Weed Science & Management

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EXTENSION

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Scan QR code with phone for copy of presentation

EXTENSION

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Weeds

- Plant out of Place (Undesired)
- Three Types

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Grassy Weeds

- Crabgrass
- Foxtail
- Goosegrass
- Quackgrass
- Bromegrass
- Nimblewill
- Bentgrass*

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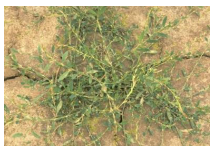
Broadleaf Weeds

- Dandelion
- Plantain
- Prostrate spurge
- Henbit
- Ground Ivy
- Knotweed



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Sedges

- Parallel veins
- Triangular stems, solid, without nodes
- Three ranked leaves – arising from each side of the stem

Example: Yellow nutsedge

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Weeds: Life Cycle

- Important to know for management strategy

Weeds are classified as:

1. Annuals
   - Summer annuals
   - Winter annuals
2. Perennials
3. Biennials

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Use Weeds as "Indicators"

- Legumes (white clover, black medic, birdsfoot trefoil), sandbur, and ground ivy may indicate low nitrogen levels

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"Indicators"

- Algae and moss may indicate excess moisture
- Crabgrass and annual bluegrass may indicate low mowing heights

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"Indicators"

- Knotweed, goosegrass, and crabgrass may indicate compacted soil
- Ground ivy and violet may indicate excessive shade

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Reasons for Weed Problems in Turf

- Fundamentals(cultural)
- Species selection
- Neglect
- Expectations
- Budget

- <u>Utilize turf where it can be competitive</u>

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Cultural Practices for Healthy Turf

- Highest mowing height
- Frequent mowing
- Reduced Irrigation
- Fertilize
- Manage traffic and compaction

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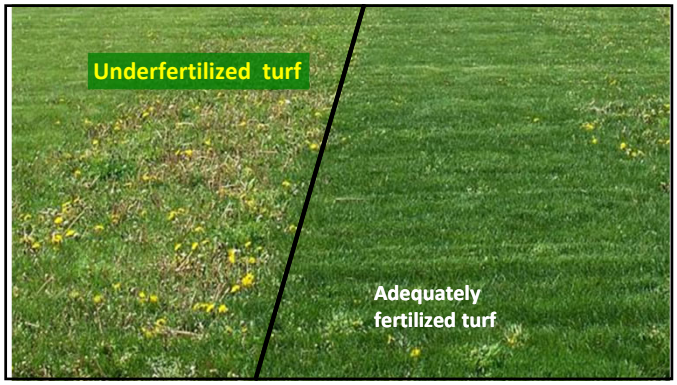

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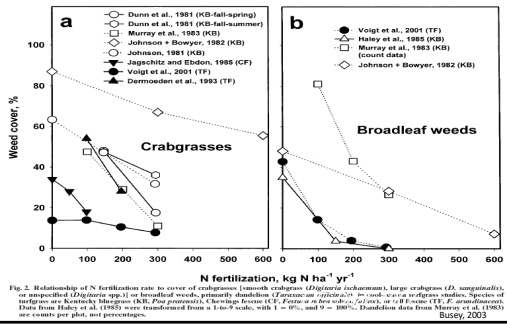
Effects of N fertilization on weed cover



Busey, 2003

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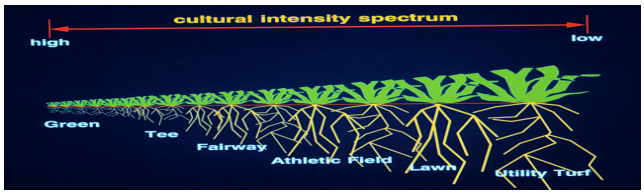
Mowing Height and Rooting Depth

- Shorter mowing heights result in:
  - Decreased rooting
  - Higher maintenance
  - Increased pest problems



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Effects of mowing height on crabgrass cover

