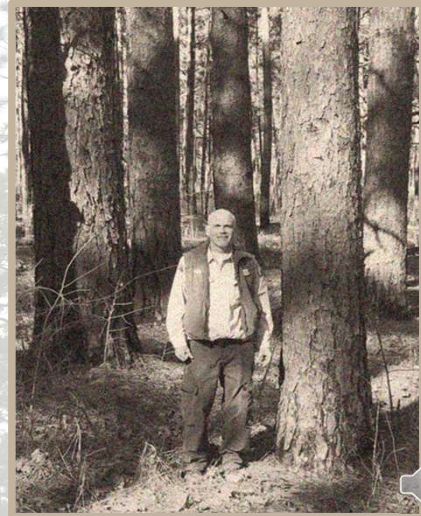


Herbicides in Forestry : Part 1

Factors That Influence Herbicides Effectiveness

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Herbicides in Forestry

- Plant physiology, bio-chemistry, agronomy, applied research, environmental conditions, plant identification, safety, certification, licensing.....
- There's a lot to know
- And they are not created equal

2

Terminology for Herbicide Characteristics

- **Activity --Foliar or Soil**
 - Herbicides with both are most effective
 - Soil active can be persistent
- **Pre- Emergent or Post emergent**



3

Terminology for Herbicide Characteristics

- **Persistence**
 - What's a half life?
 - What degrades it?
 - How will desirables be impacted?
- **Selectivity**
 - Target some plants but no effect on others
 - What plant(s) does the herbicide target?
 - Is your crop tree on the list?



4

Herbicides are prepared and sold as

Liquids

SL – Soluble Concentrate
SC – Suspension Concentrate
EC – Emulsifiable Concentrate
ME - Microemulsion
OD - Oil Dispersion
CS – Microencapsulated
Particles

Dry Materials

GR - granules & pellets
WDG – water dispersible granules
WP - wettable powders
SP - soluble powders



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Herbicide Formulations

Salts vs Ester

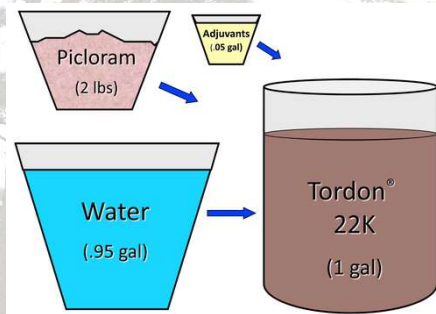
- Salts are water soluble
- Salts require a surfactant
- Esters are volatile
- Esters penetrate woody tissue



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Herbicide Formulations

- Chemical compounds that carry the active ingredient into the plant
- Active ingredient cleaves off inside the plant



Specialty Herbicide

©Trademark of Dow AgroSciences LLC

For control of susceptible broadleaf weeds, woody plants and vines on rangeland and permanent grass pastures, fallow cropland, Conservation Reserve Program (CRP) acres, non-crop areas including forest planting sites, industrial manufacturing sites, rights-of-way such as electrical power lines, communication lines, pipelines, roadsides, railroads, and wildlife openings in forest and non-crop areas

Active Ingredient:	picloram: 4-amino-3,5,6-trichloropicolinic acid, potassium salt	24.4%
Other Ingredients		75.6%
Total Ingredients		100.0%

Acid Equivalent
 picloram: 4-amino-3,5,6-trichloropicolinic acid • 21.1% • 2 lb/gal
 EPA Reg. No. 62719-6

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Active Ingredient	Trade Name	Pre-emergent	Post-emergent	Selective	Non-selective	Limited mobility	Xylem Trans-located	Phloem Trans-located	Persistent	Non-Persistent
Glyphosate	Accord		x		x			x		x
Triclopyr	Garlon		x	x				x		x
2,4-D			x	x				x		x
Hexazinone	Velpar	x	x		x		x	x	x	
Imazapyr	Arsenal	x	x		x		x	x	x	
Metsulfuron	Escort	x	x	x			x	x	x	
Clopyralid	Transline	x	x	x			x	x	x	
Sulfometuron	Oust	x	x	x	x		x	x	x	
Picloram	Tordon	x	x	x			x	x	x	
Fosamine	Krenite		x	x		x				x

