

Diagnosing Long- and Short-Term Effects of Herbicides on Landscape Plants

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Abiotic or Biotic?

Abiotic – Non-living - Uniform:

Short-term and/or Long-term Diagnosis?

- More intense – initial injury but not spreading (generally)

Long-term

- Effecting roots or 2ndary growth and or plant systems
- Persisting in the soil or the plant
= carry-over

Long-term Effects

- Disrupted acclimation and/or de-acclimation
- Reduced cold hardiness
- Tissue weakening
- Loss of tissue integrity
- Increased susceptible to mechanical injury
- Reduced nutrient uptake
- Increased incidence of decay
- Stunted roots
- Impeded vascular transport



Preemergence:

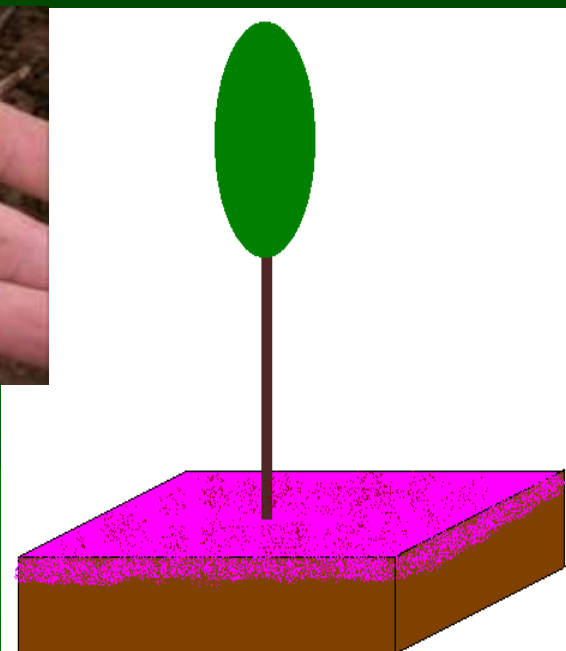
- Before emergence
- Soil-active
- Activity affected by soil conditions and envir.
- Do not kill dormant or germinated
- Incorporate = barrier

Postemergence:

- Plant-active
- Contact and systemic

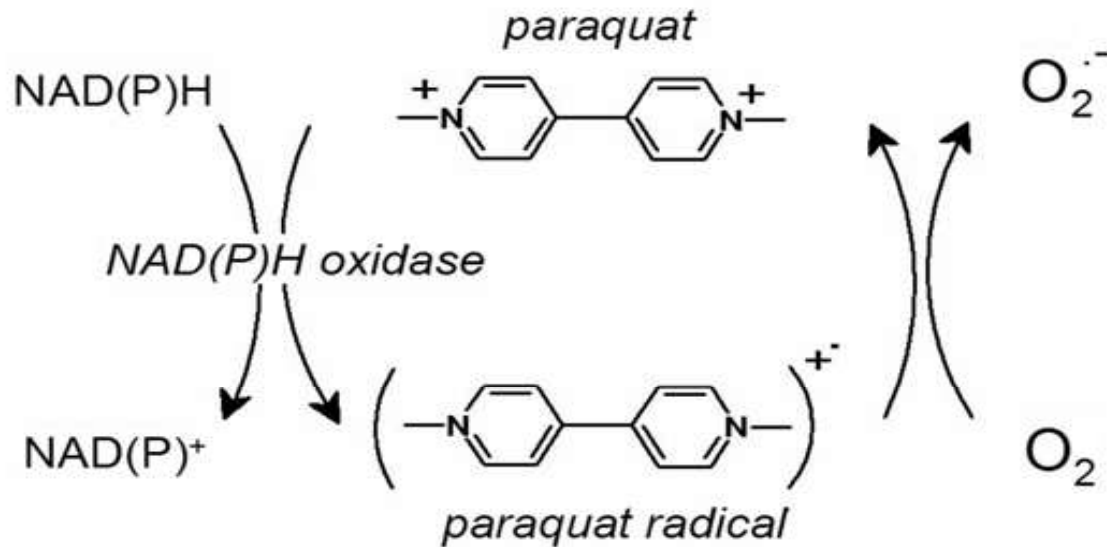


1" germ



Herbicide MOA?

Similar patterns or plant injury symptoms – occur



**Generating
free radicals**



**WSSA - 22
(PS1 inh.)**

Mode of Action (MoA)

Sequence of events from:

1. Absorption into plant
2. Translocation in plant
3. Action of the herbicide
4. Plant death



Untreated



Roundup

Pokeweed Root

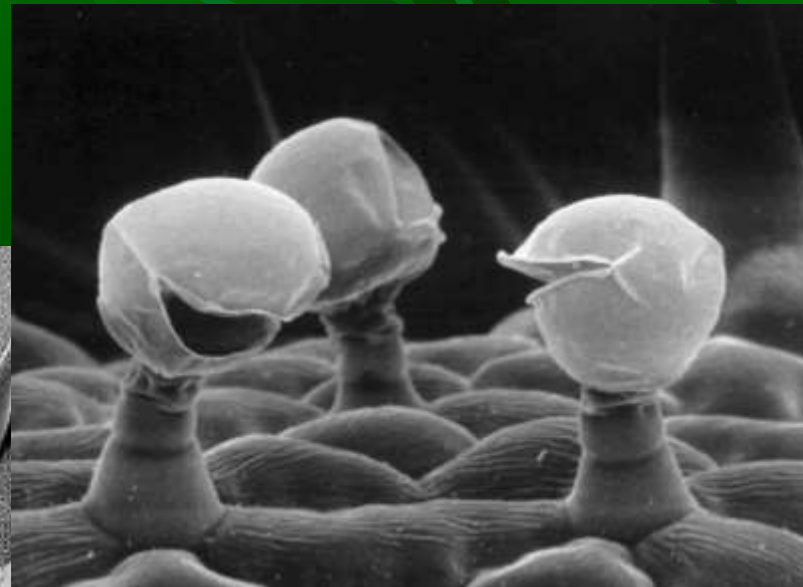
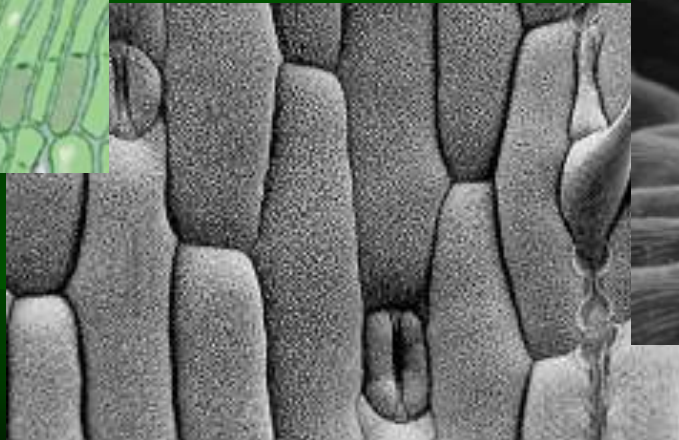
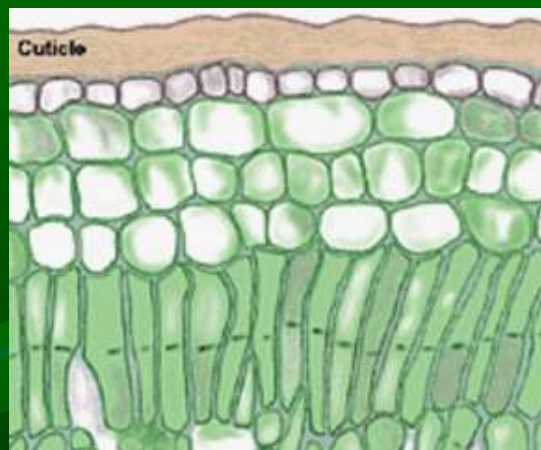
Postemergence Herbicides - Contact or Retention (foliar)

