

When good chemicals go bad: Imprelis and other herbicide disasters

Bert Cregg, Ph.D.

Michigan State University

Department of Horticulture

Department of Forestry



No bad dogs



No bad dogs



Used properly, herbicides serve critical functions in arboriculture and landscape management



But...

Sometimes things go awry



Case studies:

Tree damage by herbicides

- Unanticipated non-target impacts
 - Unknown
 - Known
- Deliberate
 - Treaty oak
 - Toomers oaks
- Dealing with tree herbicide poisoning
 - Prevention
 - Remediation



Case One: The Imprelis Saga



From: Jan Byrne <byrnejm@msu.edu>
To: Bert Cregg <cregg@msu.edu> Subject: Norway Spruce images
Date: June 14, 2011

Bert,

The attached pictures are from a client that I spoke to on the phone.

These symptoms are pretty severe and I am not sure what to attribute them to. I originally questioned herbicides, but none have been applied to the lawn. Could last week's rapid change from cool to hot temperatures have something to do with it?

Jan





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Herbicide damage on Spruce and Pine

The Plant and Pest Diagnostic Lab (PPDL) has recently received several samples of Norway spruce and white pine with symptoms that appear to be associated with injury caused by synthetic auxin (growth regulator type) herbicides. Typical off-target symptoms caused by these herbicides can include epinasty (twisting and curling) of the shoot and tips (Fig. 1) of branches. On conifers, affected new growth may turn brown and die (Fig. 2). On broadleaf plants, leaf cupping (upward or downward), bending or twisting may occur on new growth and in extreme cases, new leaves may appear irregular in size and shape (usually smaller than normal) and have abnormal leaf margins. These symptoms are similar regardless if it is an ornamental broadleaf plant or a weed. The new growth on the conifers submitted to the lab appeared to be brown and dying. Samples of Norway spruce and white pine submitted to the PPDL and injury reported in other areas of the country appear to be linked back to the common denominator of the herbicide aminocyclopyrachlor applied to nearby lawns for broadleaf weed control. The damage appears to be from root uptake rather than drift or volatilization.















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New lawn chemical chief suspect in mysterious deaths of trees

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Initial DuPont info on Imprelis

- A majority of the reports involve Norway Spruce or White Pine.
- In most cases, Imprelis was not applied alone, but in a mixture with other herbicides, either pre-emergent, postemergent and/or with a liquid fertilizer.
- Some reports indicate there may have been errors in use rates, mixing practices and/or applications to exposed roots, or the tree.
- Most golf course superintendents have used Imprelis to successfully control weeds and have not reported unfavorable tree symptoms.



WEDNESDAY, JULY 27, 2011

DuPont says its Imprelis hurt trees



More than a dozen spruce and pine trees at the company-owned DuPont Country Club near the company's headquarters in Wilmington show damage that look like the symptoms reported to have been attributed in other cases to exposure to the DuPont herbicide Imprelis, by state extension services in Pennsylvania and the Midwest. These pictures were taken from Black Gates Road and Country Club Road, adjoining the club's eastern end. DuPont had no comment on the damage. (Photo by Joseph N. DiStefano)

Follow up on tree damage reported from its new herbicide Imprelis, DuPont sent this statement this afternoon:

"Based on our ongoing review, we have observed tree injuries associated with Imprelis (R), primarily on Norway spruce and white pine trees.

"Problems appear to be concentrated in a geographic band that includes Minnesota, Michigan, Indiana, Ohio, Pennsylvania, New Jersey and Wisconsin.

"While most properties treated have had successful weed control, we are committed to continuing to work with every customer who has experienced Imprelis-related problems.

"We sincerely regret any damage to trees that Imprelis (R) may have caused. We take this seriously and are committed to customer satisfaction and responsible product stewardship.

"We are setting up processes and procedures to individually and appropriately address the





August 11, 2011, 1:43 PM

E.P.A. Halts Sale of Suspected Tree Killer

By THE NEW YORK TIMES

The Environmental Protection Agency just ordered DuPont to halt the [sale of Imprelis](#), a weed killer that some landscapers have linked to the deaths or harming of thousands of trees across the country. Read Jim Robbins's article [here](#) and come back to comment. For some background, read his account from [last month](#) on the controversial new herbicide, which had been billed as environmentally friendly.

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Breaking News, Business, Living, Politics and Policy, DuPont, Environmental Protection Agency, herbicide, Imprelis, trees, weed killers

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What is Imprelis?

