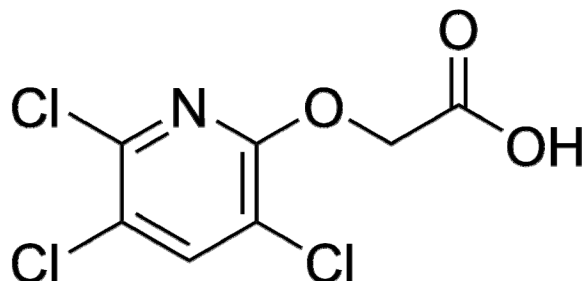


Acids, Amines, Cholines, and Esters!  
Overcoming triclopyr confusion: safety, efficacy, and  
selectivity issues for applicators



Stephen F. Enloe  
Invasive Plant Extension Specialist



Herbicide Toolbox  
for Invasive Plants

# With lawsuits and a huge settlement, a cloud remains over glyphosate

## Monsanto ordered to pay \$289m as jury rules weedkiller caused man's cancer

Court finds in favor of Dewayne Johnson, first person to take Roundup maker to trial



### Over \$2 Billion Verdict in Third Trial Against Monsanto

Michael Pilliod, Brent Wisner, Michael Baum, Alberta Pilliod, Alva Pilliod, Robert F. Kennedy, Jr. and Michael Miller

## Jury Awards \$80 Million In Damages In Roundup Weed Killer Cancer Trial

March 27, 2019 - 8:31 PM ET

RICHARD GONZALES



### KEY INGREDIENT IN ROUNDUP, HAS BEEN DESIGNATED AS A PROBABLE CAUSE OF CANCER BY THE WORLD HEALTH ORGANIZATION.

World Health Organization

### MONSANTO ROUNDUP LEGAL HELPLINE

The impacts are being felt across the country



### **Martin County stops using glyphosate**

### **Stuart votes to ban city use of chemical glyphosate**

photo by Karen via FlickrCC

### **Miami Bans Controversial Herbicides**

Roundup weed killer ban: Indian River County is latest to stop using glyphosate herbicide

## **Cities Are Worried About the Health Effects of Glyphosate**

**Mayor Jenny Durkan Announces Restrictions on the Use of Pesticides Containing Glyphosate by City Departments**

Triclopyr can be a glyphosate alternative, but the triclopyr conversation is getting a little more complicated...

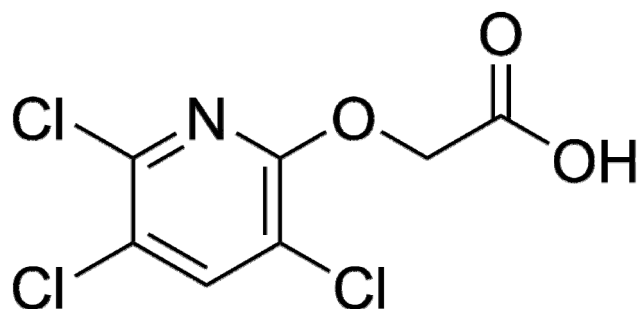


# My goal for this talk

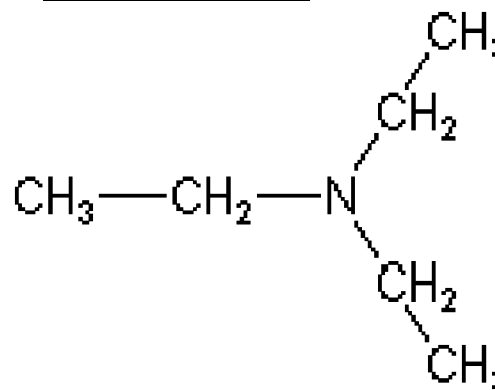
- To help you understand the differences in triclopyr formulations so you can:
  - Select the right one for the job
  - Effectively train your crews
  - Maintain or improve efficacy and efficiency
  - Maintain or improve applicator safety
  - Bottom Line: Have confidence in the tools
- NOTE: The use of trade names does not constitute UF endorsement and they are used here for clarity since they have become part of the “triclopyr lingo”

# The “Amine” Formulation

Triclopyr molecule



Triethylamine salt



- 44% active ingredient (ai)
- 31% acid equivalent (ae)
- 3 lb ae/gallon
- Garlon 3A, Triclopyr 3, Renovate and others
- Water soluble

