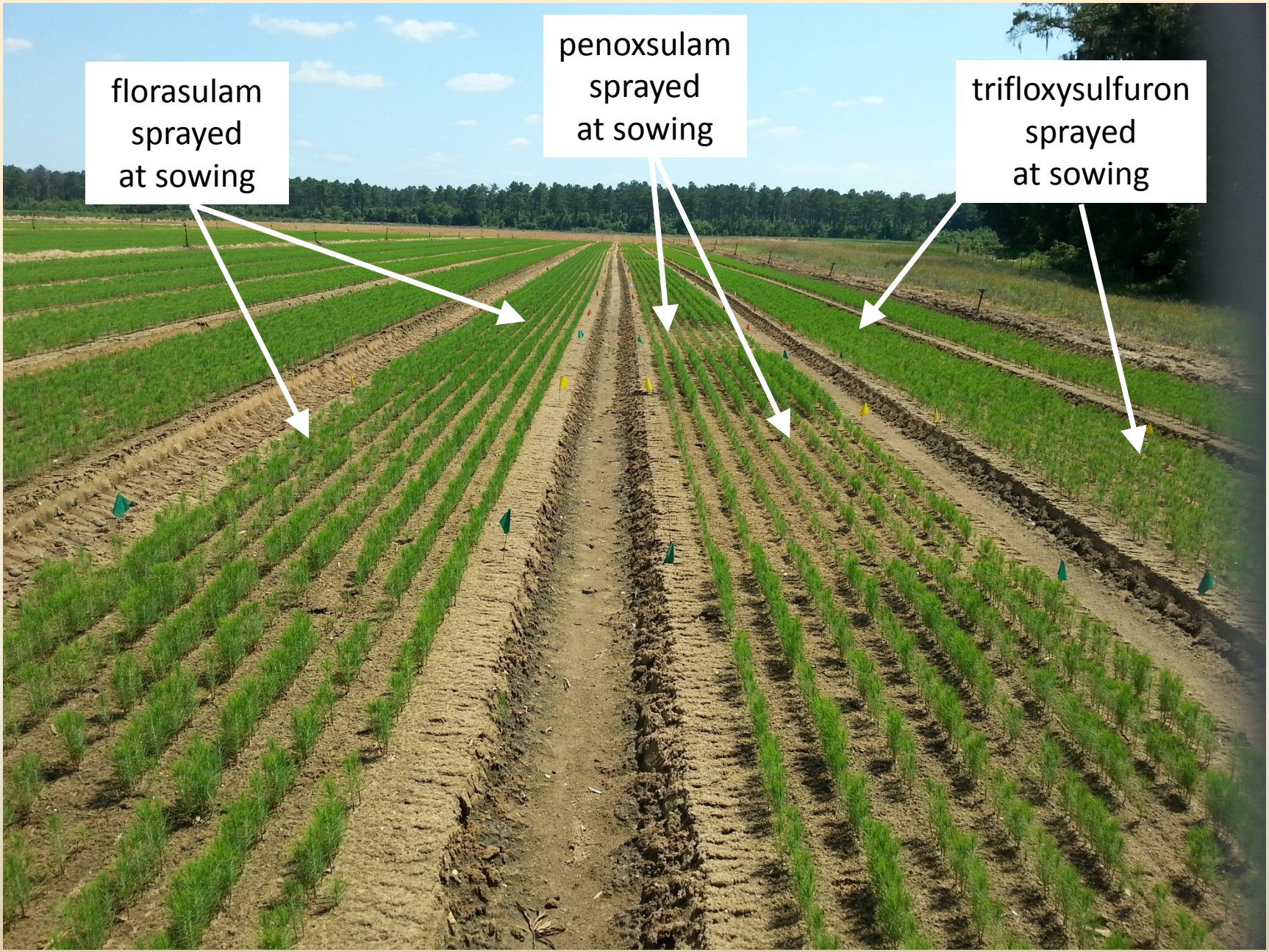
- **Post-emergent** herbicide.
- Herbicide used in cotton, sugarcane and transplanted tomato.
- Group 2 herbicide.
- Apply to small, actively growing weeds; systemic.
- Conifer nurseries NOT on label.
- For grass, broadleaf and sedge weed control.
- Also labeled as Monument® for turf applications.