Factors – influence rate and amount of uptake

Leaf hairs and surface waxes

Weather (heat, drought, rain, humidity)

Adjuvants (surfactants, crop oil concentrates)



Mitosis Inhibitors - MoA

Root inhibitors

Dinitroaniline



Group 3

Barricade 65WG
Pendulum 2G,
Pendulum 3.3 EC
Pendulum Aqua Cap
Prowl H₂O 3.8 CS
Pre-M 60DG
Corral
Surflan AS T/O
Treflan EC
Treflan QR5
OH II
Rout
Snapshot 2.5TG
Dimension

Prodiamine
Pendimethalin
Pendimethalin
Pendimethalin
Pendimethalin
Pendimethalin
Pendimethalin
Pendimethalin
Oryzalin
Trifluralin
Trifluralin
Oxyfluorfen + Pendimethalin
Oryzalin + Oxyfluorfen
Isoxaben + Trifluralin
Dithiopyr

Pyridine

Benzoic acid

Dacthal

DCPA



**Agastache
– Pendulum 2X**



**Callus
proliferation –
faulty cell walls**

Genera sensitivity and concentration – long term?

4X

2/8/2016



Mitosis Inhibitors - MoA

Shoot inhibitors (inhibits VLCFAs):

Chloroacetanilide

Group 15

Pennant Magnum

Tower

FreeHand

Kerb 3.3 SC

Kerb 50 W

Devrinol 50DF

Devrinol 10G

Metolachlor

Dimethamid -p

Dimethamid-p + pendimethalin

Pronamide

Pronamide

Acetamide

Group 15

Napropamide

Napropamide

Freehand – Echinacea – BFN, 2012

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



PPO Inhibitors (Group 14)

Diphenylether

Goal 2XL

Goal Tender

OH II

Rout

Biathalon

Oxyfluorfen

Oxyfluorfen

Oxyfluorfen+pendimethalin

Oryzalin + Oxyfluororen

Oxyfluorfen + prodiamine

Oxadiazole

Ronstar 50 WSP

Oxadiazon

N-phenylphthalimide

BroadStar G

SureGuard WDG

Flumioxazin

Flumioxazin

Triazolinone

F6875, Echelon

Sulfentrazone + prodiamine

Broadleaves

Goal volatilized in poly-house



Precursor of
Chlorophyll
and heme –
rapid tissue
destruction

SureGuard - Magnolia



SureGuard - Spirea



PPO Inhibitors

**Crinkling and
malformation**

Liriope - BroadStar



Cellulose Inhibitors (Group 20 & 21)

The logo for 'Broadleaves' is located in the top right corner. It features the word 'Broadleaves' in a stylized, outlined font with a blue-to-white gradient. Below the text is a reflection of the word. The background of the entire slide is a dark green with a pattern of lighter green, stylized leaf shapes.

Benzamide
Group 21

Gallery 75 DF
Snapshot 2.5 TG

Isoxaben
Isoxaben + trifluralin

Nitrile
Group 20

Casoron 4G

Dichlobenil

Alkylazine
Group 29

Alion -Orchard
Specticle -Landscape
Marengo G -Nursery

Indaziflam

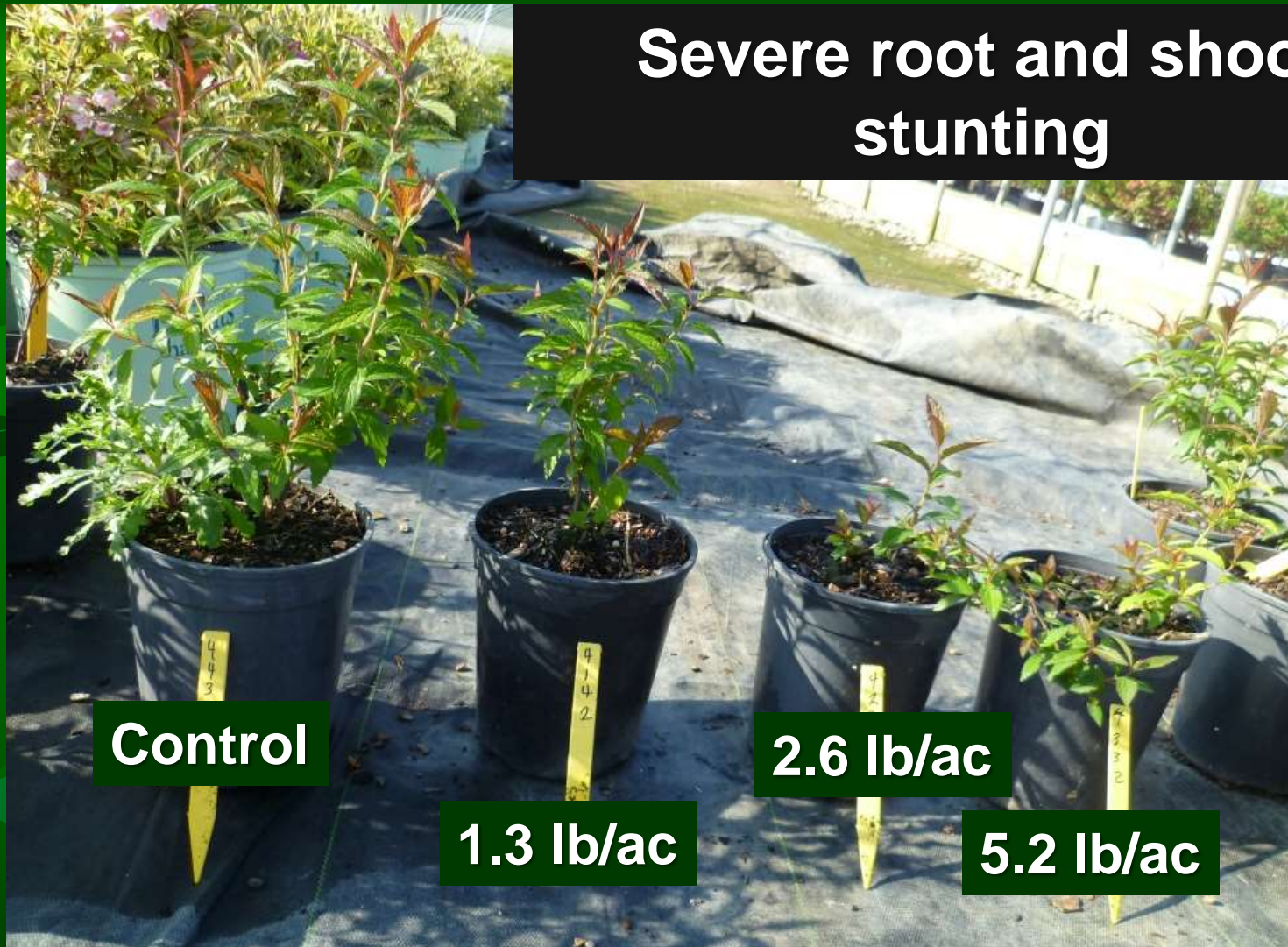
- Chlorosis or leaf discoloration - randomly on the leaf
- Parts of the leaf remain green - others parts chlorotic

Buddleia - Gallery

Cellulose Inhibitors



Severe root and shoot stunting



Root absorbed Gallery (isoxaben) = to *Spirea japonica* 'Neon Flash'



WTF!