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Factors that Influence Herbicide Effectiveness

- Stage of growth of plants
- Leaf shape and texture
- Soil – texture, pH
- Plant species (resistant vs. susceptible)



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Factors that Influence Herbicide Effectiveness

- Temperature
- Drought
- Soil Moisture
- Rainfall after application
- Light

- Tank mixes
 - antagonistic
 - synergistic
- Water quality



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The Herbicide Spray Mix

Active Ingredient (formulated as a Salt or an Ester)
plus a **Carrier** – usually water
plus an **Adjuvant(s)**



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What are Adjuvants???

Adjuvants alleviate or manage factors that limit spray performance.

- Water quality
- Spray droplet size
- Droplet bounce & run-off
- Rainfastness
- Penetration
- Spread

4000 products in US.....Largely not regulated



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What are Adjuvants???

Materials added to spray mixtures to:

- enhance performance
- improve application efficiency

For example:

- Increase deposition
- Enhance uptake
- Resist wash-off
- Minimize evaporation
- Drift reduction
- Fix application or mixing problems

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Adjuvants that Enhance Performance

Surfactants---chemicals that modify the surface properties of materials they contact and influence the wetting or spreading of the liquids.

Crop oils --- petroleum or vegetable oil based product usually 2% emulsifier and 98% oil added for dissolving waxy surfaces.

Crop oil concentrates---petroleum or vegetable oil based usually 15-20% emulsifier and 80-85% oil

Penetrants--- enhance a liquid's ability to enter pores or penetrate a surface

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Adjuvants that Improve Delivery

Emulsifiers- enable oils to be mixed in water.

Defoamers --- reduce surface tension of bubbles.

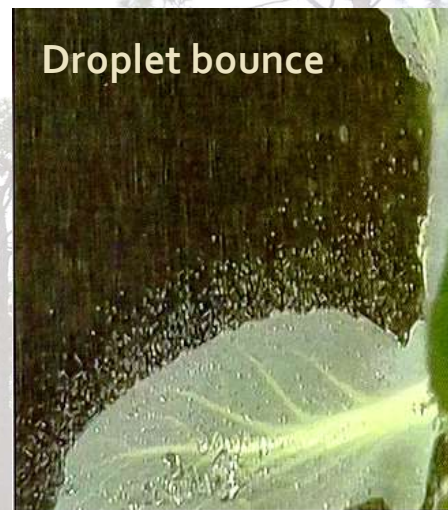
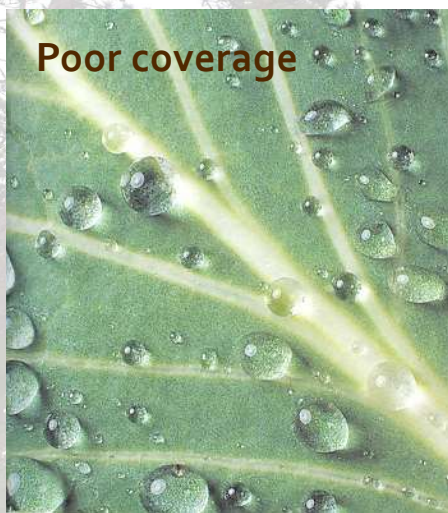
Buffers --- reduce pH of alkaline waters..