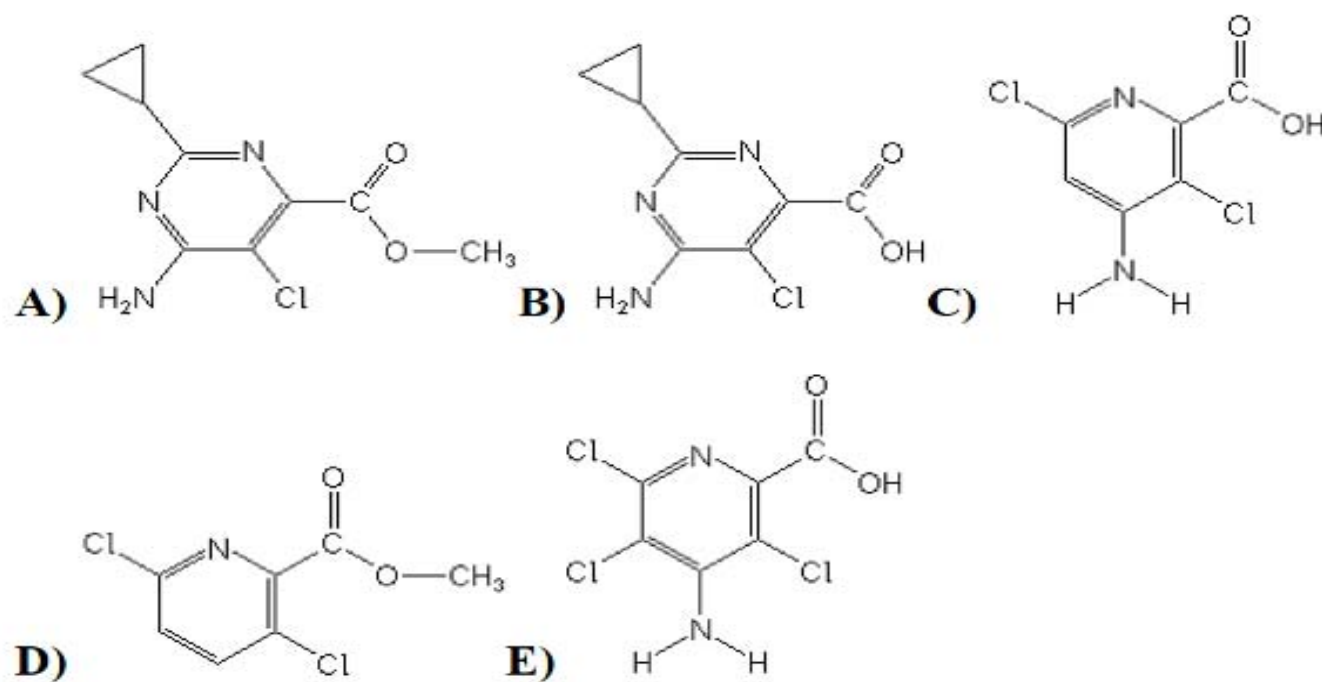
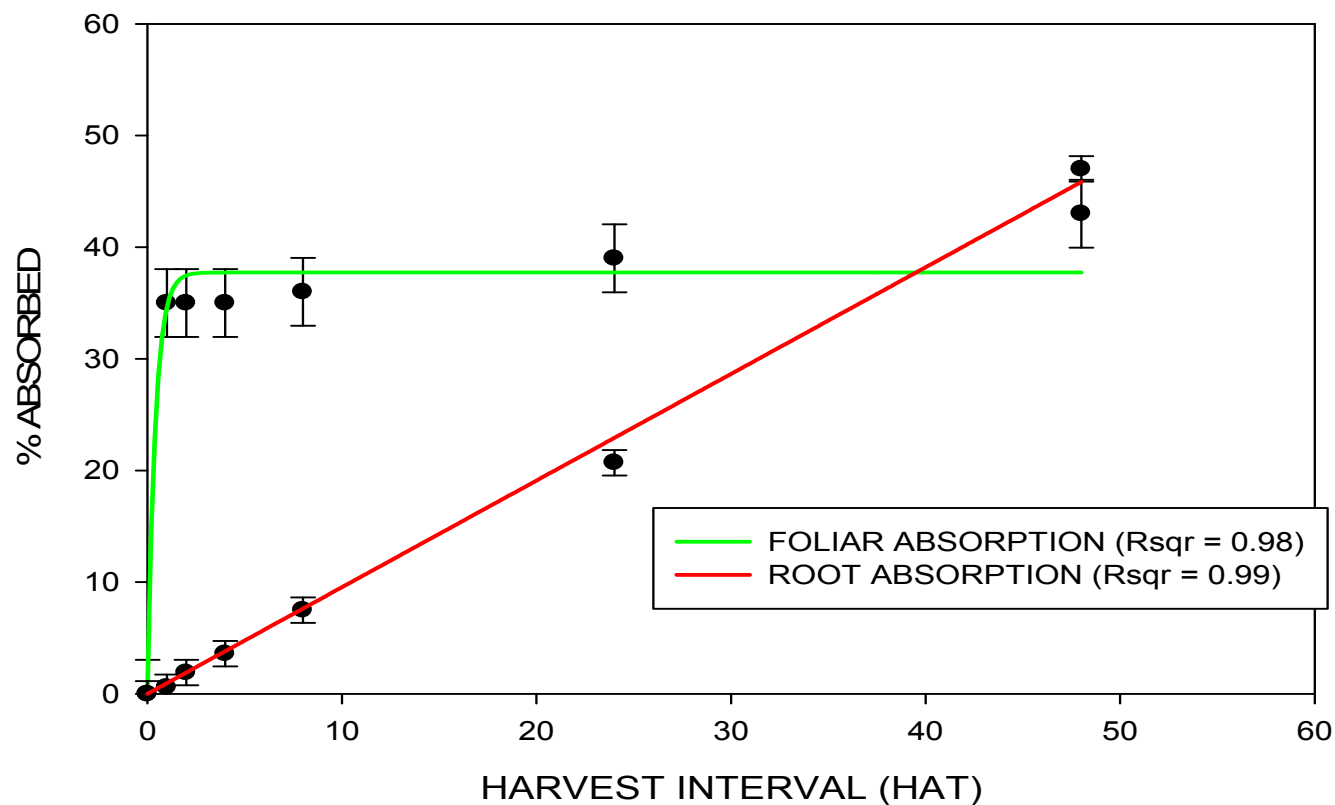


