Weed Control in the Landscape

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My History

- Native of Pennsylvania
- University of Delaware (B.S.), Virginia Tech (M.S.), Cornell (Ph.D)
- Worked for 3 years between those degrees
- Associate Professor and Extension Specialist at the University of Georgia, Griffin
- 75% Extension, 25% Research
- All aspects of weed control in ornamentals, small fruits, Christmas trees, and flower culture

What is a Weed?

- Plant out of place
- Plants whose virtues have not been discovered
- Plant that causes economic loss

Chinese Privet (*Ligustrum sinense*)

Why Control?

- Plant competition
- Hosts for insects and disease
- Beauty

Weed Life Cycles

Annual: Completes growth cycle in a single growing season (Crabgrass).

Perennial: A plant that persists and produces reproductive structures year after year (Bermudagrass).

Biennial: A plant that normally requires two growing seasons to complete its life cycle, flowering and fruiting in its second year (Wild Carrot).

Control Options

- Physical Removal
- Physical Barrier
- Bio-control
- Chemical weed control

Physical Removal

Hand removal or tillage:

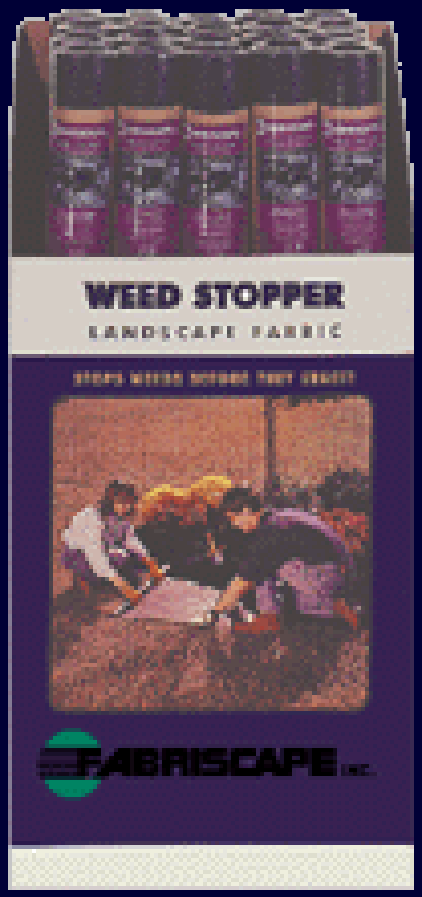
- **Tillage mainly used in bed preparation**
- **Hand removal can be useful with annual shallow rooted weeds**

Physical Removal

Flame throwers and heat:

- Flame throwers are used to remove weeds in sidewalk joints / cracks, and non-organic mulches
- Fire is used to remove brush and hardwoods from conifers
- Heat is used to steam sterilize soil in greenhouse and potting mixtures

Physical Barriers



- A film, fabric, or layer that smoothers plant growth
- Many synthetic fabrics allow air and water to pass
- Use in combination with mulches
- Many brands, expensive ($0.25 to $2 / ft^2)
- Weeds often penetrate
- Synthetics can last for many years (+10) as long as not exposed to UV

Physical Barriers

Bare soil = Weed Growth

Mulches:

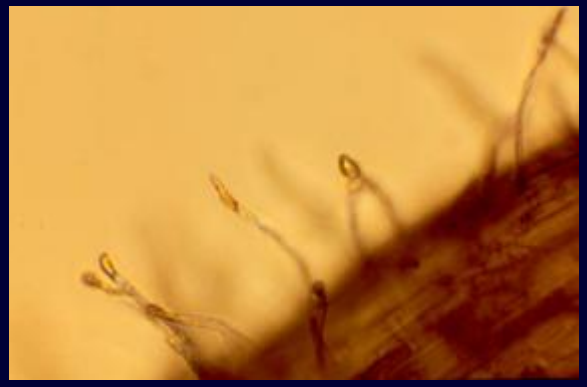
- Organic or Inorganic: (pine needles, bark or wood chips, river rock, marble chips, lava rock, etc.)
- Organic mulches should be composted!
- Maintain a 2 to 4 inch layer of mulch!
- Helps maintain soil temperatures and moisture, as well as add organic matter

Bio-control

- **Pathogens, insect, and grazing animals can be used to control weeds (Grass Carp, Goats, etc.)**
- **Pathogens and insects are hard to develop: move to desirable plants and short shelf lives**
- **Few marketable products available (The fungus *Phytophthora palmivora* was marketed for the control of strangler vine in Florida, i.e. DeVine)**

Bio-control

- The thistle weevil has been very successful at providing long term control of thistles.
- Might not see many organisms developed in the future, but might see their products or mechanisms.