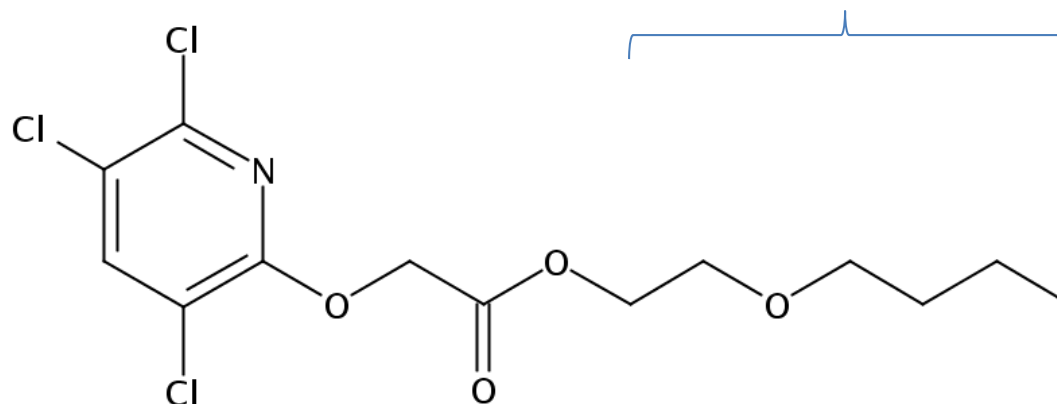




# The “Ester” Formulation

Triclopyr molecule

Butoxyethylester



- 60.45% active ingredient (ai)
- 43.46% acid equivalent (ae)
- 4.0 lb ae/gal
- Garlon 4, Triclopyr 4, Pathfinder II
- Oil soluble, but can be mixed with water

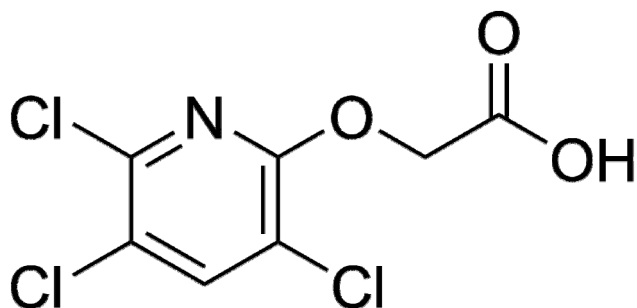
NOTE: Garlon XRT (6.3 lb ae/gal) is a more concentrated version of this ester formulation



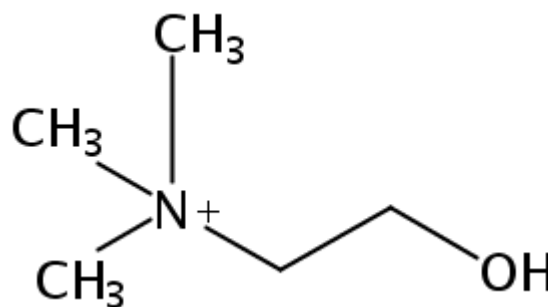


# The “Choline” Formulation

Triclopyr molecule



Choline salt

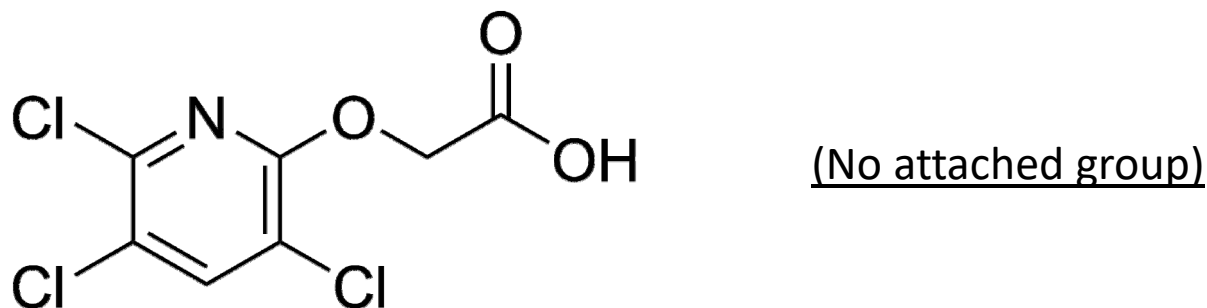


- 54.72% active ingredient (ai)
- 39.02% acid equivalent (ae)
- 4.0 lb ae/gal
- Vastlan, Vastlan HL (HL=high load)
- Water soluble



# The “Acid” Formulation

Triclopyr molecule



- NO % active ingredient (ai)
- 29.4% acid equivalent (ae)
- 2.87 lb ae/gal
- Trycera
- Intermediate – BOTH water and oil soluble

## To put it clearly...

- So now we have gone from two triclopyr products to four, with two four pounders, a three and one near three. The three still means three, the four = oil no longer applies, the one near three goes both ways...