Figure 1.1 Chemical structures of A) aminocyclopyrachlor, B) aminocyclopyrachlor methyl ester, C) aminopyralid, D) clopyralid, and E) picloram.

Root versus foliar uptake of Imprelis in pine seedlings







Damage here

Applied here

- Spiral ascent





DuPont™ Imprelis™

HERBICIDE

Professional Products

GROUP	4	HERBICIDE
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Soluble Liquid

INTENDED FOR USE BY COMMERCIAL APPLICATORS ONLY

IMPRELIS™ herbicide provides selective broadleaf weed control in cool season and certain warm season turfgrasses on Lawns (Residential, Industrial and Institutional), Golf Courses, Parks, Cemeteries, Athletic Fields, and Sod Farms.

- Controls major broadleaf weeds including dandelion, clover, plantains, wild violet and ground ivy
- Controls many other important annual and perennial broadleaf weeds
- Low application rates
- Flexible, virtually odorless, non-irritating formulation

Active Ingredient

By Weight

Potassium salt of aminocyclopyrachlor:
6-amino-5-chloro-2-cyclopropyl-4-pyrimidinecarboxylic acid*

25%

Other Ingredients

75%

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

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 thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco or using the toilet.

DuPont™ Imprelis™

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Professional Products

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Active Ingredient By Weight

Potassium salt of aminocyclopyrachlor: 6-amino-5-chloro-2-cyclopropyl-4- pyrimidinecarboxylic acid*	25%
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Other Ingredients	75%
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PERSONAL PROTECTIVE EQUIPMENT (PPE)

Applicators and other handlers must wear:

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Current Status





Déjà vu all over again...?



Jason Smith; Univ. of Florida

Suspected metsulfuron damage on live oak



Jason Smith; Univ. of Florida



Jason Smith; Univ. of Florida

Damage induced by test exposure



Jason Smith; Univ. of Florida

A road paved with good intentions...



Mark Copier; Mlive.com

Habitat applied right
of stairway





Bittersweet re-sprouting



Habitat damage on
sugar maple



Healthy sugar maple





Habitat damage on oak



Sassafras recovering



How NOT to control weeds in landscape beds





SPECIMEN

Sahara®

DG herbicide

BAREGROUND VEGETATION CONTROL IN SPECIFIED NONCROPLAND AREAS

ACTIVE INGREDIENTS:

Imazapyr (2-[4,5-dihydro-4-methyl-4-[(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid) 7.78%