Envoke®
trifloxysulfuron

Grasp®
penoxsulam

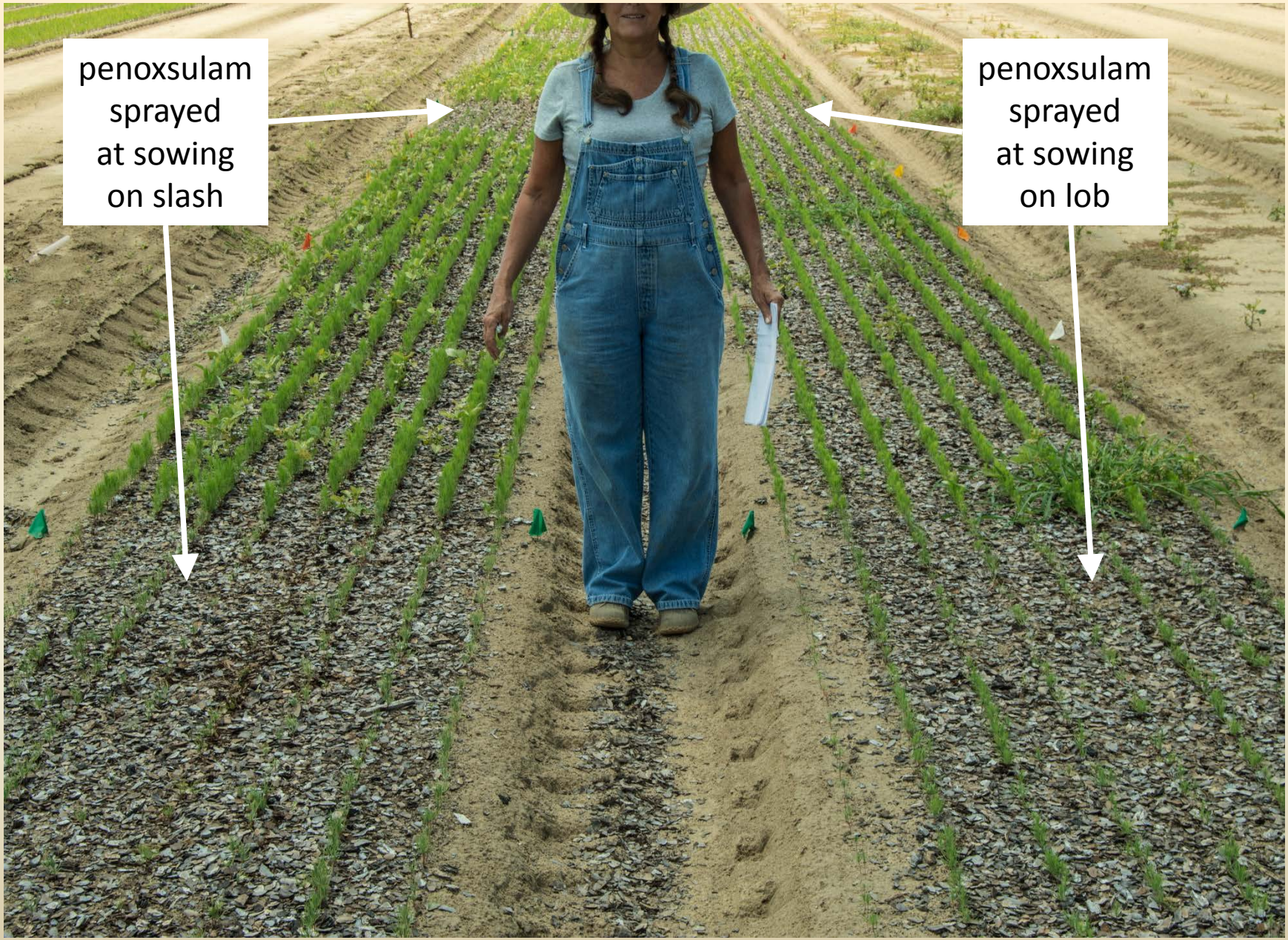
Defendor™
florasulam

Selma, AL florasulam