SHOCKING!



WELL CRAP



Selective Grass Postemergence:

- (young grasses only – no effect on sedges)

Group 1

- Acclaim- fenoxaprop-p
- Envoy- clethodim (most effective on Bermuda grass and tall fescue) (Only one for *Poa annua*)
- Fusilade TO- fluazifop-p-butyl (60% burn on river birch and burning bush)
- Segment (13%) (Poast 18%- need non-ionic)- sethoxydim

ACCase Inhibitors

Symptoms

- Grasses
- ✓ Gradual discoloration of whorl
- ✓ Chlorosis to necrosis
- ✓ Growing point separates



Selective Broadleaf Postemergence

ACCase promoters:

- Lontrel or stinger - clorpyralid (most effective on Asteraceae and leguminaceae – (thistles, groundsel, marestail, clovers) (over the top of Pw, **Ps**, Sn, Sw, Cw, *Taxus*) can be root absorbed – so no drench plant
- ✓ No docks, lambs quarters, smartweed
- Garlon - triclopyr

Canada Thistle – Lontrel application

March, 2015

– clean after 4 weeks



Selective Broadleaf Postemergence

ACCase promoters:

Synthetic Auxin – WSSA Group 4

Chemical Family

Example Herbicide:

Trade Name

1. Phenoxy-carboxylic acid

2,4-D

MCPA

2,4,5 T

2. Benozic acid

Dicamba

3. Pyridinecarboxylic acid

Lontrel

Tordon 22K

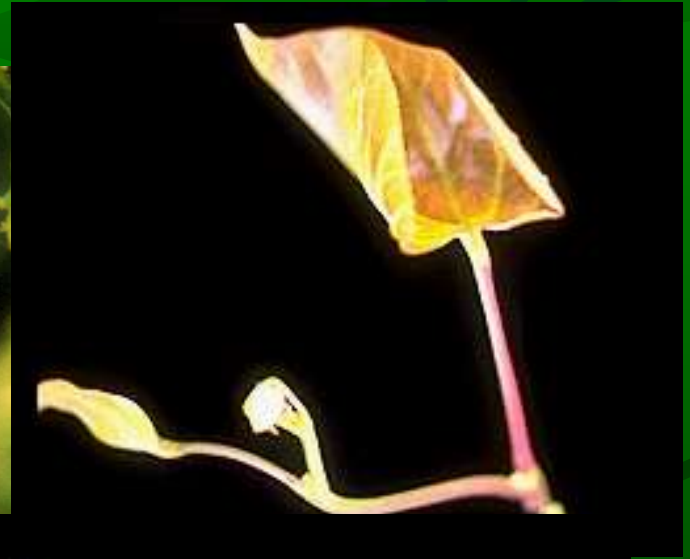
Garlon

4. Pyrimidinecarboxylic acid

Imprelis

Synthetic Auxins

Inhibition or damage caused: epinasty=downward twisting, abnormal leaf and stem growth, callus tissue formation, death