To put it clearly...

**ONE DOES NOT SIMPLY SPEAK OF TRICLOPYR**

**WITHOUT CLARIFYING THE FORMULATION**

# In a little more current terms...



**The triclopyr guy**

@herbicidefreak



Follow

Some of y'all never kept up with triclopyr tech and it really shows...

@ [herbicidefreak](#)



2:48 PM - 6 February 2020

## The good news: there are many similarities across triclopyr formulations

- Auxin mimic mode of action
- Highly phloem mobile
- No confirmed resistance to triclopyr
- Limited to no soil activity in most situations
- Selectivity: control broadleaf (dicot) species
- Very active on woody species, vines

# Symptomology of Auxin Mimic Herbicides

- Twisting and curvature from uneven cell growth
- Cupping, puckering, and crinkling of leaves
- Stem swelling and cracking













# Garlon 3A label (triclopyr amine)

## Woody Plant Species

alder	dogwood	salt cedar <sup>2</sup>
arrowwood	elderberry	salmonberry
ash	elm	sassafras
aspen	gallberry	scotch broom
Australian pine	hazel	sumac
bear clover (bearmat)	hornbean	sweetbay magnolia
beech	kudzu <sup>1</sup>	sweetgum
birch	locust	sycamore
blackberry	madrone	tanoak
blackgum	maples	thimbleberry
Brazilian pepper	mulberry	tulip poplar
cascara	oaks	waxmyrtle
ceanothus	persimmon	western hemlock
cherry	pine	wild rose
chinquapin	poison ivy	willow
choke cherry	poison oak	winged elm
cottonwood	poplar	
crataegus (hawthorn)	salt-bush	
Douglas fir	( <i>Baccharis</i> spp.)	

<sup>1</sup>For complete control, re-treatment may be necessary.

<sup>2</sup>Use cut surface treatments for best results.

# Garlon 4 Ultra label (Triclopyr ester)

## Woody Plants Controlled

alder	chinquapin
madrone	scotch broom
arrowwood	choke cherry
maples	sumac
ash	cottonwood
mulberry	sweetbay magnolia
aspen	Crataegus (hawthorn)
oaks	sweetgum
bear clover (bearmat)	dogwood
persimmon	sycamore
beech	Douglas fir
pine	tanoak
birch	elderberry
poison ivy	thimbleberry
blackberry	elm
poison oak	★ tree-of-heaven
blackgum	gallberry
poplar	( <i>Ailanthus</i> ) <sup>1</sup>
★ boxelder <sup>1</sup>	★ gorse
salmonberry	tulip poplar
Brazilian pepper	hazel
saltbush	wax myrtle
buckthorn	★ hickory
( <i>Braccharis</i> spp.)	wild rose
cascara	hornbeam
salt cedar <sup>1</sup>	willow
Ceanothus	kudzu <sup>2</sup>
sassafras	winged elm
cherry	locust

<sup>1</sup>For best control use either basal bark or cut-stump treatment

# Vastlan label (Triclopyr choline)

## Woody Plants and Weeds Controlled

alder	dogwood	salt cedar <sup>2</sup>
arrowwood	elderberry	salmonberry
ash	elm	sassafras
aspen	gallberry	scotch broom
Australian pine	★gorse	sumac
bear clover (bearmat)	hazel	sweetbay magnolia
beech	hornbean	sweetgum
birch	kudzu <sup>1</sup>	sycamore
blackberry	locust	tanoak
blackgum	madrone	thimbleberry
Brazilian pepper	maples	tulip poplar
★broom, Scotch, French, Spanish, Portugese	★melaleuca (seedlings)	waxmyrtle
cascara	mulberry	western hemlock
ceanothus	oaks	wild rose
cherry	persimmon	willow
chinquapin	pine	winged elm
choke cherry	poison ivy	
cottonwood	poison oak	
crataegus (hawthorn)	poplar	
Douglas fir	★Russian olive 1/ salt-bush ( <i>Baccharis</i> spp.)	