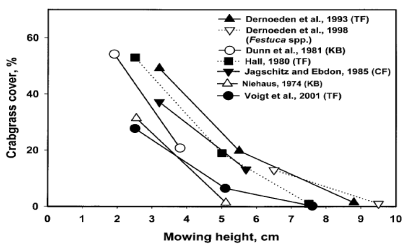

Fig. 1. Relationship of mowing height to cover of crabgrasses [smooth crabgrass (*Digitaria ischaemum*) or not specified (*Digitaria* spp.)] in cool-season turfgrasses. Species of turfgrass is Kentucky bluegrass (KB, *Poa pratensis*), Chewings fescue (CF, *Festuca rubra* subsp. *fallax*), or tall fescue (TF, *F. arundinacea*).

Busey, 2003

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Ross Braun
@Ross_Braun

These two lawns were established with the same sod at the same time (2017). Both lawns have never received a pesticide application. However, one is fertilized twice a year (mainly fall) and mowed higher all year. #Lowinputturf pic.twitter.com/2l4Hy0nEYp

7/31/20, 7:24 AM

Note: both receive similar amounts of water (rain only with no in-ground irrigation) with the one on the right receiving hose sprinkler watering when minimal rain has occurred for 3+ weeks.

Management matters (KB in Indiana)

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Chemical Control

- Preemergence
  - Apply before weeds germinate
  - Very effective on annual weeds
- Postemergence
  - Apply to actively growing weeds
    - Contact
    - Systemic

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When to apply preemergence herbicides

- Soil temperatures exceed 50°F
- Occurs first:
  - In landscape beds
  - Thinned turfgrass
  - Near sidewalks
  - Better to apply early than late

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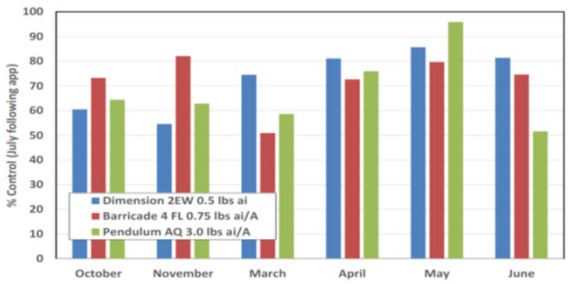
Crabgrass control on July 15 from PRE's applied on 6 different dates in fall/spring. (Averaged over three years, UNL 2013)



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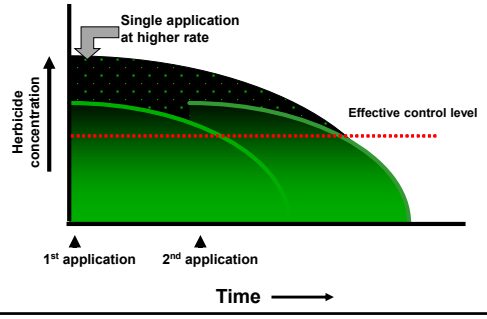
Split preemergence herbicide applications



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Preemergence Herbicide "efficacy"

- Less than adequate control
- Timing and application rates are correct, so…?

- Reasons for "failure"
  - Poor turf conditions
  - Tough weeds/lots of them
  - High rainfall/irrigation
  - Non-Uniform application
  - Insufficient early irrigation/rainfall

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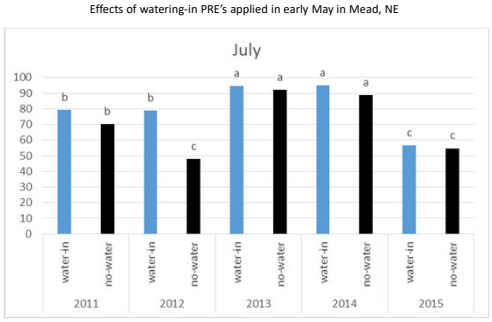

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Effective Use of Preemergence Herbicides

- Start with heathy turf
- Better to apply too early
- App timing is flexible within reason (earlier/split apps)
- Water in
- Uniform application is essential
- Label rates
- Split applications can provide extended season control