application at sowing on lob



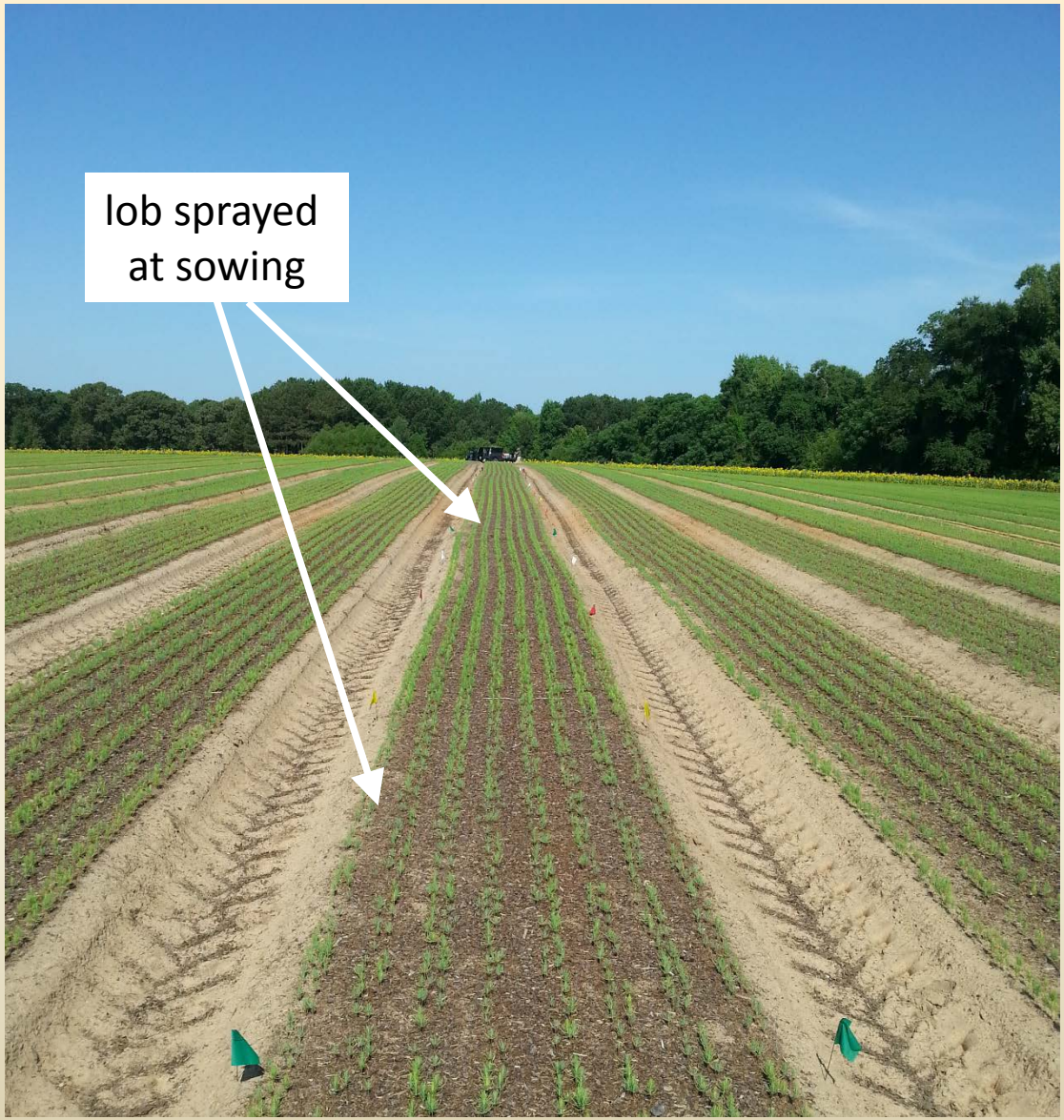
Selma, AL 3 ‘new’ herbicides study at 8 weeks post-sowing in lob