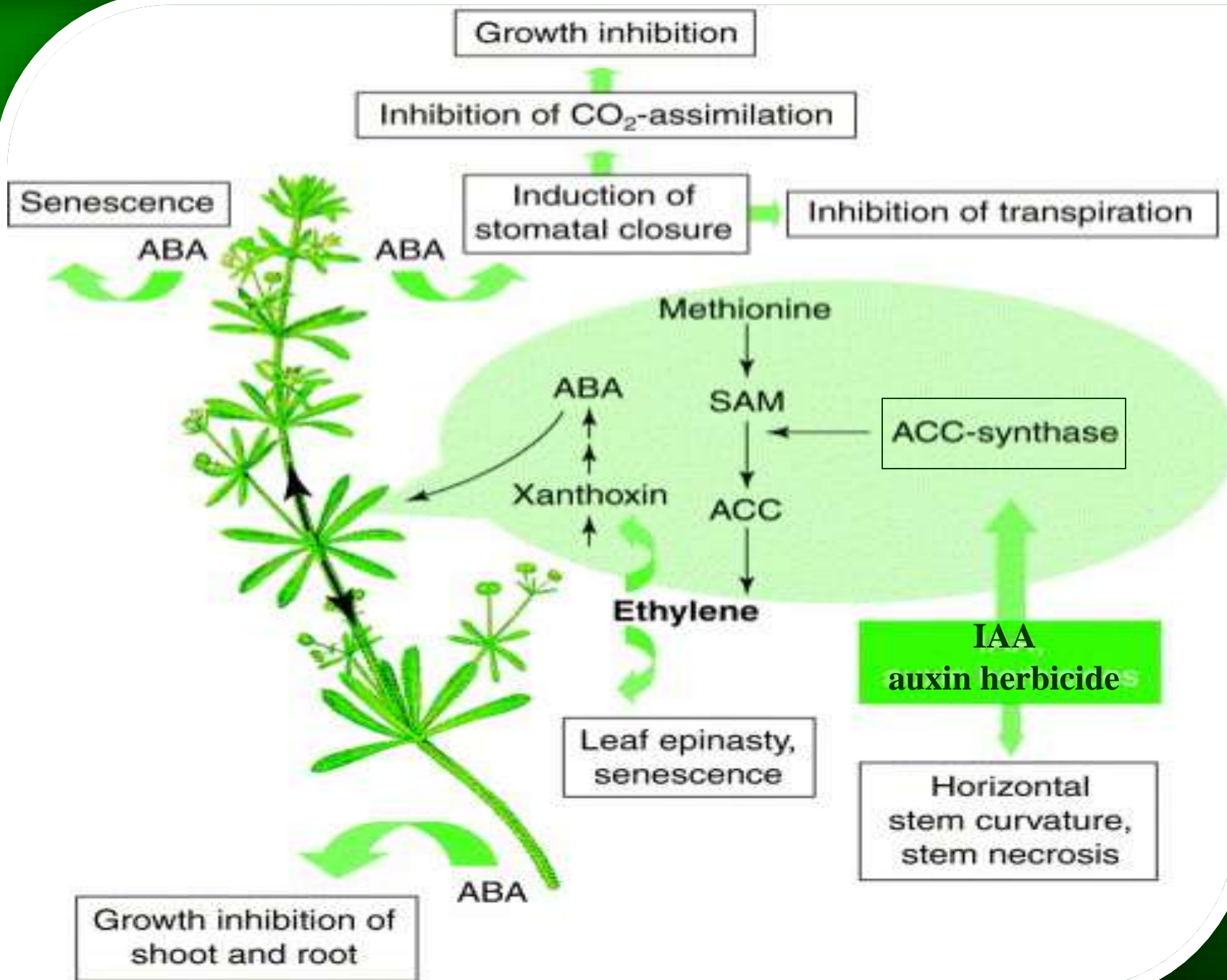


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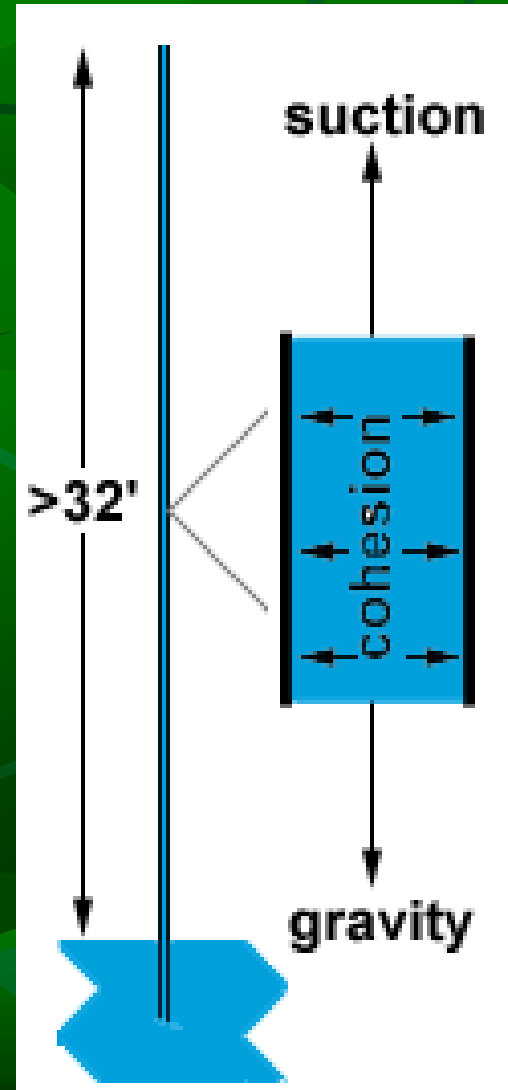




Cracked calluses appears along stems

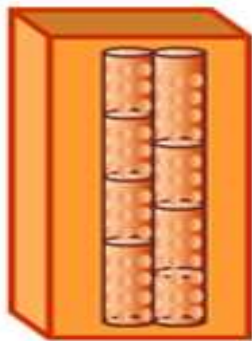
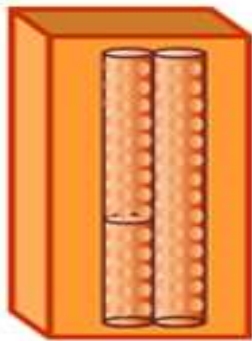


Transpiration

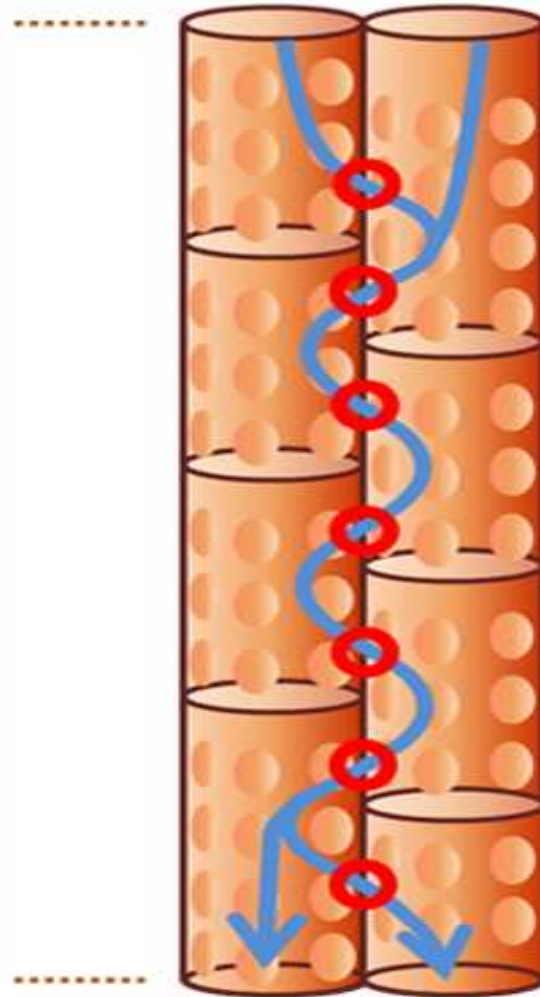
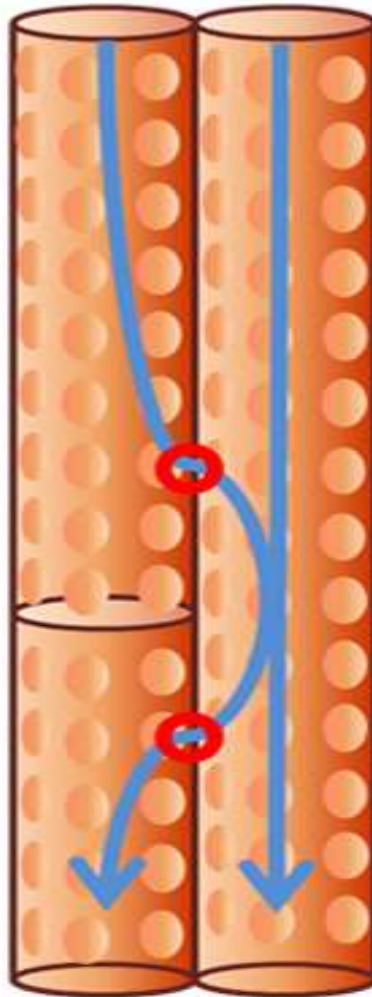