Site 2 in 1990


Site 2 in 1996

Chemical Weed Control

- **Last alternative, usually combined with other control measures**
- **Products are safe when used properly.**
- **They are easy to use, and save hours of labor**
- **Two herbicides that had a huge impact on food production, 2,4-D and atrazine, simply changed the world forever.**

Herbicides

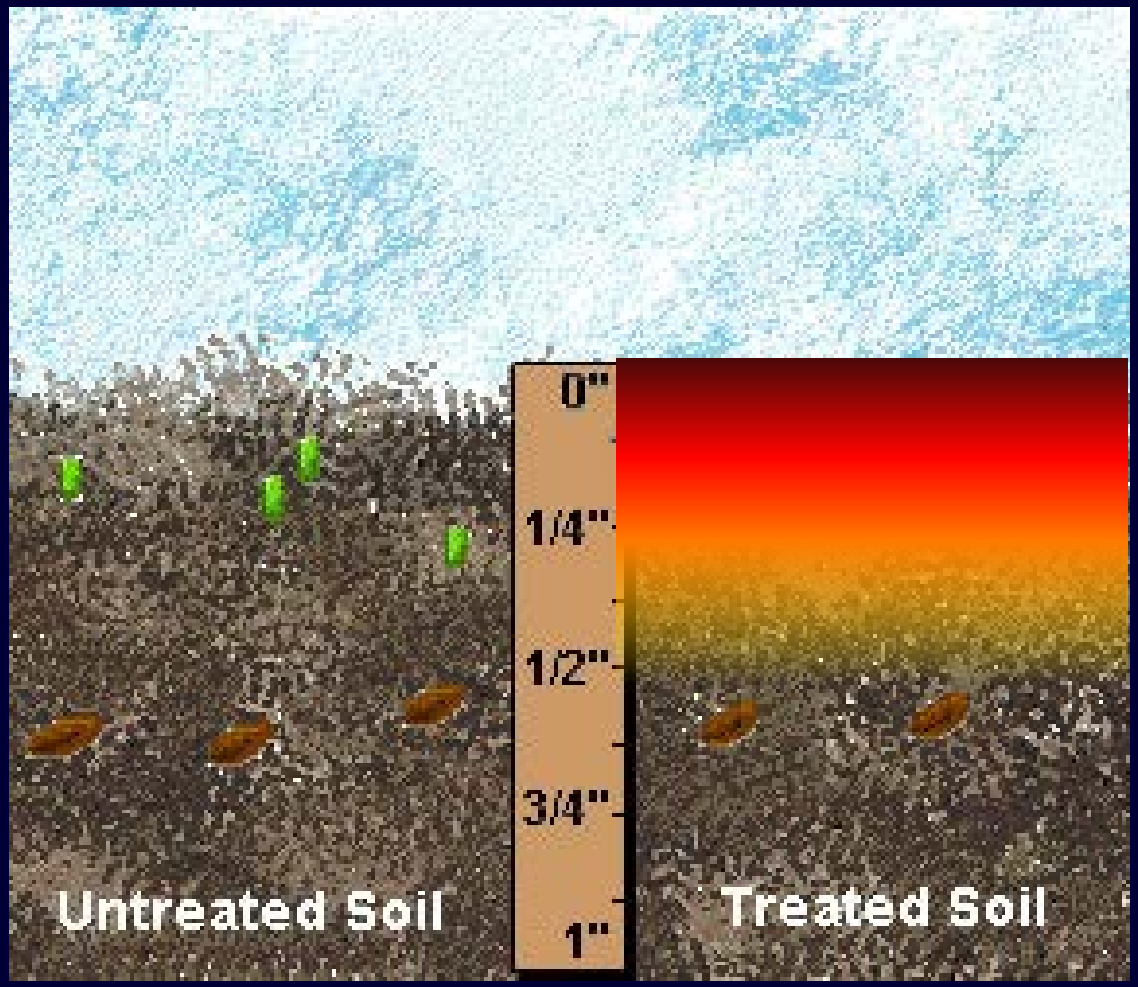
Preemergent

- Apply to bare soil or mulch before germination of seeds
- Need water to move (activate) herbicide into seed germination zone