Dikuron (3-[3,4-dichlorophenyl]-1,1-dimethylurea) 62.22%

INERT INGREDIENTS: 30.00%

TOTAL: 100.00%

EPA Reg. No. 241-372

EPA Est. No. _____

U.S. Patent No. 4,798,619

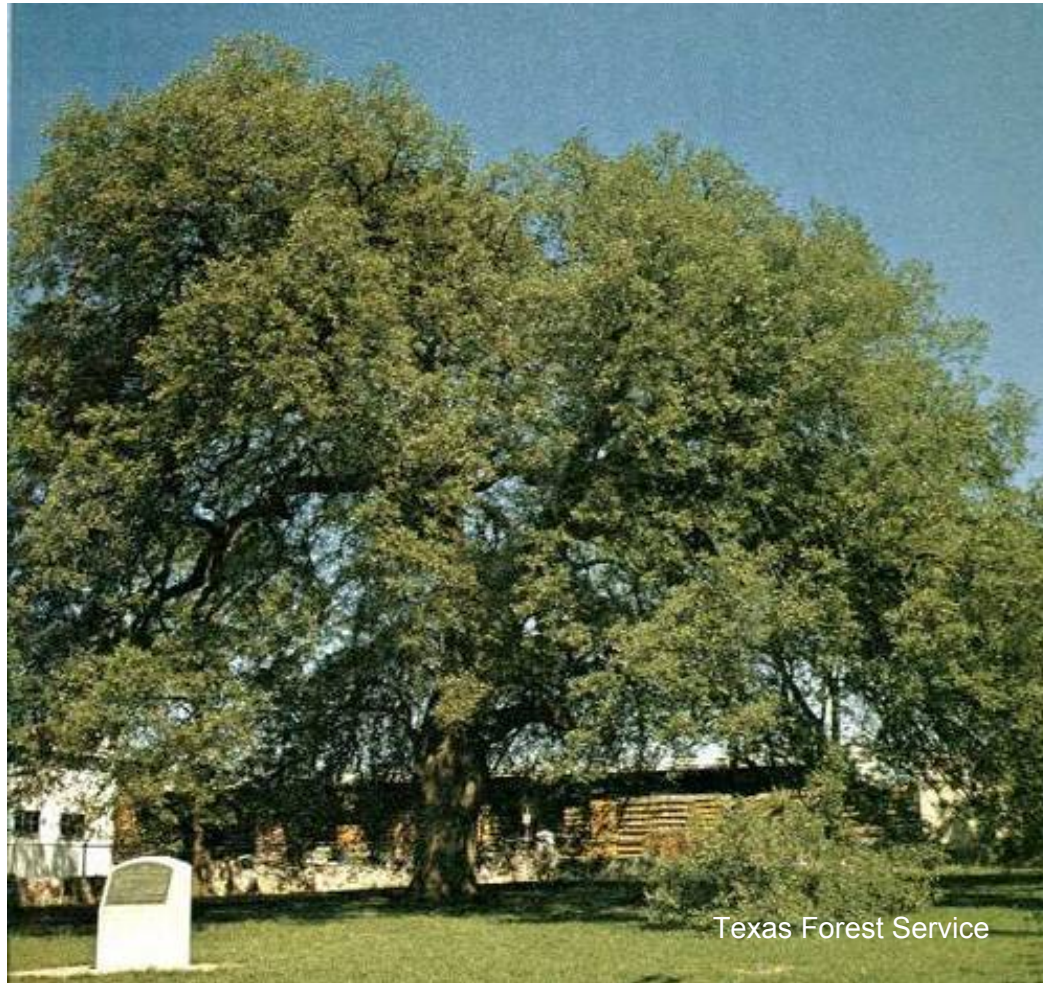








Deliberate herbicide injury



Texas Forest Service



Haphaestos, wikimedia commons

Toomer's oaks – Auburn, Alabama



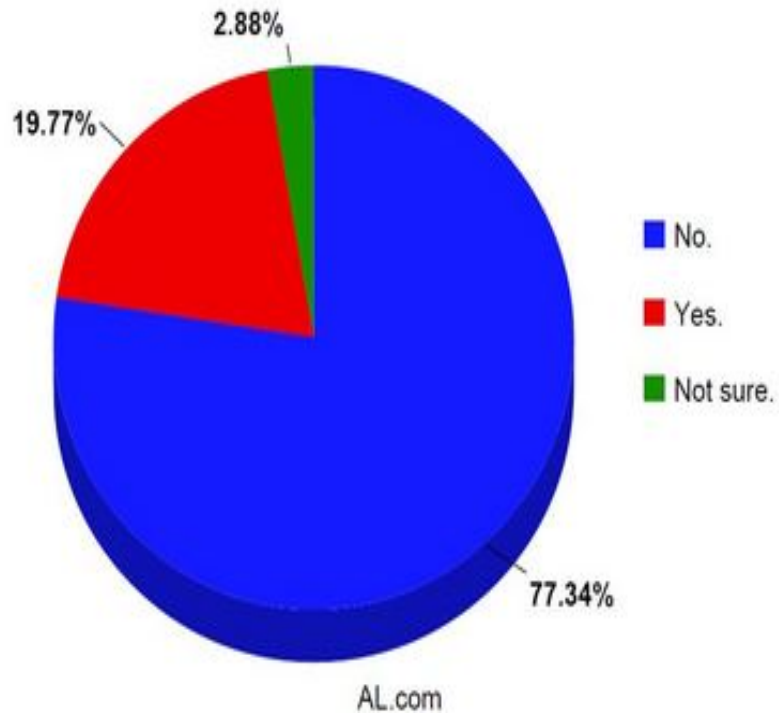
Toomer's oaks removal

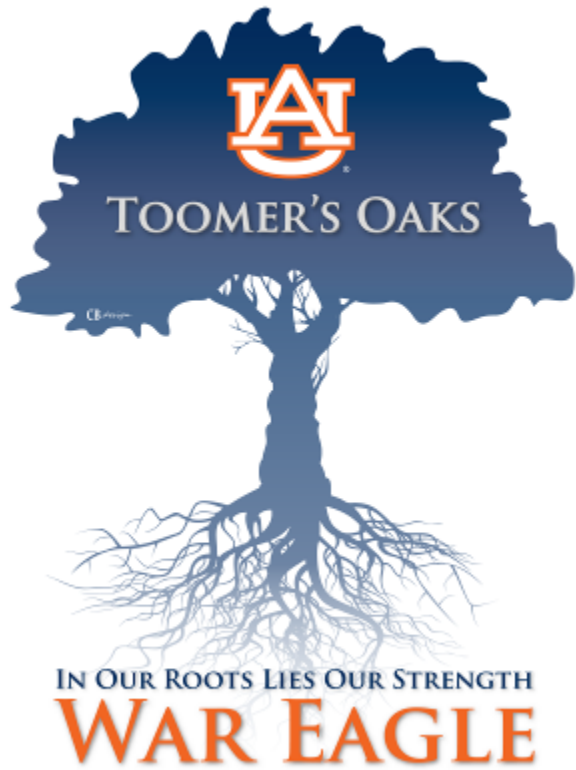


John Reed; USA Today Sports

Status