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Weed Seed Germination Soil Temperatures

- Crabgrass >55° to 60°F for 7 to 10 days up to 95°F
- Goosegrass >65°F for several weeks
- Yellow Foxtail 68° to 92°F
- Barnyardgrass 72° to 90°F
- Grassy Sandbur 52 F to 75 F
- Prostrate Spurge 60°F to 100°F
- Henbit 68 and 59
- Prostrate Knotweed 35-40 cease at 50˚ F

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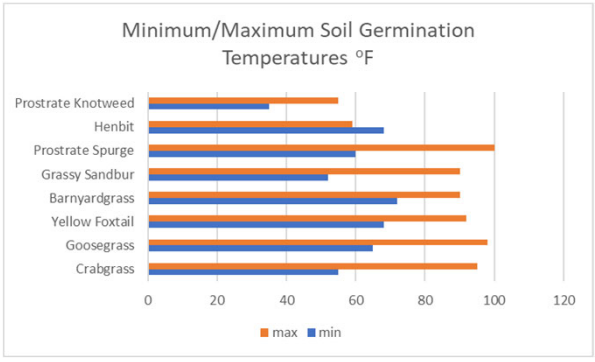

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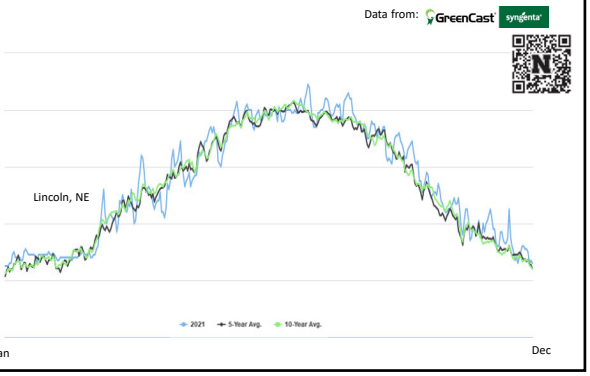

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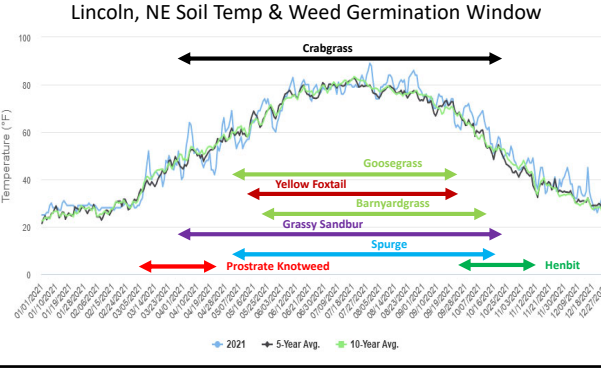

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Show me some data!

- Barricade (prodiamine), Dimension (dithiopyr) and Pendulum (pendimethalin) applied at full rate on May 1 or June 1, 2022
- Same applied at ½ rate on May 1 FB same on June 15
- Drive XLR8 (quinclorac) applied at full rate on June 1
- Drive XLR8 applied with each pre on June 1
- 2 locations in proximity, one with heavy crabgrass and one with heavy yellow foxtail
- Data collected on cover and converted to % control based on untreated