Postemergent

- Apply any time after seed has germinated
- Need a certain period of dryness after application

Pre Herbicides



Activation or leaching (Via water) is required to get herbicide in weed seed germination

Herbicides

- **Selective herbicides** control a certain group of plants, but safe on others (2,4-D)
- **Non-selective** herbicides control all plants that they come in contact with (Roundup)

Herbicides

Foliar applied or soil applied:

- **Preemergent (Preen)**
- **Postemergent (Roundup)**
- **Pre / Post (Image)**

Herbicides

- Formulations are created to be applied dry (granular) or as a liquid (sprayable)
- Sprayables are made with concentrates (liquid or dry)

Herbicides

Trade names, common chemical names, and confusion!

Trade name: Roundup

Active ingredient (Common chemical name): glyphosate

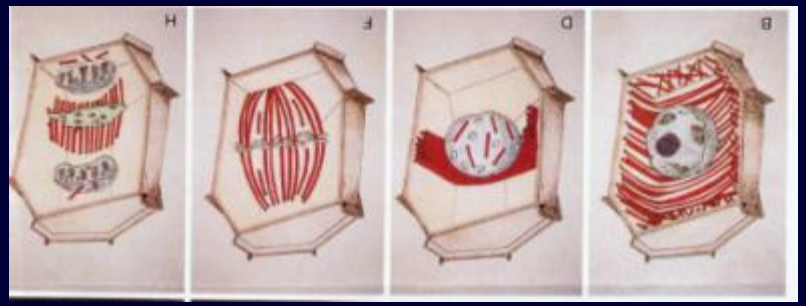
Full chemical name: *N*-(phosphonomethyl)glycine

Mode-of-action

- All herbicides have a mode-of-action or a chemical means by which they control a plant (some have multiple).
  - Glyphosate (i.e. Roundup) inhibits the EPSP synthase pathway and the production of tryptophane, tryrosine, and phenyalanine
- Some plants have mechanisms by which they detoxify herbicides (most have multiple).
  - Most grass plants have the ability to detoxify phenoxy (2,4-D) herbicides by performing a biochemical process called NIH shift

Mode-of-Action Dinitroanilines

- **Include the herbicides: Trifluralin (Treflan), Pendimethalin (Pendulum), Oryzalin (Surflan), Benefin (Balan), Prodiamine (Barricade)**
- **The colored herbicides**
- **Only used as preemergent herbicides**
- **Backbone of the ornamental industry**
- **Causes microtubule disruption in plants**
- **Used to change ploidy number in tissue culture**



Pre Herbicides for the Nursery Industry

Trade Name	Active	Containers (C) / Field (F)	Landscape Use
Casoron	(dichlobenil)	F	Y
Dimension	(dithiopyr)	F, C	Y
Broadstar	(flumioxazin)	F, C	N
Gallery	(isoxaben)	F, C	Y
Pennant	(metolachlor)	F, C	Y
Devrinol	(napropamide)	F, C	Y
Surflan	(oryzalin)	F, C	Y
Ronstar	(oxadiazon)	F, C	Y
Weedfree 63	(oxyfluorfen)	F,C	Y
Pendulum	(pendimethalin)	F, C	Y
Barricade	(prodiamine)	F, C	Y
Kerb	(pronamide)	F	N
Princep	(simizine)	F	Y
Treflan	(trifluralin)	F, C	Y

Post Herbicides for the Nursery Industry

Non-Selective Herbicides

Trade Name	Active
Reward	(diquat)
Finale	(glufosinate)
Roundup	(glyphosate)
Goal	(oxyfluorfen)
Scythe	(pelargonic acid)

Grass Herbicides

Trade Name	Active
Envoy	(clethodim)
Acclaim Extra	(fenoxaprop)
Fusilade II	(fluazifop-p-buytl)
Segment (aka: Vantage)	(sethoxydim)

Selective Broadleaf Herbicides

Trade Name	Active
Basagran	(bentazon)
Lontrel	(clopyralid)
Sedgehammer (aka: Manage)	(halosulfuron)
Image	(imazaquin)
Garlon	(triclopyr)