Should Harvey Upke get a break on his restitution payments to Auburn University?





Preventing herbicide damage

- Drift
 - Particles
 - Vapor
- Soil
 - Uptake
 - Movement



Minimizing drift

- Wind
 - <10 mph
 - Spray with wind
- Particle size
 - Maximum nozzle size
 - Minimum pressure



Particle Drift

	Feet traveled in 3 mph wind
Droplet type	
Fog	15,840
Very fine	1,100
Fine	44
Medium	28
Course	9
Fine rain	5

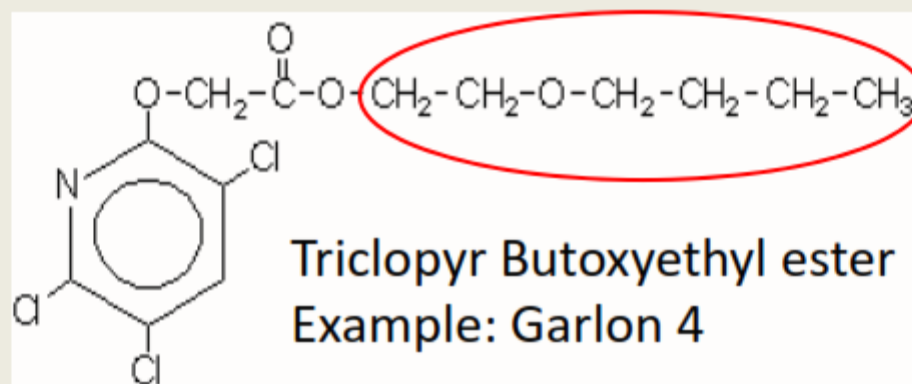
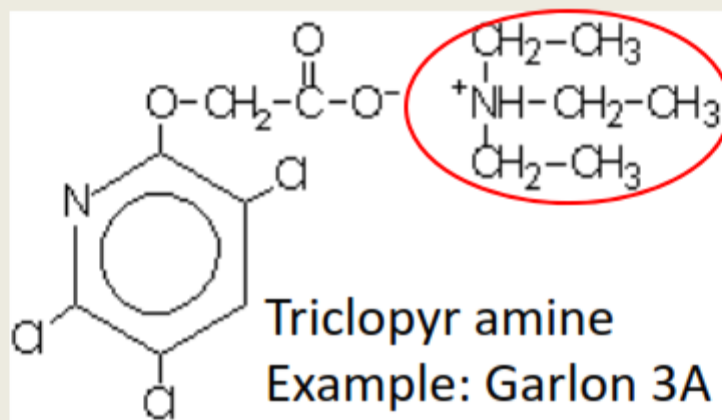