Byromville, GA penoxsulam application at sowing on slash



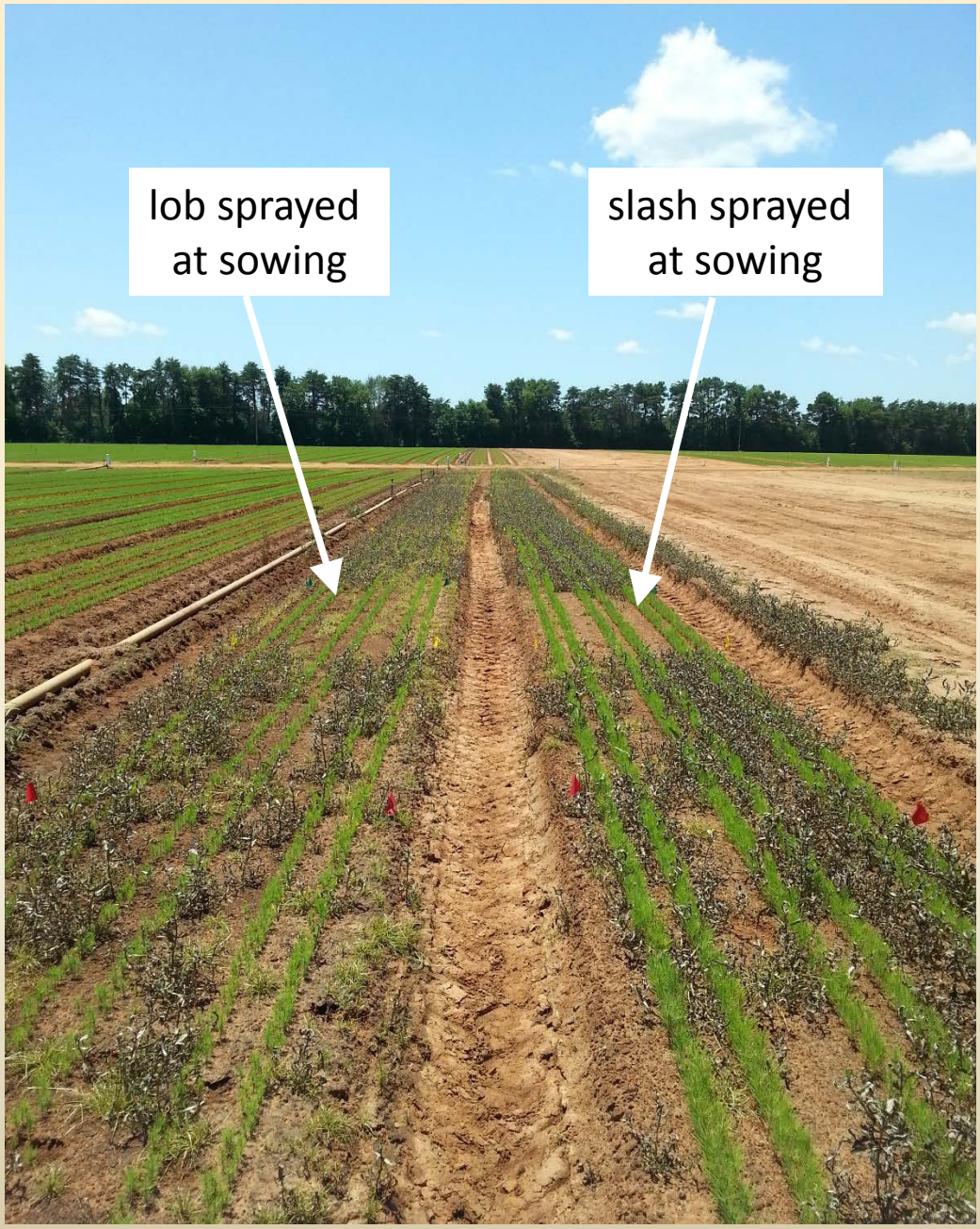
Byromville, GA penoxsulam study at 8 weeks post-sowing