Combo Herbicides

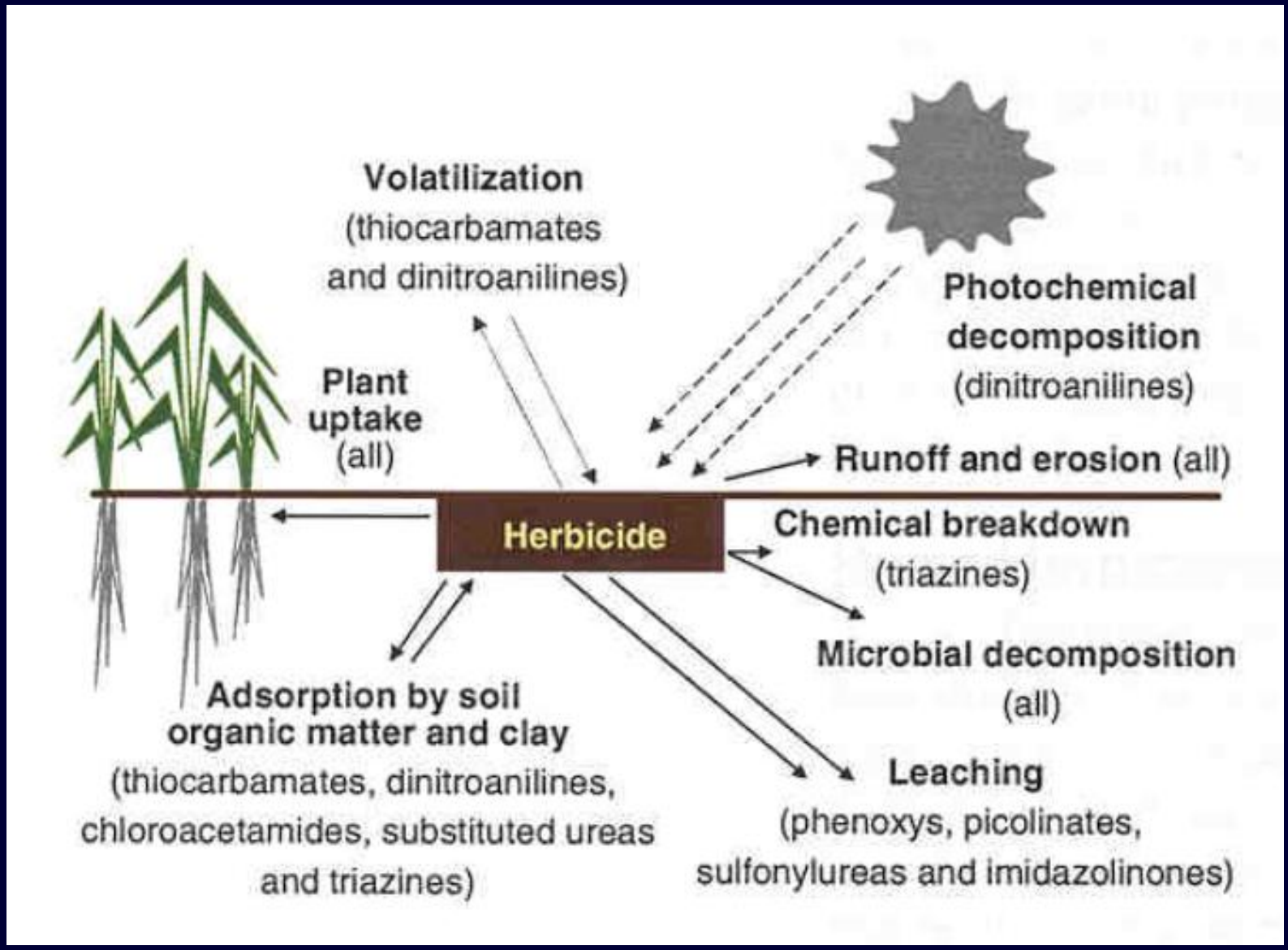
- Dry formulation
- Contain a burndown herbicide (oxyfluorfen) and a preemergent herbicide (pendimethalin)
- Easy to apply and forgiving