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--------% Control-------

				July 9, 2022		August 29, 2022	
				Crabgrass	Foxtail	Crabgrass	Foxtail
Untreated Check				0h	0g	0f	0g
Dimension 2EW	2	pt/a	1-May	100a	45cde	94a	51bcd
Dimension 2EW	1	pt/a	May 1-June 15	92ab	13fg	68a-d	13fg
Barricade 4FL	30	fl oz/a	May 1	90ab	18efg	76abc	42b-f
Barricade 4FL	15	fl oz/a	May 1-June 15	44efg	25efg	37de	48b-e
Pendulum Aquacap	4.2	pt/a	May 1	95ab	24efg	89a	43b-f
Pendulum Aquacap	2.1	pt/a	May 1-June 15	89ab	21efg	78ab	30d-g
Dimension 2EW	2	pt/a	June 1	84abc	32def	69a-d	43b-f
Barricade 4FL	30	fl oz/a	June 1	31fg	23efg	20ef	35c-f
Pendulum Aquacap	4.2	pt/a	June 1	27g	15fg	17ef	17efg
Drive XLR8; Dimension	64; 2	oz/a; pt/a	June 1	90ab	98a	88a	45b-e
Drive XLR8; Barricade	64; 30	oz/ac	June 1	85abc	88a	63abc	43cde
Drive XLR8; Pendulum	64; 4.2	oz/a; pt/ac	June 1	83ab	93a	66ab	46b-e
Drive XLR8 + MSO	64	fl oz/a	June 1	73bcd	78ab	66ab	34ef

33

--------% Control-------

				July 9, 2022		August 29, 2022	
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Drive XLR8; Pendulum	64; 4.2	oz/a; pt/ac	June 1	83ab	93a	66ab	46b-e
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--------% Control-------

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Dimension 2EW	2	pt/a	1-May	100a	45cde	94a	51bcd
~~Dimension 2EW~~	~~1~~	~~pt/a~~	~~May 1-June 15~~	~~92ab~~	~~13fg~~	~~68a-d~~	~~13fg~~
Barricade 4FL	30	fl oz/a	May 1	90ab	18efg	76abc	42b-f
~~Barricade 4FL~~	~~15~~	~~fl oz/a~~	~~May 1-June 15~~	~~44efg~~	~~25efg~~	~~37de~~	~~48b-e~~
Pendulum Aquacap	4.2	pt/a	May 1	95ab	24efg	89a	43b-f
~~Pendulum Aquacap~~	~~2.1~~	~~pt/a~~	~~May 1-June 15~~	~~89ab~~	~~21efg~~	~~78ab~~	~~30d-g~~
Dimension 2EW	2	pt/a	June 1	84abc	32def	69a-d	43b-f
Barricade 4FL	30	fl oz/a	June 1	31fg	23efg	20ef	35c-f
Pendulum Aquacap	4.2	pt/a	June 1	27g	15fg	17ef	17efg

35

--------% Control-------

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Drive XLR8 + MSO	64	fl oz/a	June 1	73bcd	78ab	66ab	34ef

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Summary

- Apply early rather that later
- Split apps with lower rates were problematic
- Foxtail populations were near 100% resulting in poor control and questionable data for objective
- Use of post emergence annual grass herbicides (quinclorac (Drive); *mesotrione (Tenacity); topramezone (Pylex)* may provide added benefit in timing flexibility and broadleaf activity

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Postemergence Weed Control

- Perennials are hardy and difficult to control
- Herbicide uptake and translocation vary
- Death of the weed may be slow
- Mature weeds may not be controlled completely
- Control annuals when young
  - Hit them hard early

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When to control broadleaf weeds

- Fall is BEST
  - Controls most life cycles
  - Herbicides are more readily translocated to roots
  - Less risk for ornamental damage
  - Turf is in ideal growing conditions to allow it to fill voids
- Spring Control
  - Ester Formulations work better in cool weather but can cause damage to nearby ornamentals
  - Combination products with multiple AI's
  - Best to time a few weeks before or after flowering
  - New herbicide controls seedheads (Florasulam)
    - Late fall or early spring applications

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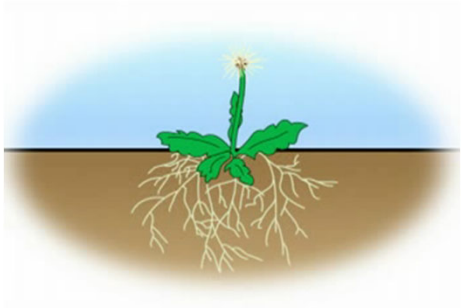
Spring application to perennial weeds