Drift Control Agents- reduce spray drift



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Nothing covers more poorly than water
With water we get this



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Wetting agents *reduce surface tension* increasing droplet spread and uptake



Herbicide in water



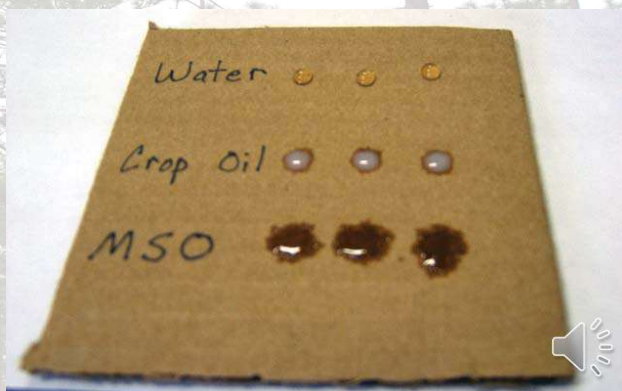
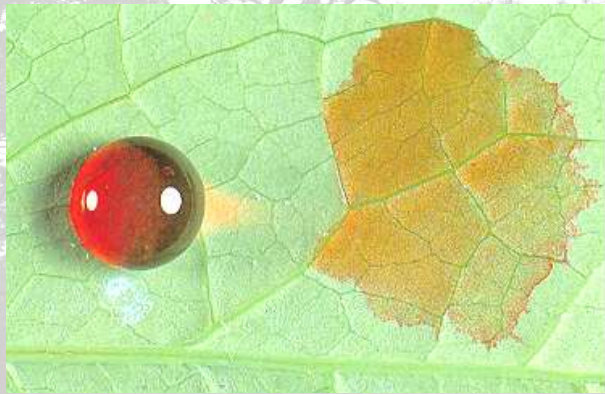
Herbicide in water
plus surfactant



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Surfactants.....

Increase **spread on leaf** improving absorption
Increase **deposition efficiency** on leaf surface



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Common products

Surfactants

- **Non-ionic surfactant (NIS)**
- **Silicone** containing silicone

Oils

- **Seed oils**, esterified free fatty acids from plant cotton, soybean, or canola
- **Crop oils**, paraffin derived from mineral oil
- **Basal oils**, mixed mineral oils containing paraffin, aromatic and naphthelene
- **Tallow amine**, free fatty acids from animal fat



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Non-ionic Surfactants (NIS)

- Increases wetting and spreading
- Makes water imitate oil
- Improves coverage
- **Treats the Water not the Surface**



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Free Fatty Acids – MSO , Crop Seed Oils, Petroleum Oils

- Sticking- less wash-off due to rain
- Enhances deposition
- Reduces droplet evaporation
- Increases Penetration
- **Treats the surface – not the water**



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OrganoSilicanes

- Maximum wetting and spreading
- Reduced bounce
- Increased evaporation reduces deposit and absorption



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Common forestry products without surfactants

Common Name	Trade Names
glyphosate	Accord® XRT
imazapyr	Arsenal® AC Polaris®
metsulfuron methyl	Escort® XP® Patriot®
sulfometuron methyl	Oust® XP® Spyder®

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Droplet Size Effects Spray Drift

Droplet Diameter(microns)	Type of Droplet	Time to fall 10 feet in still air	Travel distance w/ 3mph breeze
5	Fog	66 minutes	3 miles
100	Mist	10 seconds	409 feet
500	Light Rain	1½ seconds	7 feet
1000	Moderate Rain	1 second	4.7 feet

From *Weed Science: Principles and Practices*, G.C. Klingman



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Droplet size can be reduced by:

- Decreasing airspeed
- Decreasing spray pressure
- Reducing shear to the nozzles by directing backwards
- Using special atomizers(nozzles) that provide less breakup

- **Adding Polymer Adjuvants**
 - increase viscosity, make droplets larger, less prone to drift.
Used for water-based spray.

Note: Excessive amounts of surfactant increase drift potential



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Herbicides work selectively

- It is as important to know what the chemical you choose doesn't kill as what it does!