Angiosperm xylem vessels

Gymnosperm xylem tracheids

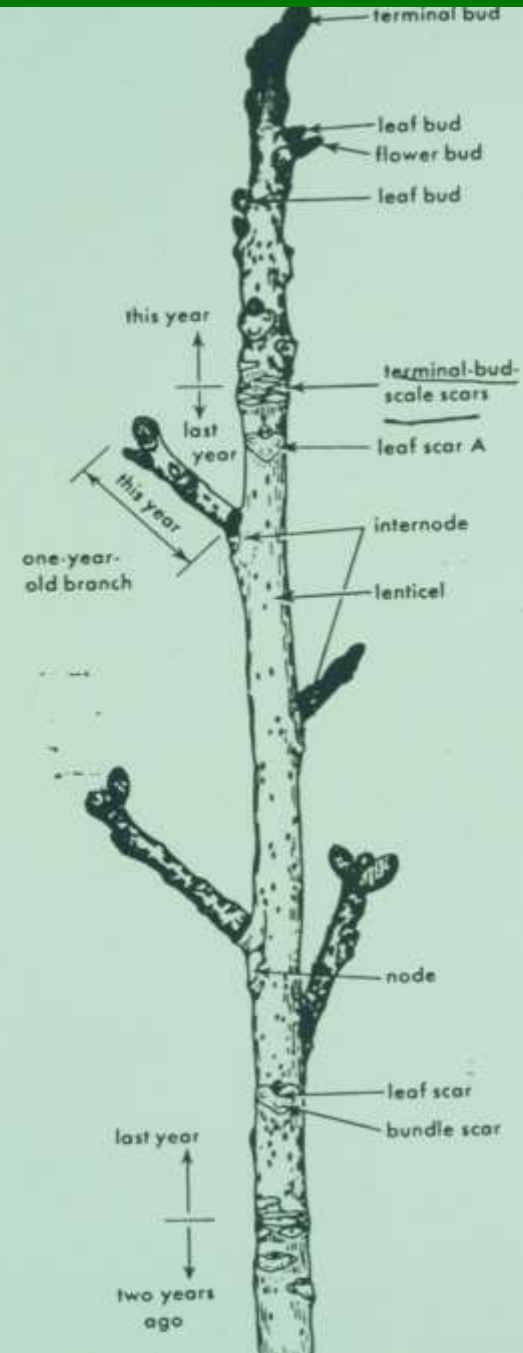


Water flow
Filtration points

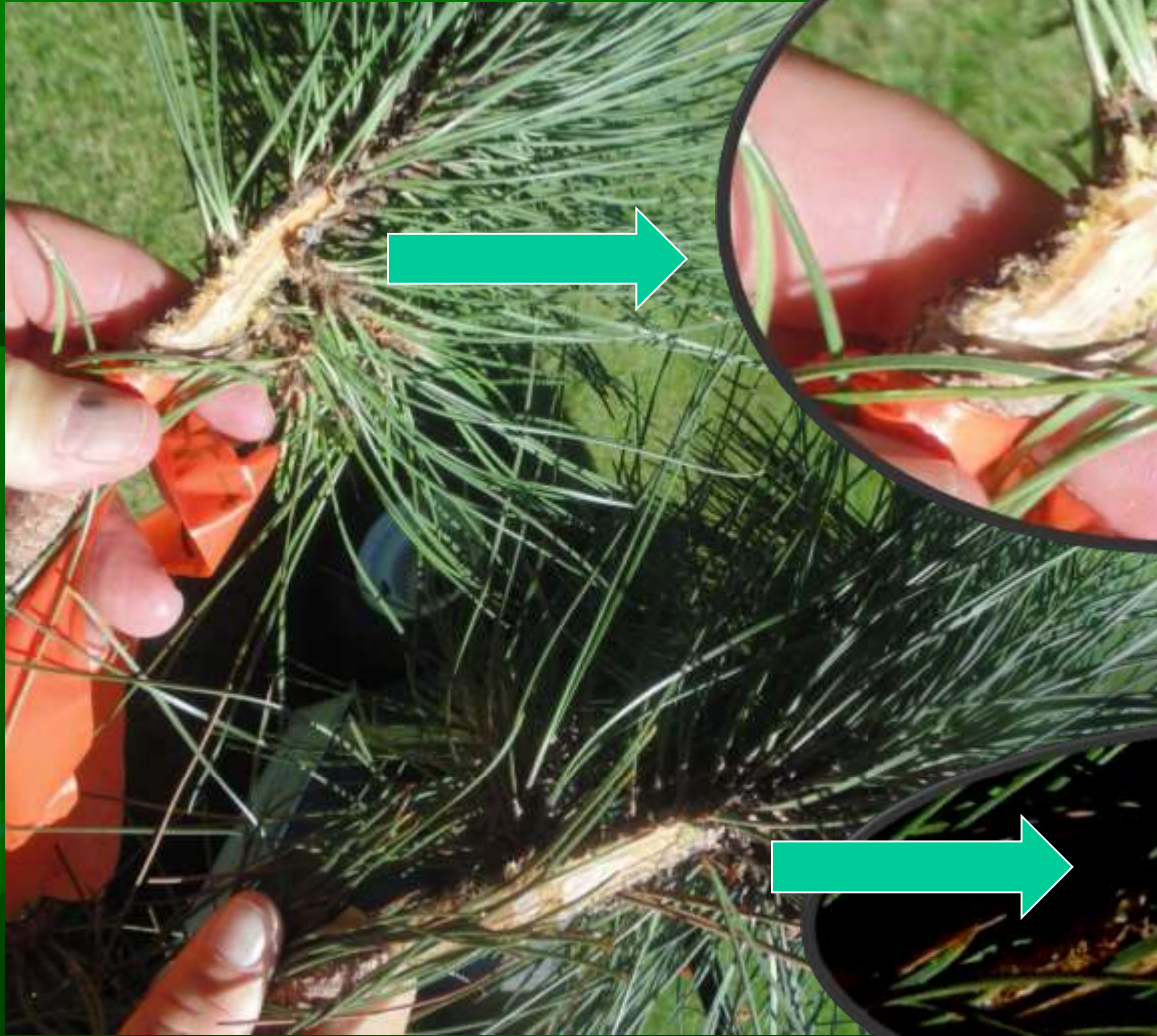


2 Types of Growth Roots & Shoots

1. Extension



Partial Cambial Death



2/8/2016

Bioassay Cucumber



Callus, brittle stems,
epinasty



Photosystem I inhibitors (Group 22)

- Rapid contact action
- Speckling from drift





**Bipyridyllims – Paraquat
desiccant**



2/8/2016

Paraquat Injury (Gramoxone)

Diquat - Reward

- Contact burn of foliage
- Brown leaf spots = drift
- Overall leaf death – if coverage is thorough
- Hot, humid days – symptoms = rapid
- Contact injury – not systemic = plants will outgrow foliage injury
- Sun to activate

Glutamine Synthesis Inhibitors (Group 10):

Massive accumulation of ammonia

= cell destruction

= reduces pH gradient across the membranes

= inhibits energy production and growth

Alligator-ing in bark:

Finale - glufosinate

Ignite

With atrazine = Liberty

Aristocrat pear

Photosystem II Inhibitors



Photosystem II Inhibitors



Never apply to foliage

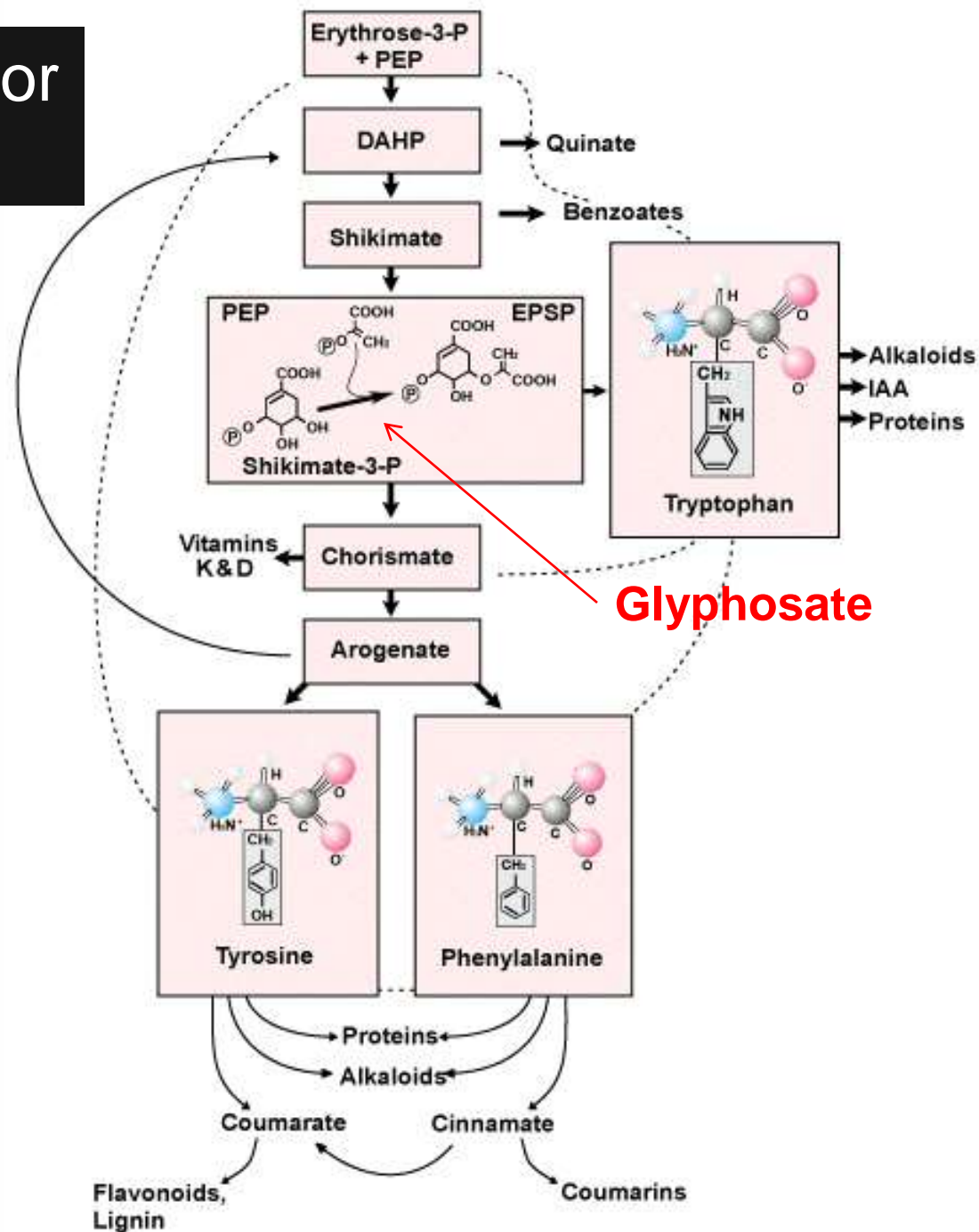


EPSP Synthase Inhibitor (Group 9):

Glyphosate

Potent inhibitor of
enzyme that
catalyzes the
reaction of PEP
and EPSP

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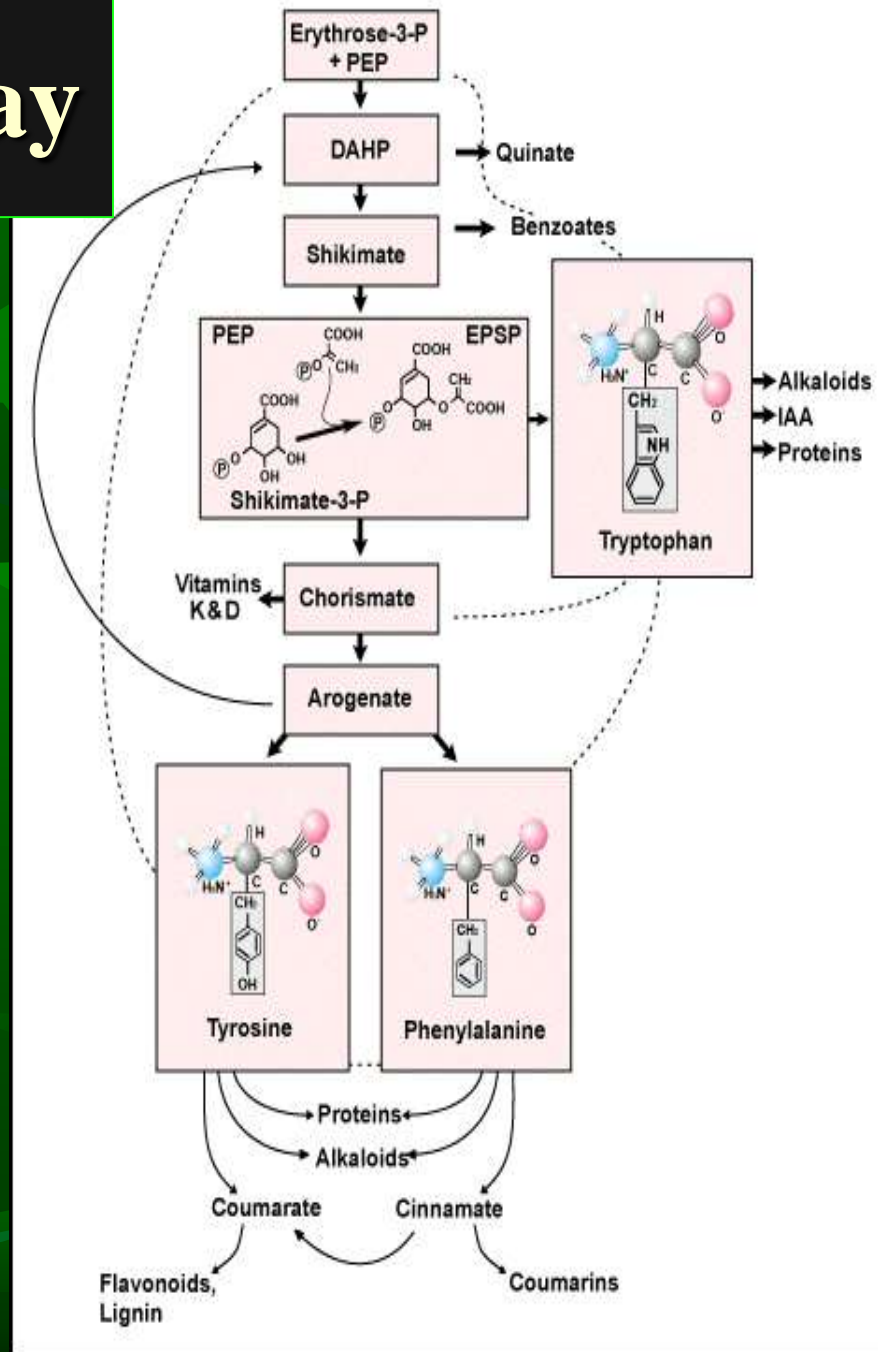


Shikimic acid pathway

- Link 1° and 2° metabolism (Carlisle & Trevors, 1988).