Combination Herbicide for the Ornamental Industry

Trade Name	Formulation	Active	Containers (C) / Field (F) / Landscape (L)
OH2	3 GR	oxyfluorfen / pendimenthalin	F, C, L
Rout	3 GR	oxyfluorfen / oryzalin	F, C, L
Kansel+	3.25 GR	oxadiazon / pendimethalin	F, C, L
Snapshot	2.5 GR	isoxaben / trifluralin	F, C, L
Showcase	2.5 GR	isoxaben / trifluralin / oxyfluorfen	F, C, L
XL (Amaze)	2 GR	benefin / oryzalin	F, C, L
Regal O-O	3 GR	oxyfluorfen / oxadiazon	F, C, L
RegalStar	1.2 GR	oxadiazon / prodiamine	F, C, L
Weedfree 75	5 GR	oxyfluorfen / trifluralin	F, C, L

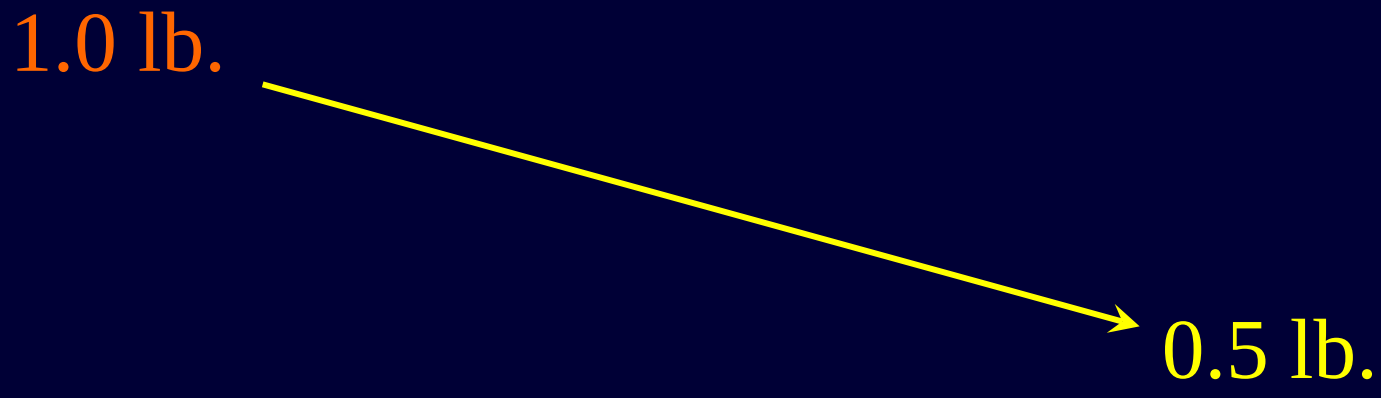

Control
Herbicide Treatments

Herbicide Fate



Herbicide ½ Life

Amount of time it takes a herbicide to reach one-half (t1/2) of the originally applied concentration. Expressed in days, wks, months, yrs.



Post Herbicides – Avg. t1/2

Herbicide	Days (soil)
2,4-D	10
Dicamba (Vanquish)	21 – 84
Clopyralid (Transline)	40
Triclopyr (Garlon)	10 – 46
Sethoxydim (Poast)	5
Glyphosate (numerous)	47
Glufosinate (Finale)	7

Organic

- **Organic production - Several products on the market that contain burndown type chemicals:**
  - **Acetic Acid**
  - **Malic Acid**
  - **Strong Soap**
  - **Clove oil**
  - **Lemon 0il**
- **Also one preemergent product Corn Gluten**

Roundup

- Glyphosate (i.e. Roundup) inhibits the EPSP synthase pathway and the production of tryptophane, tryrosine, and phenyalanine. This pathway is not present in mammals (LD_{50} is safer than table salt)
- Roundup resistant crops (Soybeans, Corn, Canola, Cotton, and others in the future)

Roundup

- Lots of new formulations
- Glyphosate is off patent
- 0.25 to 10% Concentration – using 41% active (25 to 50% if wicking, 50 to 100% if treating stumps)

Roundup

Glyphosate damage in ornamentals (sub lethal doses)

Adjuvant

Spray additives used to enhance herbicide performance and include:

- **Surfactants**
- **Crop Oils**
- **Antifoaming Agents**
- **Drift Control Agents**

Adjuvant

Enhancement of Herbicide Activity:

- **Surfactants** (X-77, Kinetic): Added when mixing herbicides, but included in many formulations.
- **Crop Oils** (MSO, COC): Added when mixing grass herbicides (Select, Fusilade II).