<sup>1</sup>For complete control, re-treatment may be necessary.

# Trycera label (triclopyr acid)

<b>WOODY PLANTS CONTROLLED</b>		
alder	dogwood	salmonberry
arrowwood	elderberry	sassafras
ash	elm	scotch broom
aspen	gallberry	sumac
Australian pine	hazel	sweetbay magnolia
bear clover (bearmat)	hornbeam	sweetgum
beech	kudzu	sycamore
birch	locust	tanoak
blackberry	madrone	thimbleberry
blackgum	Melaleuca (seedlings)	tulip poplar
Brazilian pepper	maples	waxmyrtle
cascara	mulberry	western hemlock
ceanothus	oaks	★ white titi
cherry	persimmon	wild rose
★ Chinese tallow	pine	willow
chinquapin	poison ivy	winged elm
choke cherry	poison oak	
cottonwood	poplar	
Crataegus (hawthorn)	Salt-brush ( <i>Baccharis</i> spp.)	
Douglas fir	salt cedar	

## To put it plainly...

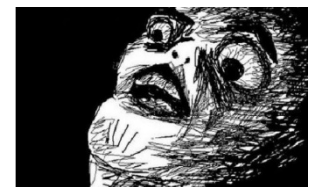
- So, the new four and the new one near three both have a few more species than the old three and old four, but none of them have many of the species that need to be controlled...
- But that's ok, right?
  - The sight of use on the label is what is important