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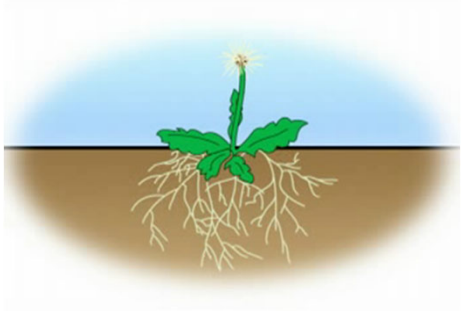
Fall application to perennial weeds



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Postemergence Herbicide "Failure"

- Weeds wilt and die back but regrow
- Why?
  - Application timing
  - Weed species
  - Weed health
  - Weed age
  - Post-application management of lawn
  - Weather
  - Adjuvants

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Effective Use of Postemergence Herbicides

- Start with healthy turf
- Apply to actively growing weeds
- Multiple ai products (we have many options)
- Fall applications


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Yellow nutsedge

- A perennial weed found in both cool- and warm-season turfgrasses
- Tolerates close mowing and competes for water and nutrients

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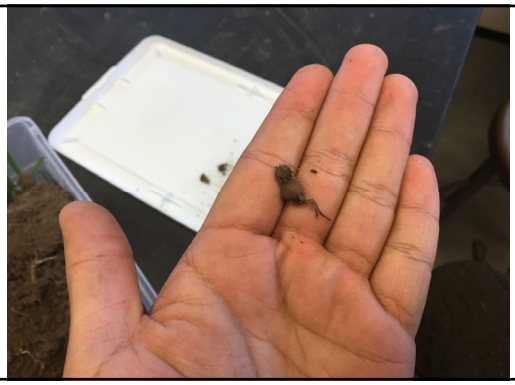

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Tubers

- Difficulty to control it is a result of its intensive system of underground tubers, and its tolernace to most herbicides
- Tuber production in yellow nutsedge is highly prolific

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Polyculture Sample **Monoculture Sample**

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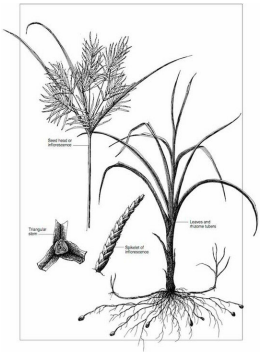
- Viable tubers may remain dormant in the soil for multiple years and may sprout repeatedly
- Results of herbicide control of yellow nutsedge are inconsistent



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When to control yellow nutsedge

- As early as it was first identifiable – early June
  - Tubers are immature
  - Control tubers that start forming
  - Herbicides are more readily translocated to roots, rhizomes and tubers
- Sequential application
  - Make a second application 3 or 6 weeks after the initial application
  - Sequential application works better than single app

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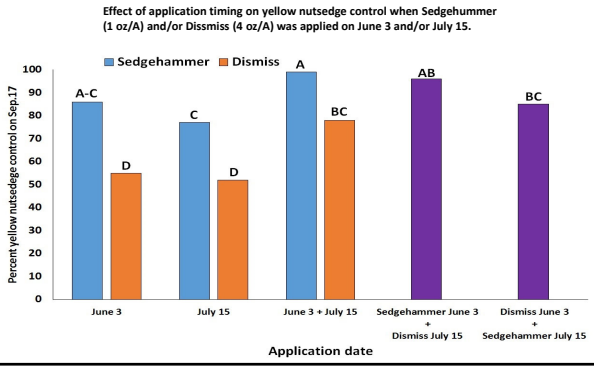

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Yellow nutsedge control

- Treat as early as it was first identifiable – early June
- Sequential application with 3 to 6 weeks interval
- Sedgehammer may work better when controlling yellow nutsedge within turf
- Herbicide Rotation
  - Prevent potential herbicide resistance
  - Apply Sedgehammer first when rotating with Dismiss

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Set ourselves up to be successful

- Proper Management
  - Reduces weeds
- Reduce the number of negative factors
  - Research (study)
  - Follow labels
  - Take advantage of new chemistry
- Proper Planning and Training

Finally!! Make Educated Decisions

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Herbicide Resistance
Definition

- genetic characteristic of a weed or plant biotype to survive a herbicide application

Biotype = a group of plants within a species that has biological traits that are not common to the population as a whole.