- Whatever you do not killyou release



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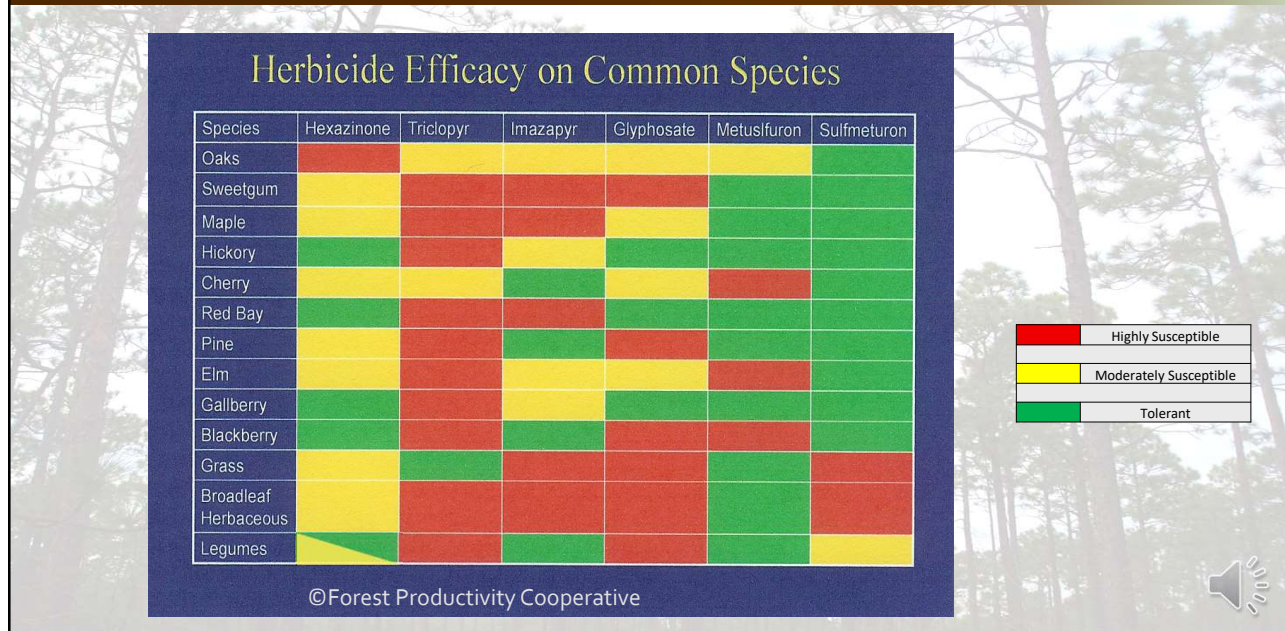
27

Right Herbicide + Timing + Rate = Success!

Two side-by-side photographs showing the results of herbicide application. The left photo shows a field with sparse green weeds on a cleared, debris-covered ground. The right photo shows a field with dense, tall, brown, dead vegetation. The text "Right Herbicide + Timing + Rate = Success!" is displayed in white on a dark brown background above the photos. The image is framed by a light gray border with a faint tree pattern.