Woody Weed Control

- Trees, Shrubs, and Vines can be controlled with stump applications.
- Roundup and Garlon can be used at 50% or full strength, and painted to fresh cut stems or stumps.
- In unmanaged areas, you can do a basal bark application with Garlon and other herbicides.

Cut

Paint

The nasty weeds!

Difficult Weeds

Yellow nutsedge
(*Cyperus esculentus*)

Purple nutsedge
(*Cyperus rotundus*)

Weeds

Hairy bittercress (*Cardamine hirsuta*)

Weeds

Creeping Woodsorrel (Oxalis corniculata)

Weeds

Spurge (*Euphorbia* sp.)

Weeds

Phyllanthus spp.

Weeds

Mulberry weed (*Fatoua villosa* sp.)

Florida Betony

Florida Betony (*Stachys floridana*)

Bermudagrass (*Cynodon dactylon*)

Weeds

Selective Control:

- Envoy (clethodim)
- Fusilade (fluazifop-p-buytl)
- Vantage (sethoxydim)

Non-Selective Control:

- Roundup (glyphosate >5% solution using 41% to make that 5%)

English Ivy ***Hedera helix***

Bamboo

- **Planted for ornamental uses and escaped – most *Phyllostachy spp.***
- **Growth characteristics makes bamboo difficult to control**

***Phyllostachys* spp.**

Results

2004 Control of bamboo (*Phyllostachys rubromarginata*) with selected herbicides.

		Bamboo Control			
Treatment	**Rate**	**8 WAT**	**16 WAT**	**25 WAT**	**61 WAT**
	kg ai/ha	**----------**	**%**	**----------**	**----------**
Untreated		**0 b**	**0 b**	**0 c**	**0 c**
Dichlobenil	**17.9**	**23 b**	**23 b**	**0 c**	**7 c**
Glyphosate	**4.5**	**88 a**	**88 a**	**82 b**	**47 b**
Imazapyr	**1.7**	**87 a**	**87 a**	**95 a**	**88 a**
LSD (0.05)		**25**	**25**	**3**	**15**

Results

Imazapyr 1.7 kg ai/ha

Glyphosate 4.5 kg ai/ha

Safety

- Know the plants you are trying to control
- Read the herbicide label
- Calibrate your equipment
- Wear appropriate safety equipment
- Common sense

Plant Books

- **Manual of Vascular Flora of the Carolinas, by Radford, Ahles, and Bell (Publisher: The University of North Carolina Press)**
- **Flora of North America (Publisher: Oxford Press)**

Weed Books

- **Weeds of the NorthEast**, by Uva, Neal, Ditomaso (Publisher: Cornell University Press)
- **Color Atlas of Turfgrass Weeds**, by McCarty, Everest, Hall, Murphy, Yelverton (Publisher: Ann Arbor Press)
- **Weeds of the West**, by Whitson, Burrill, Dewey, Cudney, Nelson, Lee, Parker (Publisher: University of Wyoming)
- **Forest Plants of the Southeast and Their Wildlife Uses**, by Miller and Miller (Publisher: Southern Weed Science Society)

Web Page

Web Pages that have ~80% of all MSDS's and Label:

http://www.cdms.net

http://www.greenbook.net

Future of Weed Control

- Several herbicides in the pipe line, and we might see them in the next few years.
- New herbicide formulations!
- Fabrics with herbicides?

Biotechnology

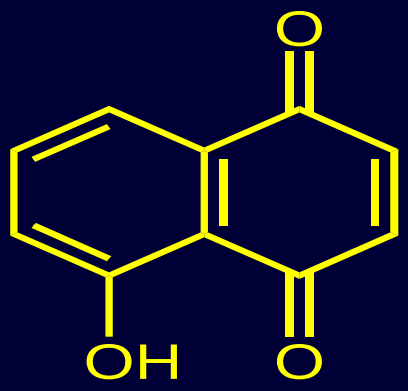
- **Roundup resistance was created by inserting a bacterial EPSP gene into a plant.**
- **A few more horticultural crops may be released in the future, and they include turfgrass and vegetables.**

Allelopathy?