- *interestingly, plants also have a genetic capacity to develop resistance to many abiotic stresses like drought, heat, cold etc. based on exposure and subsequent selection pressure*

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Why Are Plants Resistant to Herbicides?

- altered site of action
- enhanced metabolism
- sequestration

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Herbicide Resistance

- **cross resistance**

* weed biotype that has gained resistance to more than one herbicide with the same mode/mechanism of action. Same or different families.

- **multiple resistance**

* weed biotype that has developed tolerance to more than one herbicide (or stress) brought about by different selection pressures *(different modes/mechanism of action)*.

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Herbicide Resistance
Around the World (2020)

- 509 Resistant Biotypes
- Resistance identified in 21 of the 31 herbicide sites of action: 164 different herbicides
- 266 Species (153 dicots and 113 monocots)
- More than 270,000 locations in 71 countries

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The Beginning of Documented Weed Resistance

- 1968 (Washington)
- nursery crops
- common groundsel
- atrazine and simazine

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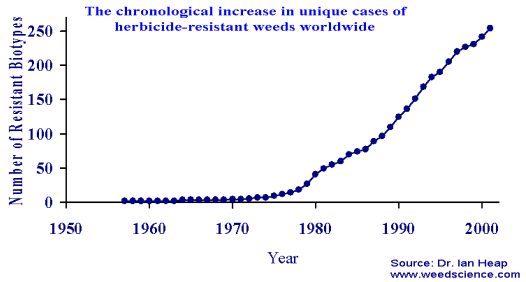

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Weed Characteristics That Favor Resistance

- reproductive capability
- seed dispersal mechanisms

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Herbicide Characteristics/Strategies That Impact Weed Resistance

- single site of action
- used multiple times during the growing season
- used for consecutive growing seasons
  - Resistance can be developed within 2 years depending on species and/or herbicide
- used without other control strategies

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Herbicide Resistance Should Only Be Suspected When:

- other causes of herbicide failure have been ruled out
- the same herbicide or herbicides with the same mode of action have been used year after year
- weed that is normally controlled is not controlled while others weeds of the same species are
- healthy weeds are mixed with controlled weeds (same species)
- a patch of uncontrolled weed is spreading, post multiple applications of the same herbicide

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Causes of Herbicide Failures

- weed size
- moisture
- temperature
- humidity
- rate
- application method
- calibration
- others

All possible reasons for reduced control should be investigated before considering the possibility of resistance

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Herbicide Resistant Weeds
Strategies for Control/Prevention

- proactive vs. reactive
- use other weed management tactics (healthy turf, mowing, compaction control, deficit irrigation)
- rotate herbicides with different MOA
- prevent seed production
- clean mowing and cultivation equipment

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Herbicide-resistant weeds in turfgrass: current status and emerging threats (Brosnan et al, 2020)

Documented cases:

- smooth crabgrass (NJ)
- goosegrass (SE-US; cross resistance)
- annual bluegrass (world; cross resistance)
- annual sedge (*Cyperus* sp; SE-US)
- spotted spurge (SE-US)
- yellow nutsedge (in rice; halosulfuron)
- buckhorn plantain (IN, PA)
- barnyard grass
- green foxtail

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How does it happen?