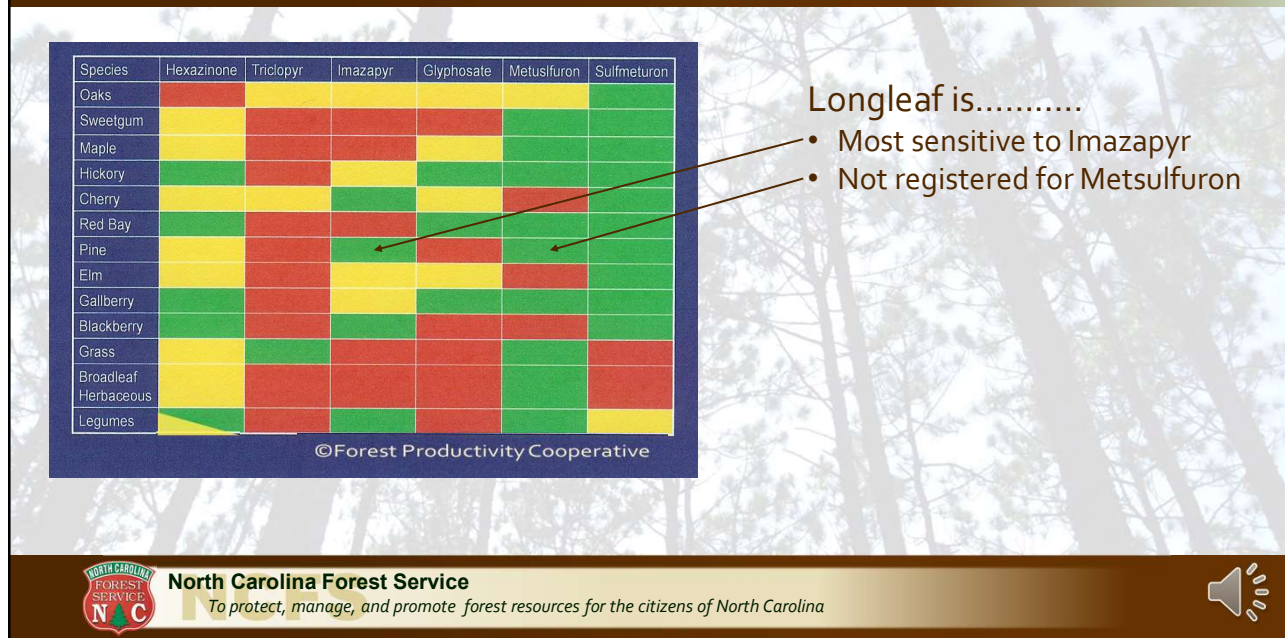
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Right Herbicide + Timing + Rate



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Cautionary Note for Longleaf!



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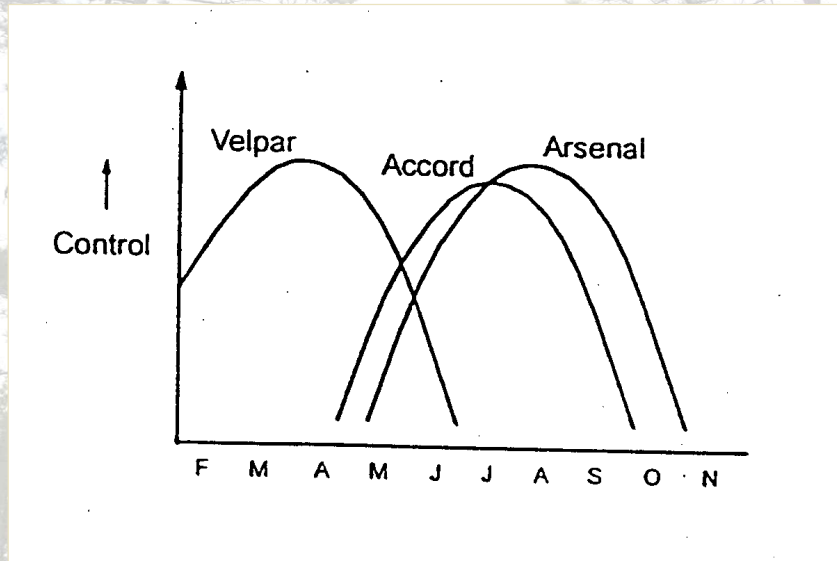


North Carolina Forest Service

To protect, manage, and promote forest resources for the citizens of North Carolina