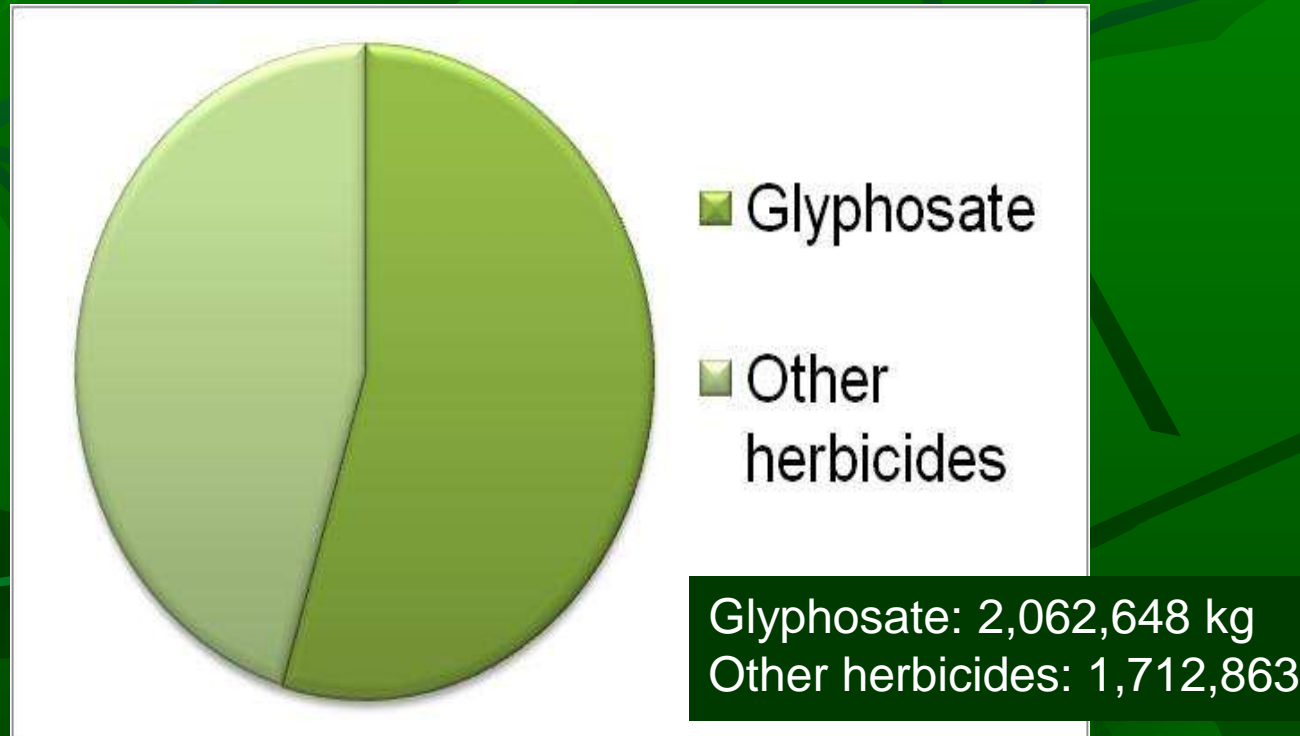
- Reduced:

- ✓ Phenolics
- ✓ Tannins
- ✓ Lignin
- ✓ Flavonoids
- ✓ IAA



Is Glyphosate Safe??

- Total Herbicide Use



Survey of pesticide use by OMAFRA, 2010
(McGee, Berges, Beaton)

- Formulations with more effective surfactants also more widely used

Is Glyphosate Safe??

- Active growth – (including **green bark**, (suckers)).



Susceptibility of genera, Dosage, Frequency of use and used according to label

Herbicide Entry



Green Bark?



Lenticels



Injuries

RED MAPLE

Glyphosate (carryover) damage



BORDER FORSYTHIA

Glyphosate (carryover) damage



- Abnormal leaf development

Crab Apple



Dose and Frequency

- Broken down quickly in soil
- Breaks down “very” slowly in the plant
- Remaining for years (Stasiak *et al.* 1991 and 1992)
- Giese, L. and H. Mathers. 2011. Visible injury one and two years after



Maple, OSU

Block Shikimic Acid Pathway

- Stasiak et al. (1991) *Prunus pensylvanica* and *Populus tremuloides* = ↑ **shikimic acid** after sublethal dose and visual injury **one and two years** after.
- Stasiak et al. (1992) - 2 yr. *Betula papyrifera* = ↑ **shikimic acid 10-fold at 0.5% X (2.1 kg/ha)**
= 1 yr. later – 2yr. still ↑ shikimic acid

Your Trees on Crack!



Effect of Postemergence Herbicide on Sucker Removal/Injury of Field Trees

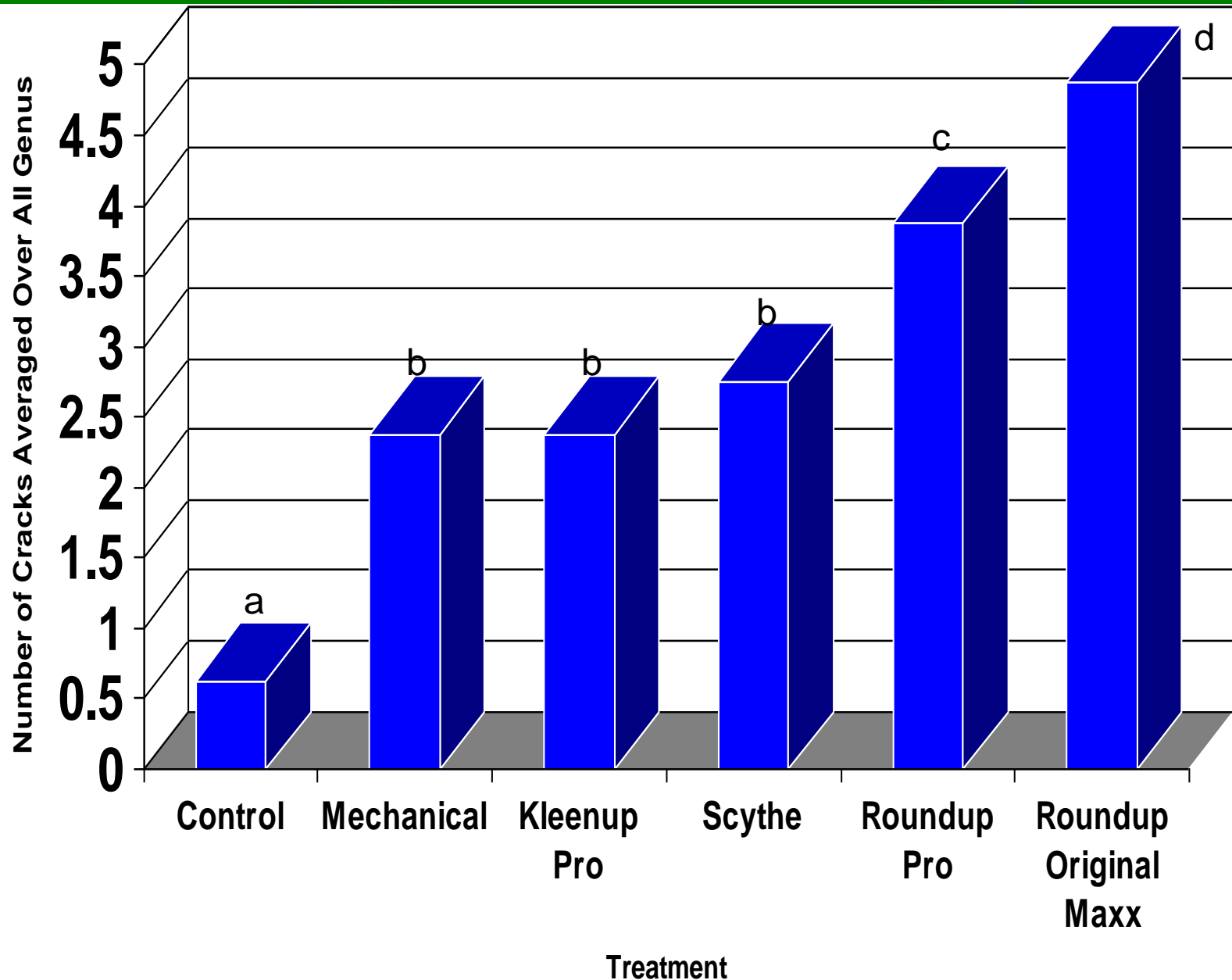
Objectives

- 1) Evaluate the effects of chemical with mechanical removal of suckers or similar injury in four tree species on the Northeast and Southwest sides.
- 2) Evaluate cold hardiness with regard to sucker removal/injury and postemergent herbicides.