Buena Vista, GA
florasulam study
at sowing on lob

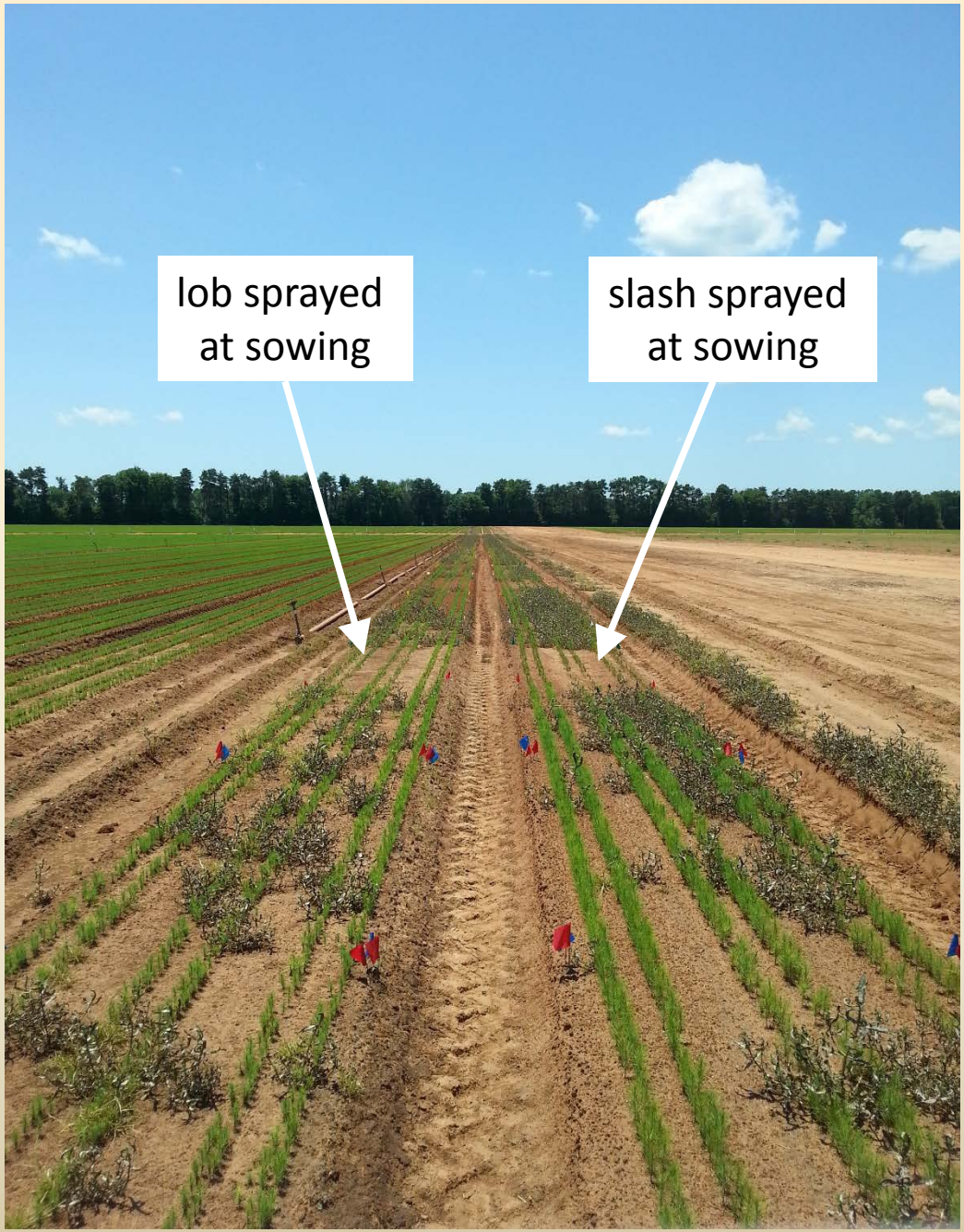


Buena Vista, GA
penoxsulam study
at 8 weeks post-sowing
on lob

Camden, AL penoxsulam application at sowing on slash



Camden, AL
florasulam study
at 8 weeks post-sowing



Camden, AL
penoxsulam study
at 8 weeks post-sowing

Camden, AL
trifloxysulfuron study
at 8 weeks post-sowing

At study conclusion

- Record seedling and weeds density (identify weeds) in each treatment plot.

- Take sample seedlings from each treatment plot to laboratory for seedling measurements.

2016 Dismiss® trial

- Installed at 1 nursery on loblolly and slash.
- Target weed is goosegrass.
- Sprayed at lowest recommended rate at 8, 12, 16 and 8 & 12 weeks post-sowing.

Dismiss®
sulfentrazone

- **Post-emergent** herbicide.
- Herbicide used in turf and container/field grown ornamentals.
- Group 14 herbicide.
- Apply to small, actively growing weeds ; not systemic.
- Conifer nurseries NOT on label; “field nursery stock plants”.
- For broadleaf, sedge and goosegrass weed control.
- Also labeled as Spartan® for agricultural applications.

Dismiss®

TURF HERBICIDE

For Selective Weed Control in Turf Sites Including Residential and Institutional Lawns, Athletic Fields, Commercial Sod Farms, Golf Course Fairways and Roughs. Also for use as Selective Weed Control in Container and Field grown ornamentals.

EPA Reg. No 279-3295 **EPA Est. 279-IL-1**

Active Ingredient:	**By Wt.**
Sulfentrazone*	39.6%
Other Ingredients:	60.4%
	100.0%

*N-[2,4-dichloro-5-[4-(difluoromethyl)-4,5-dihydro-3-methyl-5-oxo-1H-1,2,4-triazol-1-yl]phenyl]methanesulfonamide.

Contains 4.0 pounds of active ingredient per gallon.

KEEP OUT OF REACH OF CHILDREN

CAUTION

See other panels for additional precautionary information.

FIRST AID	
If inhaled	• Move person to fresh air. • If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible. • Call a poison control center or doctor for further treatment advice.