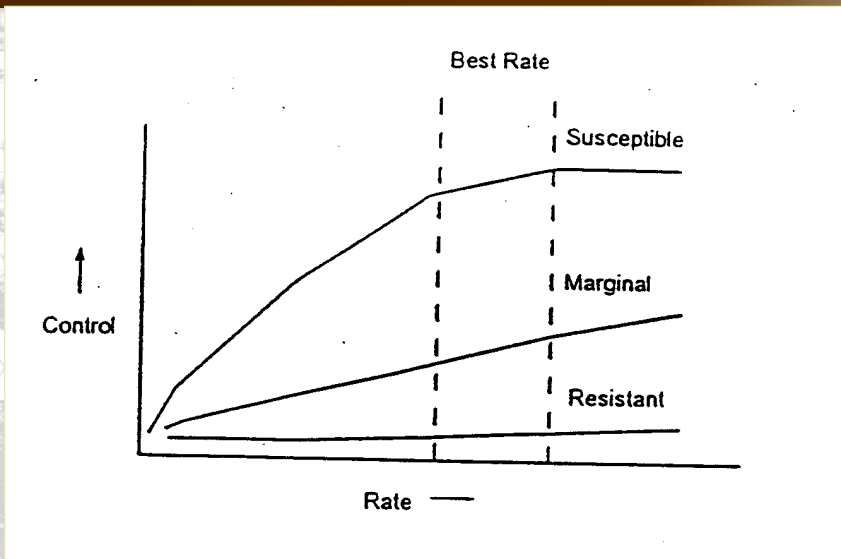


Right Herbicide + Timing + Rate

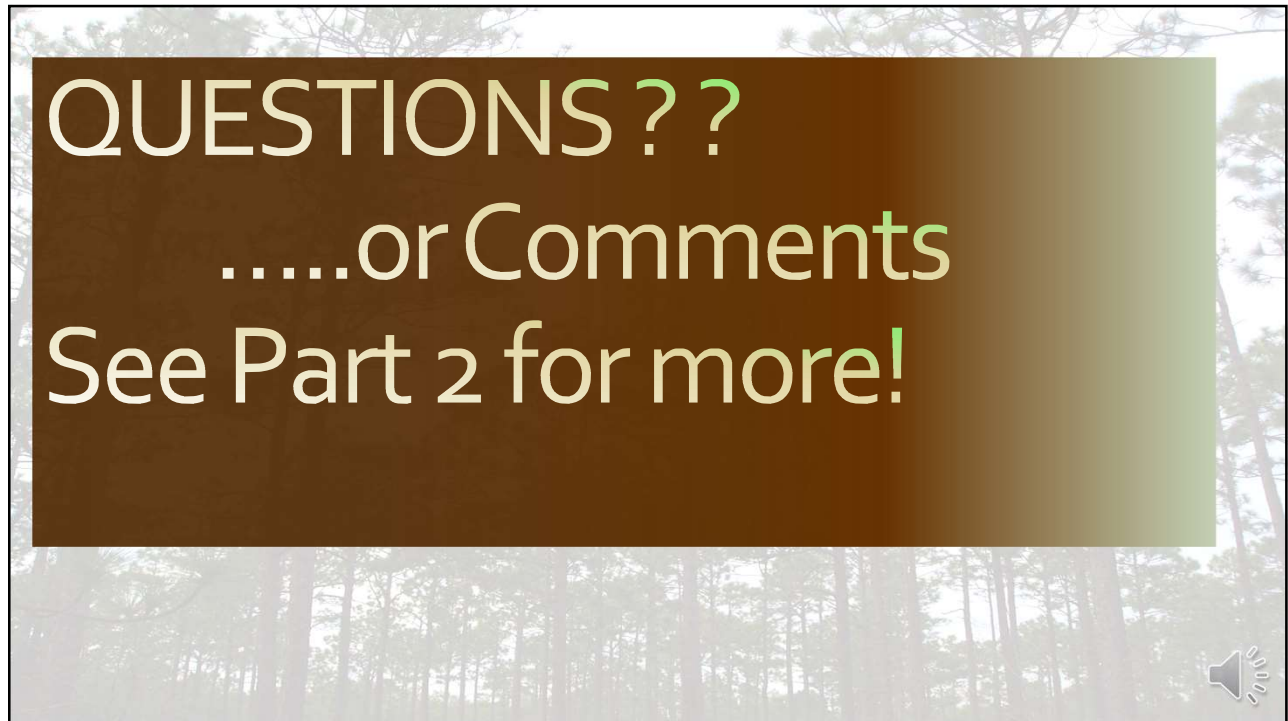


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Right Herbicide + Timing + Rate



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QUESTIONS??
.....or Comments
See Part 2 for more!