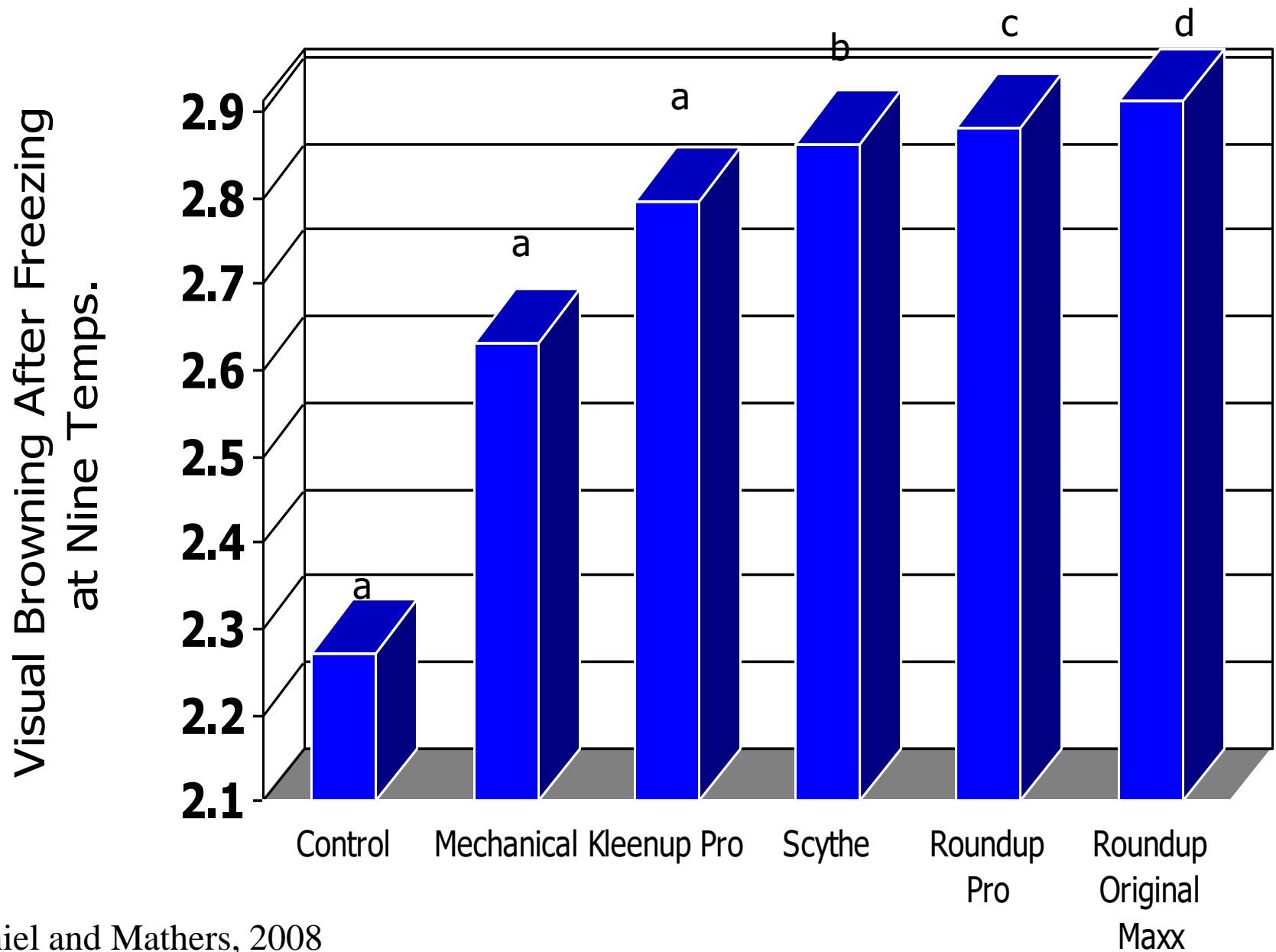


Kyle Daniel – PhD
candidate

Number of Cracks per Treatment Averaged over Genera



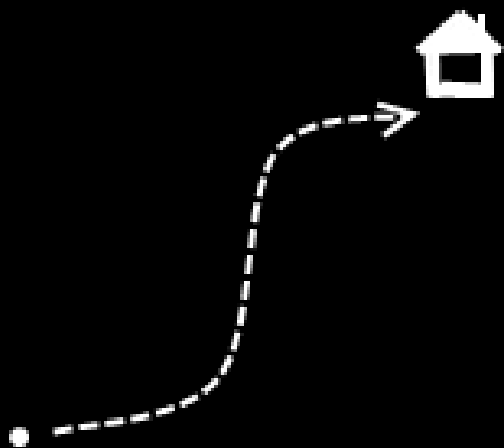
Over 4 genera, 9 Freeze Temps





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Take Home

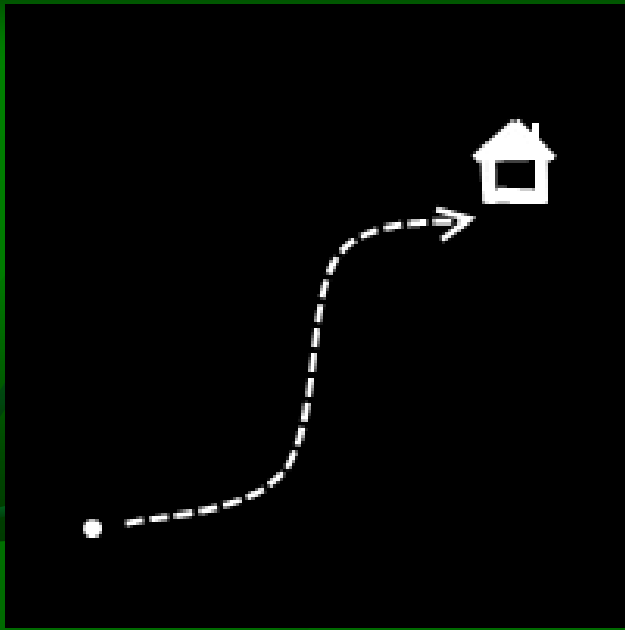


1. Shield - whenever using postemergence herbicide especially glyphosate around trees “always” use a spray shield or funnel guard!!!
2. Use proper sucker removal products!!

Sucker Removal

- Mechanical removal, however, has been shown to increase sprouting.
- Sprout inhibitors such as Tre-Hold® Sprout Inhibitor A-112, Tre-Hold® RTU or other formulations containing naphthalene acetic acid (NAA) inhibit the development of adventitious shoots
- ✓ Replaces the apical dominance of the tree.





Take Home

3. Preemergence herbicides should be relied upon - applied spring and fall
4. Limit all postemergence herbicides!!

Acknowledgements

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 2. Sunleaf Nurseries, LLP, Madison, OH
 3. Herman Losely & Son, Inc., Perry, OH
 4. Willoway Nurseries, Inc., Huron
 5. Willoway Nurseries, Inc. ,Avon, OH
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