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a poison control center or doctor for further treatment advice.
If in eyes	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a poison control center or doctor for treatment advice.
If swallowed	• Call a poison control center or doctor immediately for treatment advice. • Do not give any liquid to the person. • Do not induce vomiting unless told to do so by the poison control center or doctor. • Do not give anything by mouth to an unconscious person.
HOTLINE NUMBER	
Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-331-3148 for emergency medical treatment information.	
For Information Regarding the Use of this Product Call 1-800-321-1FMC (1362).	

PRECAUTIONARY STATEMENTS

Hazards to Humans (and Domestic Animals)

CAUTION

Causes moderate eye irritation. Harmful if inhaled, swallowed, or absorbed through skin. Avoid breathing vapor or spray mist. Avoid contact with skin, eyes or clothing.

Personal Protective Equipment (PPE)

Applicators and other handlers must wear: long-sleeved shirt and long pants, waterproof gloves, and shoes plus socks.

Discard clothing and other absorbent materials that have been drenched or heavily contaminated with this product. Do not reuse them. Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

User Safety Recommendations:

Users should:

- Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.

FMC

FMC Corporation
Agricultural Products Group
1735 Market Street
Philadelphia PA 19103

Net Contents: 6 ounce

01-02-13

Objectives of sulfentrazone (Dismiss®) 2016 study:

1. What is the tolerance of bareroot loblolly and slash pine to sulfentrazone at different application times?

2. What is the effectiveness of sulfentrazone on goosegrass and other weeds at different application times?

At study conclusion

- Record seedling and weed density (identify weeds) in each treatment plot.