Vapor drift

- Avoid potentially volatile herbicides
 - Ester formulations
 - Dicamba
- Avoid still conditions and inversions
- Avoid high temperature/humid conditions
 - 70's: Little or no effects
 - 80's: Potential effects on sensitive plants/growth
 - 90's: Damage likely to sensitive plants



Triclopyr Molecules



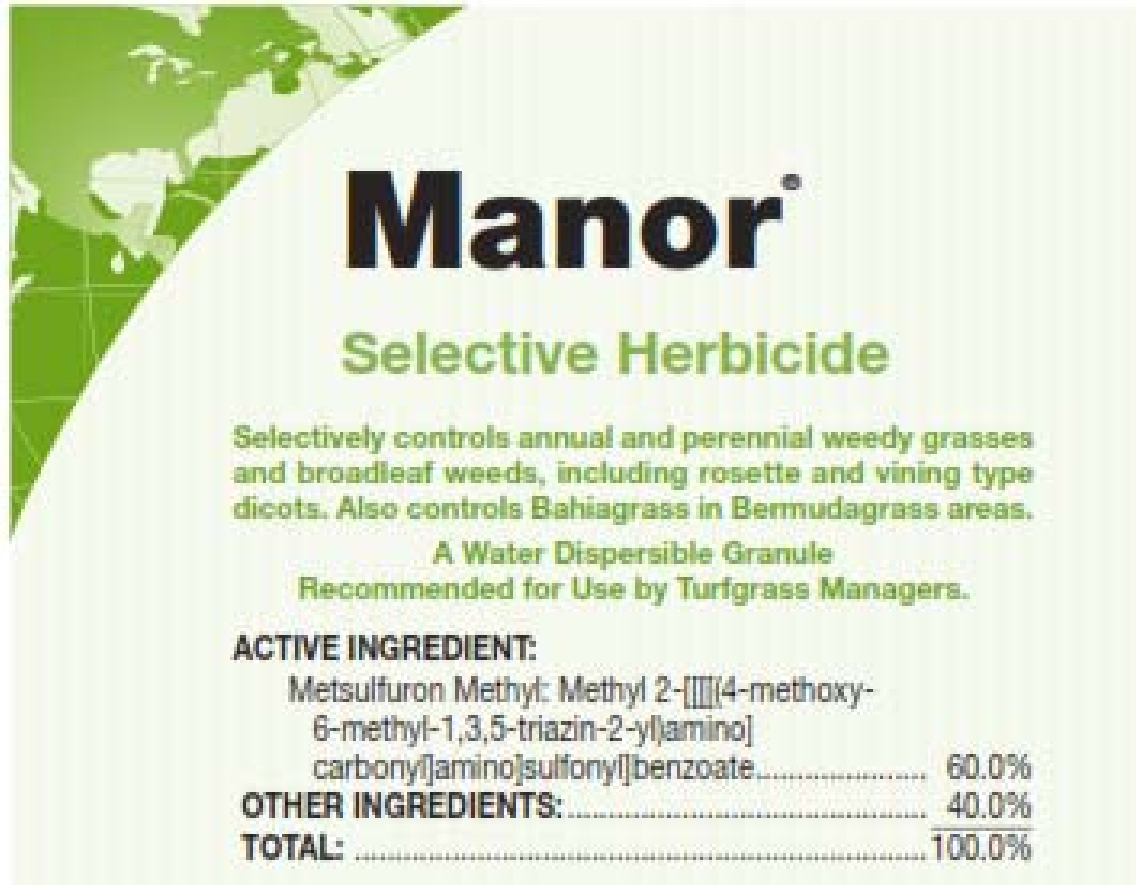
Herbicide Root Activity

High root uptake can increase potential for non target impacts

A.I.	Half life (days)	Mobility	Root Uptake
2,4-D	<28	moderate	moderate
Dicamba	14	low to medium	moderate
Glyphosate	47	low	very low
Hexazinone	90	high	high
Imazapic	120	low	moderate
Imazapyr	142	moderate	high
Metsulfuron	<42	low	high
Triclopyr	<46	moderate	moderate



Read and understand label



Manor[®]

Selective Herbicide

Selectively controls annual and perennial weedy grasses and broadleaf weeds, including rosette and vining type dicots. Also controls Bahiagrass in Bermudagrass areas.