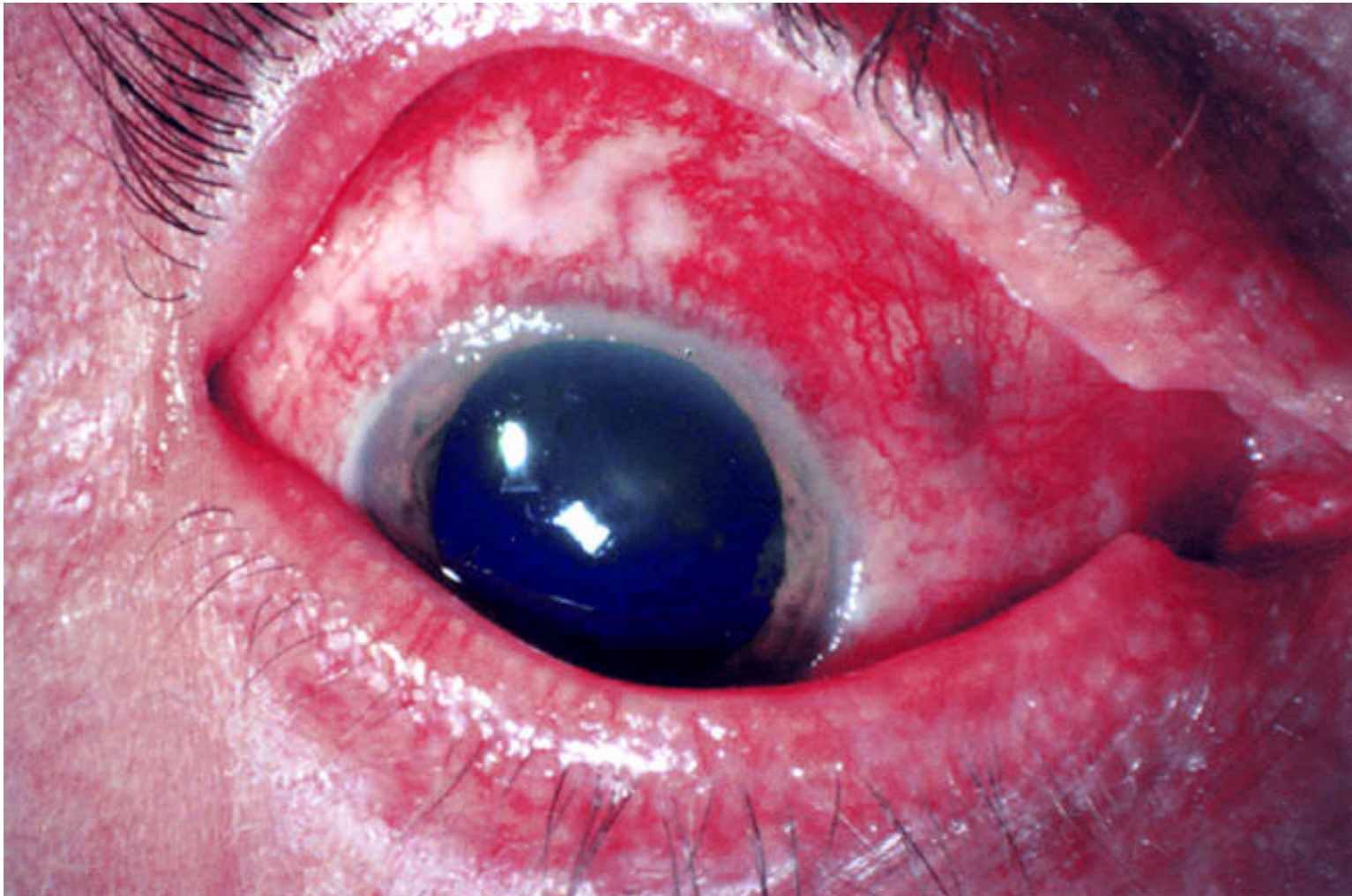


# Triclopyr Formulations and Applicator Safety

*Trigger warning*



# Chemical burn from herbicide exposure

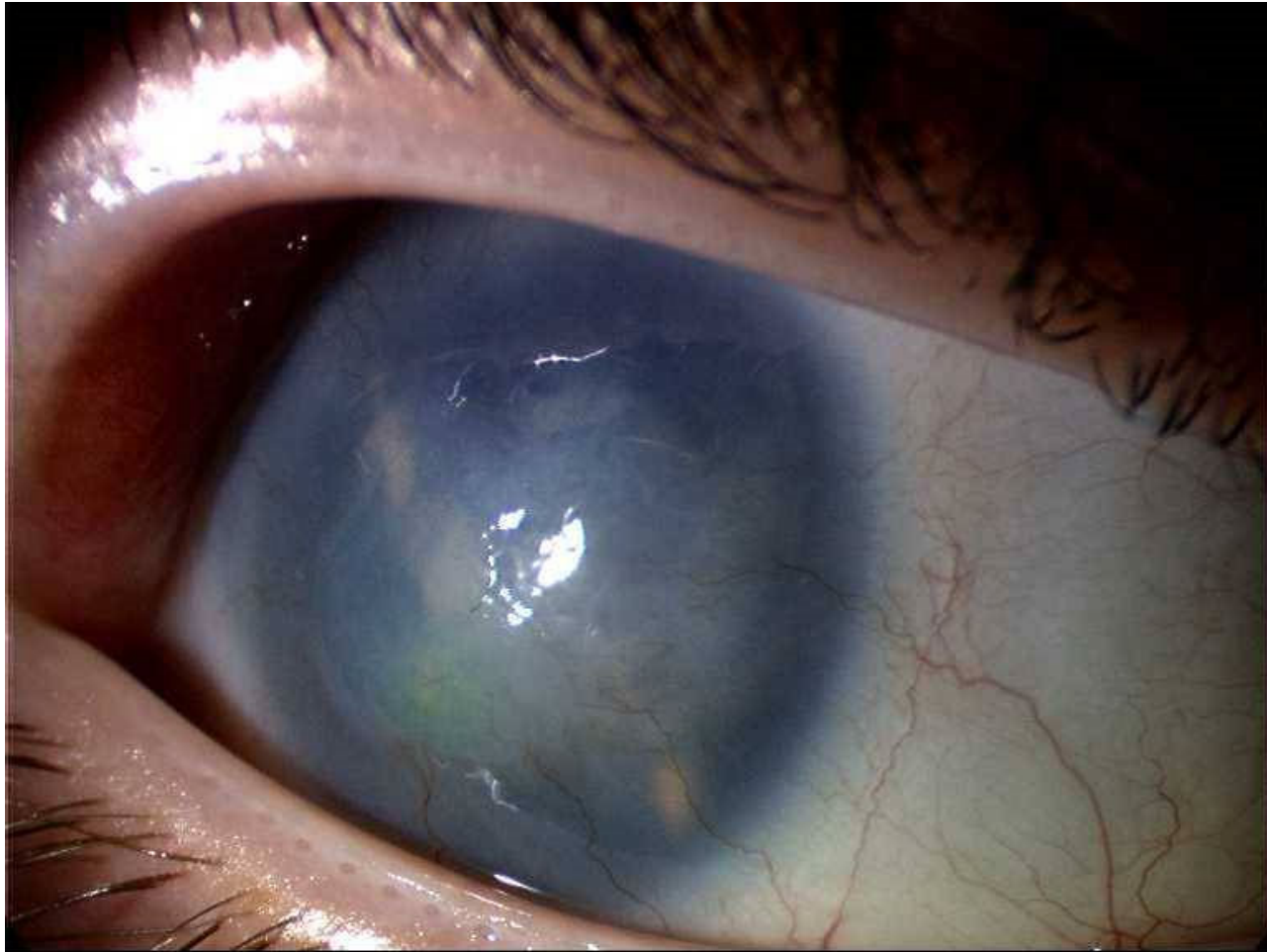


[Br J Ophthalmol. 2002 Mar; 86\(3\): 350–351](#)

## SIGNAL WORDS IN RELATION TO EYES (DERMAL TOXICITY)

<u>Signal Word</u>	<u>Eye Effects</u>	<u>What it means</u>
<b>danger</b>	Corrosive corneal opacity not reversible	Corrosive-permanent or severe eye damage
<b>warning</b>	Corneal opacity: reversible within 7 days; irritation persisting for 7 days	Moderate eye damage
<b>caution</b>	No corneal opacity: no irritation, or reversible within 7 days	None to mild eye irritation

# What is corneal opacity?



# Applicator Safety and Eye Injury

Formulation	Signal word	Eye Injury
Amine (Garlon 3A)	Danger	Corrosive-causes irreversible eye damage

## To “See” the issue clearly...

- So, the new four that was designed to replace the old three is safer on the eyes than the old three but not as safe as the old four, and the new one near three has the same eye issues as the old three except now you can use it like the old four but it is not as safe as the old four...

# Triclopyr Required PPE by Formulation

- Long-sleeved shirt, long pants, shoes, socks, chemical resistant gloves
  - Garlon 4, Pathfinder II
- Long-sleeved shirt, long pants, shoes, socks, chemical resistant gloves, protective eyewear
  - Garlon 3A
- Long-sleeved shirt, long pants, shoes, socks, waterproof gloves, protective eyewear