- **Plants use this mechanism to gain a competitive advantage**
- **Allelochemcials have been reported in weeds such as Johnsongrass, (*Sorghum halepense)* and trees such as Black Walnut (*Juglans nigra)***
- **The future?**

Allelopathy?

- **Plants use this mechanism to gain a competitive advantage**
- **Classic example: Black Walnut (*Juglans nigra*)**

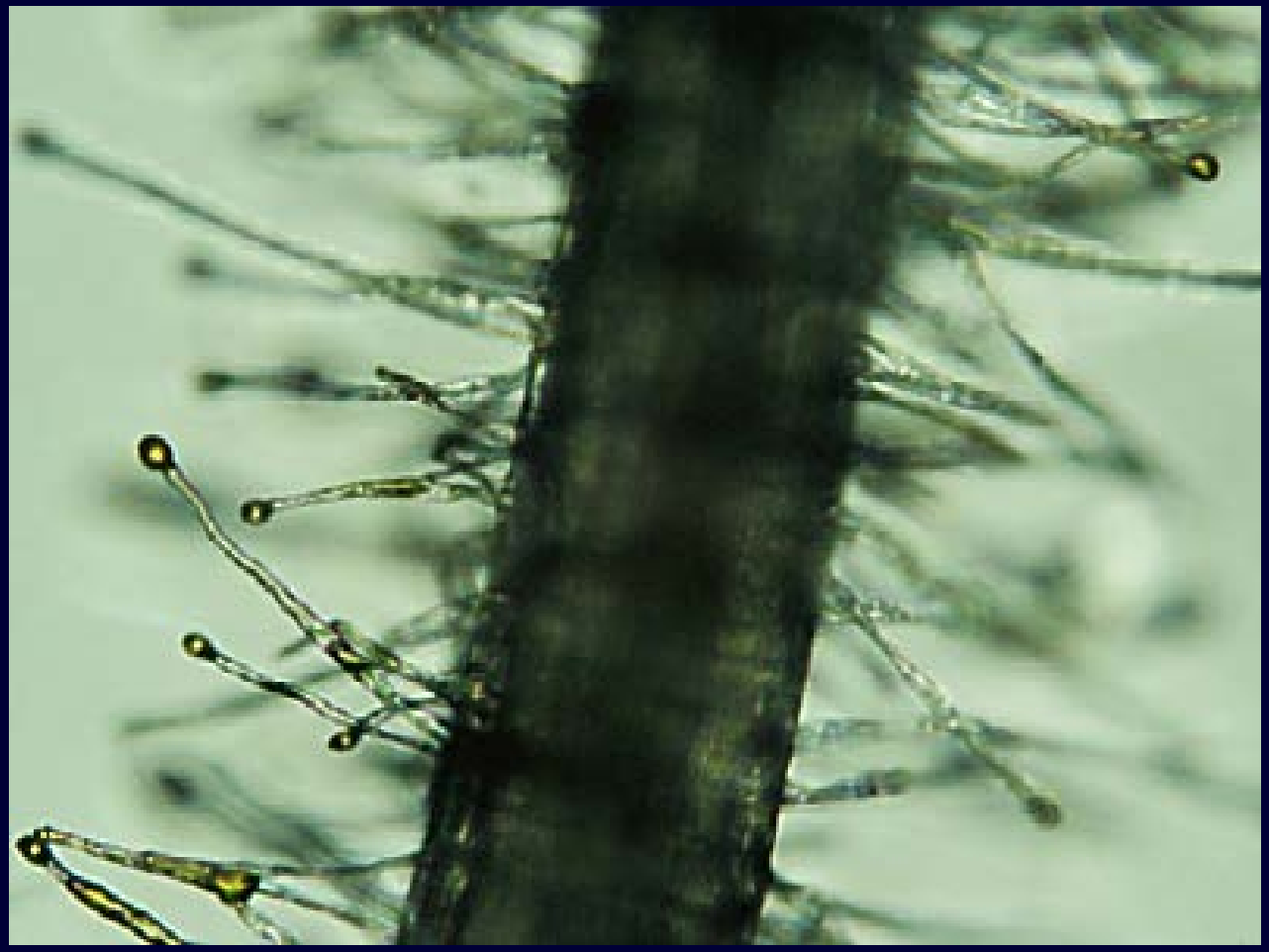


5-Hydroxy-[1,4]naphthoquinone

(juglone)

(Atrazine)

Future of Weed Control



Questions?