A Water Dispersible Granule
Recommended for Use by Turfgrass Managers.

ACTIVE INGREDIENT:

Metsulfuron Methyl: Methyl 2-[[[4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]amino]sulfonyl]benzoate..... 60.0%

OTHER INGREDIENTS:..... 40.0%

TOTAL: 100.0%

Read and understand label



Bareground vegetation control in specified noncropland areas

Active Ingredients:

imazapyr: (2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid) 7.78%

diuron: (3-[3,4-dichlorophenyl]-1,1-dimethylurea). 62.22%

Other Ingredients: 30.00%

Total: 100.00%

EPA Reg. No. 241-372

EPA Est. No.

Read and understand label

PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS AND DOMESTIC ANIMALS CAUTION

Harmful if absorbed through skin. Causes moderate eye irritation. Avoid contact with skin, eyes or clothing.

PERSONAL PROTECTIVE EQUIPMENT (PPE):

Some of the materials that are chemical-resistant to the product are listed below. If you want more options, follow the instructions for category A on an EPA chemical-resistance chart. **Applicators and other handlers must wear:** Long-sleeved shirt and long pants, shoes, socks and chemical-resistant gloves made of any waterproof material such as polyethylene or polyvinyl chloride. 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 CONTROL STATEMENTS:

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.

IMPORTANT: When reduced PPE is worn because a closed system is being used, handlers must be provided all PPE specified above for "Applicators and other handlers" and have such PPE immediately available for use in an emergency, such as a spill or equipment break-down.

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.

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 apply where runoff water may flow, during periods of intense rainfall or to water saturated soils as off-target movement and injury may occur. Do not contaminate water when cleaning of equipment or disposing of equipment washwaters. Do not apply product through any type of irrigation system.

Read and understand label

USE PRECAUTIONS

Use lower rates for minimum chlorosis of the turf.

Do not apply this product to turf under stress from drought, insects, diseases, cold temperatures, high temperatures of above 85°F on cool season grasses or poor fertility as injury may result.

Do not apply to turf less than 1 year old.

Do not use on Bt grass where it is the desired turf, as severe injury may result.

Do not treat ornamentals such as shrubs and trees in treated areas for at least 1 year after the last application or become dormant for at least 2 years.

IMPORTANT

Addition of a nonionic surfactant of at least 80% active ingredient at 0.25 percent by volume (1 quart per 100 gallons) provides maximum performance, but may temporarily increase chlorosis of the turf.

Allow one week between the application of this product and other control (pesticide containing) products. (This guideline can be relaxed where severe insect or disease attack requires immediate treatment).

DO NOT USE ON FOOD OR FEED CROPS. Injury to or loss of desirable trees or other plants may result from failure to observe the following: Do not apply this product (except as instructed) or drain or flush equipment on or near desirable trees or other plants, or on areas where their roots may extend or in locations where the chemical may be washed or moved into contact with their roots.

When overseeding, wait 2 months (8 weeks) after application. Do not apply to any body of water, including streams, irrigation water or wells. Do not apply where runoff water may flow onto agricultural land, as injury to crops may result.

Do not allow spray drift onto adjacent crops or other desirable plants or trees as injury may occur.

Follow these

- Stop spray downwind
- High temperature
- these conditions
- Use large droplet size sprays to minimize drift.
- Use spray pressures of 35 psi or less when applying this product.

If the label says it's IMPORTANT then it's probably important!!!

Read and understand label

COMPATIBILITY

Before full-scale mixing of this product with other pesticides, fertilizers, secondary plant nutrients, adjuvants, surfactants or other chemicals, you must determine the compatibility of the proposed mixture. Use proportionate quantities of each ingredient and mix in a small container. Add one product thoroughly with the diluent before adding another product. If no incompatibility is evident after 30 minutes, the mixture is generally compatible for spraying. To evaluate potential short term effects of applying the mixture, test the tank mix combination on a few plants or a small area before larger-scale treatments. Wait at least 2 to 3 days for problems to become apparent.