- Take sample seedlings from each treatment plot to lab for seedling measurements.

Shortcuts to Herbicide-related Research Reports, Technical Notes and old Coop Notes on SFNMC website

SFNMC 1995-2016 Research Report Content Shortcuts (for herbicide keywords search)

2016

16-03 Pendulum AquaCap *pendimethalin* , bareroot lob & slash, buttonbush, container lob & slash, willow

16-04 Marengo *indaziflam* , bareroot lob, slash, cedar, directed spray pin oak, container lob, slash, longleaf, plastic & styroblock containers, willow

2015

15-01 Marengo *indaziflam* , willow, container lob, longleaf, shortleaf, slash

15-04 Terracyte, Ecotec, moss, liverwort, container Frasier fir

2014

14-01 PAC *pendimethalin* , Goal *oxyfluorfen* at sowing, spurge, lob

14-02 PAC *pendimethalin* , galls, growth 1 year after outplanting, lob

14-03 PAC *pendimethalin* , 8, 12, 16 weeks after sowing, galls, spurge, lob

14-04 Marengo *indaziflam* , spurge, at 0, 6 and 12 weeks, lob

14-05 Raptor/Clearcast *imazamox* , morningglory, white oak, red oak, plum, swamp chestnut oak

14-06 RonstarFlo *oxadiazon* , PAC *pendimethalin* , Goal *oxyfluorfen* , lob, carpetweed, goosegrass, sedge, pigweed

2013

13-03 PAC *pendimethalin* , maple, sweetgum, sycamore, blackgum, ash, pear

13-04 sedge, RonstarFlo *oxadiazon* , PAC *pendimethalin* , Goal *oxyfluorfen* , Cobra *lactofen* , Certainty *sulfosulfuron* , lob

13-05 morningglory, hazelnut, persimmon, plum, swamp chestnut, water oak, willow oak, PAC *pendimethalin* , Dismiss *sulfentrazone* , Broadstar *flumioxazin*

2012

12-01 PAC *pendimethalin* Tower *dimethanamid,* slash, lob, spurge, grass,

12-03 PAC *pendimethalin* , spurge, sycamore, black oak, cherrybark oak, sawtooth oak

12-05 undiluted PAC *pendimethalin* , container lob, galls, outplanting, greenhouse

2011

11-05 pine bark mulch, seed efficiency, PAC *pendimethalin* , lob

2010

10-03 purple & yellow nutsedge, spurge, lob, Tower *dimethenamid* , Matrix *rimsulfuron*

10-04 PAC *pendimethalin* , spurge, Freehand *dimethenamid* , lob, slash

2009

09-01 lob, spurge, PAC *pendimethalin*

09-02 nutsedge, lob, League *imazosulfuron,* Matrix *rimsulfuron*

09-03 spurge, lob, Escort *metsulfuron*

2007

07-01 spurge, lob, Oust *sulfometuron* , Escort *metsulfuron* , Cobra *lactofen* , MSMA, Stinger *clopyralid,* Reflex *fomesafen*

07-02 MSMA, nutsedge, lob

07-03 shielded, Escort *metsulfuron* , Sedgehammer *halosulfuron* , lob

2006

06-01 MSMA, nutsedge, lob

06-02 Sedgehammer *halosulfuron,* nutsedge, oak

06-03 shielded, Escort *metsulfuron* , Sedgehammer *halosulfuron* , lob

06-04 lob, Outlook *dimethenamid* , Broadstar Sureguard *flumioxazin, spurge*

Handout in your packet

See Nina for spreadsheet to use ‘Find’ feature

Recap

5 trials in 26 installations conducted in 2015

6 trials in 17 installations in progress in 2016

Shortcuts to herbicide-related
Research Reports on SFNMC website

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