  - Trycera, Vastlan



# Triclopyr Site Use Comparison

Formulation	Non-crop				
Amine (Garlon 3A)	Yes				
Ester (Garlon 4)	Yes				
Ester RTU (Pathfinder II)	Yes				
Acid (Trycera)	Yes				
Choline (Vastlan)	Yes				

# Foliar Treatment

Formulation	High Volume Foliar
Amine (Garlon 3A)	1-3%
Ester (Garlon 4)	0.5-1.5%
Ester RTU (Pathfinder II)	NO!
Acid (Trycera)	1-3%
Choline (Vastlan)	0.75-2.25%

Complete foliar coverage is critical





# What about surfactants for foliar treatment?

Formulation	Needed?
Amine (Garlon 3A)	YES
Ester (Garlon 4)	YES
Acid (Trycera)	YES (NIS)
Choline (Vastlan)	YES (NIS)



# Low volume Basal Bark Treatment (Use an oil carrier)

Rule of thumb: For stems less than 6 inches DBH for thin-barked species, less than 4 inches DBH for thick-barked species

Formulation	Basal bark
Ester (Garlon 4)	20-30%
Ester RTU (Pathfinder II)	100%
Acid (Trycera)	20.8-31.4%



# Points to consider for basal bark

- Many applicators reduce Garlon 4 concentration to 10% v/v when treating smaller stems
- In Florida, Trycera basal bark treatment can be done at 10% v/v by treating a higher treatment band (~18 inches) at a higher application volume (very thoroughly spray to wet)
  - This increases your oil carrier use but can reduce total herbicide applied compared to Garlon 4 @ 20% v/v
  - This really needs verification across the US

# Oil Carriers (Is there a best one?)

✓ ~~Diesel~~

✓ ~~Kerosene~~

✓ Bark oils

✓ Mineral oil

✓ Vegetable oil

✓ Crop oil?