IMPORTANT: MIXING WITH OTHER SUBSTANCES MAY INCREASE THE RISK OF MIXING INCOMPATIBILITIES, REDUCING EFFECTIVENESS AND/OR CAUSE CROP INJURY OR LOSS. ANY LIABILITY FOR LOSS, INJURY OR DAMAGE RESULTING FROM THE USE OF A MIXTURE NOT SPECIFIED ON THIS LABEL OR IN MANUFACTURER'S SUPPLEMENTAL LABELING DISTRIBUTED FOR THIS PRODUCT IS SPECIFICALLY DISCLAIMED BY MANUFACTURER.

Don't forget about adjuvants!!!



Read and understand label

TANK MIXES

Sahara DG herbicide may be tank mixed with **Roundup®**, **Herbex®** (diuron), **Oust®**, **Garlon®**, **Fluoro®**, **Banvel®**, **Vanquish®**, **Pendulum®**, **Plataeu®** or **Arsenal® herbicides**. Tank mixes with 2,4-D or products which contain 2,4-D, have resulted in reduced performance of perennial weed control.

Consult manufacturer's labels for specific rates and weeds controlled. Always follow the more restrictive label when making an application involving tank mixes.



Read and understand label

PRECAUTIONS FOR AVOIDING INJURY TO NONTARGET PLANTS

Untreated trees can occasionally be affected by root uptake of **Sahara DG** through movement into the topsoil. Injury or loss of desirable trees or other plants may result if **Sahara DG** is applied on or near desirable trees or other plants, on areas where their roots extend, or in locations where the treated soil may be washed or moved into contact with their roots.

Treatment of powdery dry soil or light sandy soil when there is little likelihood of rainfall soon after treatment may result in off-target movement and possible damage to desirable plants when soil particles are moved by water and/or wind. Injury to crops may result if treated soil is washed, blown, or moved onto land used to produce crops. Exposure to **Sahara DG** may injure or kill most crops.

Avoiding injury to nontarget plants. Hey, THIS could be important!!!



Remediation



Likelihood of remediation success depends on several factors

- Herbicide
 - Product, Concentration, Length of exposure
- Tree
 - Type, Vigor before exposure
- Environmental conditions
 - Minimize further stresses to tree



HERBICIDE INJURIES TO TREES—SYMPTOMS AND SOLUTIONS

by James R. Feucht

Abstract. Arborists are frequently called upon to diagnose injuries to trees that may be the result of herbicides incorrectly or inappropriately applied by the client or an adjoining neighbor. In many cases, an arborist is blamed for causing the damages to a client's trees. Arborists need to recognize herbicide symptoms and mimicking symptoms, as well as learn appropriate corrective measures. The presentation compares symptoms caused by herbicides such as 2, 4-D, banvel, and triazine compounds with mimicking symptoms for non-herbicide causes. Foliage and soil residue of herbicide contaminants is documented with laboratory tests showing the minimum residues required to cause damage to various trees from soil sterilants such as bromacil, prometon and tebuthiuron.

Arborists and landscape managers frequently encounter injuries to trees caused by incorrectly or inappropriately applied herbicides. Applications are often made by the client or may be the result of herbicides used on adjoining properties. It is important that arborists and managers of landscaped properties learn to recognize herbicide injury symptoms, mimicking symptoms, and steps that can be taken to alleviate the injury. This paper

steepness of slope, water solubility of the product and the amount of rainfall or irrigation.

A common source of tree injury by herbicides, but often overlooked, is application of soil sterilants within the root zone of trees. Unfortunately, many still believe that root spread of a tree is equal to the branch spread or so called "drip line". As a result, soil sterilants may be unwittingly applied over the absorbing roots of trees. Research, of course, has shown that root spread of a tree far exceeds the branch spread (2, 4, 5, 6, 7).

A relatively common occurrence is damage from soil sterilants applied to gravel strips bordering a property, driveways and fence lines. Trees adjacent to such areas will absorb the herbicide, resulting in severe injury or even death. Frequently, the soil sterilant is applied by owners of properties adjacent to the tree that is damaged, not realizing that roots of the neighboring tree encroach their property. Due to the long residual ac-



Herbicide remediation

- First, do no harm
 - Trees can often recover from significant damage if further stresses are minimized
- Learn as much as possible about product
 - e.g., If product has short half-life, it may already be gone from soil
- Soil removal + activated charcoal
 - 2-4 lb/1000 sq ft
 - May not help if tree has already had a significant dose



The legal stuff...

- Document
 - Spray records
 - Photos
 - Measurements
- Collect samples
 - Foliage
 - Soil
 - Samples can be frozen and analyzed later



Questions?