# Basal bark treatment in standing water: Can you do it?

- Garlon 4

It is permissible to treat non-irrigation ditch banks, seasonally dry wetlands (such as flood plains, deltas, marshes, swamps, or bogs) and transitional areas between upland and lowland sites where surface water is not present except in isolated pockets due to uneven or unlevel conditions. Do not apply to open water (such as lakes, reservoirs, rivers, streams, creeks, salt water bays, or estuaries).

- Trycera

- Has an aquatic label
- Impel Red Basal oil and some other basal oils are labeled for aquatic use
- Operationally, this allows crews to keep treating when water is up
- CAVEAT! Be careful with this. Stewardship is critical!

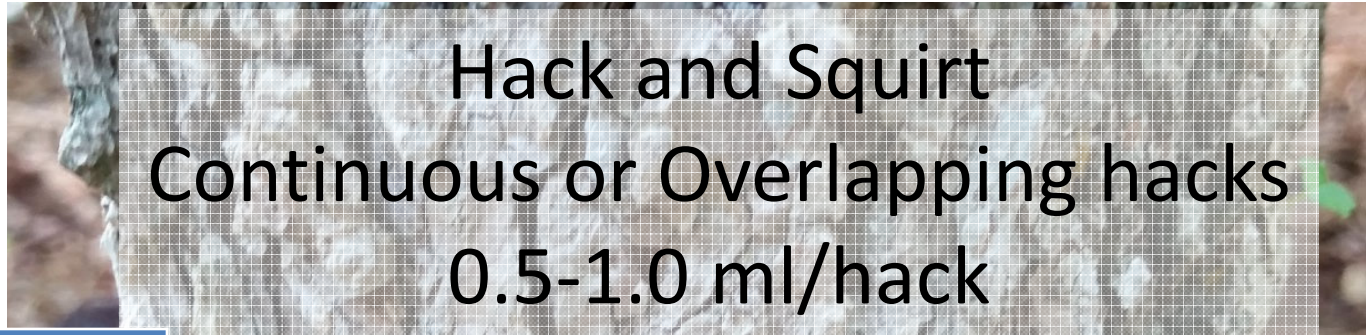


# Cut Stump Treatment

Formulation	Cut Stump
Amine Garlon 3A	50-100%
Ester Garlon 4	20-30%
Ester RTU Pathfinder II	100%
Acid Trycera	100%
Choline Vastlan	100%







Formulation	Hack and squirt
Amine (Garlon 3A)	50-100%
Ester (Garlon 4)	No
Ester RTU (Pathfinder II)	No
Acid (Trycera)	50-100%
Choline (Vastlan)	50-100%



## For non-crop sites...

- Max label rate per acre is:
  - Garlon 3A = 9 lb ae/A = 3 gal/A
  - Garlon 4 = 8 lb ae/A = 2 gal/A
  - Vastlan = 9 lb ae/A = 2.25 gal/A
  - Trycera = 9 lb ae/A = 3.15 gal/A

So now the new four has a different use pattern than the old four, and the new one near three can be used like both the old four and the old three and can be applied at a lower concentration and a higher rate per acre when using it like the old four for basal bark treatment...



# Triclopyr formulation non-target issues

- Volatility for ester (Garlon 4) formulation
  - >85F
- Soil residual activity and tree injury?
  - High concentration
  - High application volume
  - Dense shrub canopies
  - Shallow, overlapping roots
- Grass injury when doing basal bark method
  - “Basal ring of death”
- Some monocot injury observed with Trycera
  - Sawgrass (*Cladium jamaicense*)

# Summary

- The new formulations bring more options to the table
- Vastlan bring increased worker safety, higher concentration, reduced product volume needed, aquatic label
  - Limited verification of efficacy but the label has a few more species
- Trycera bring increased flexibility (one product for all application methods)
  - Eye injury issue is real
  - Limited verification of efficacy but the label has a few more species
  - DO NOT ignore stewardship when working in or around water simply because it has an aquatic label
- Triclopyr ester and amine formulations are still useful

# Summary

- The new four can be used in water but cannot mixed with oil
- The new one near three can be used in water and can also be mixed with water or oil



# Summary



**ONE DOES NOT SIMPLY SPEAK OF TRICLOPYR**

**WITHOUT CLARIFYING THE FORMULATION**



# Questions?

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