Two Possibilities

- Survival of the fittest (*I did everything right*)
  - Selects for naturally occurring resistance in pest population
  - Selection pressure
- What happened to my genes (*mutagenesis*)?
  - Induces physiological changes in plant
  - Extremely rare in plants, confined mostly to virus and other "simple" organisms

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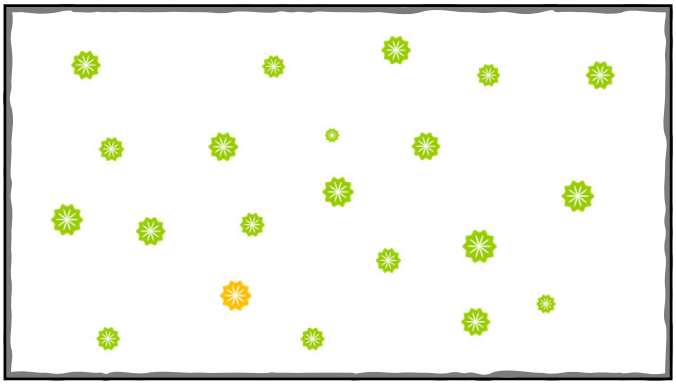

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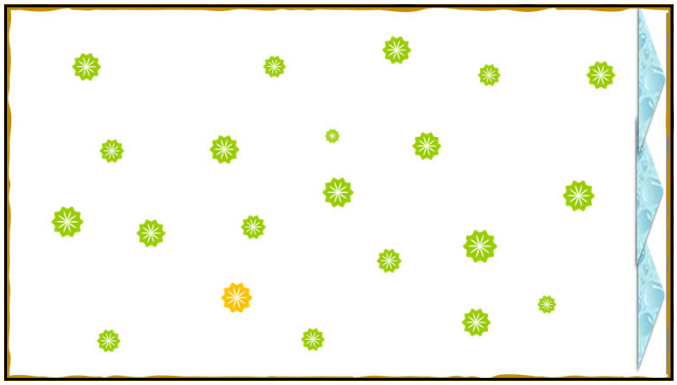

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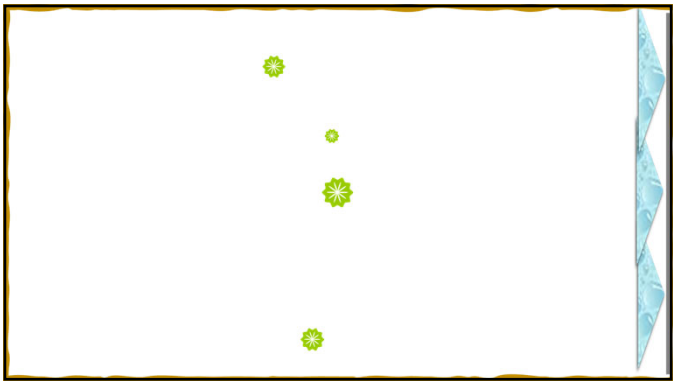

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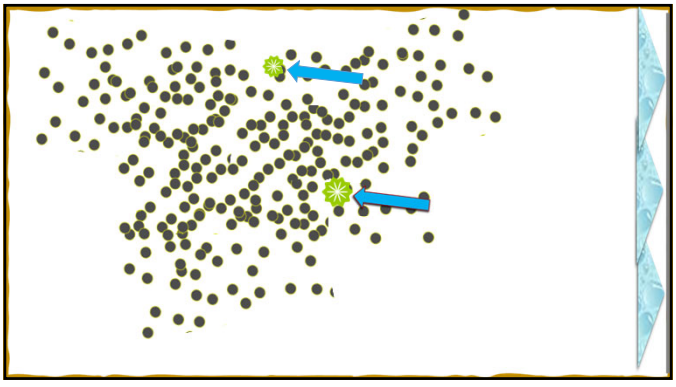

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Summary of Herbicide Mechanism of Action
Weed Science Society of America (WSSA)

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Summary of Herbicide Mechanism of Action According to the Weed Science Society of America (WSSA)

1 **Acetyl CoA Carboxylase (ACCase) Inhibitors**

Aryloxyphenoxypropionate (FOPs) cyclohexanedione (DIMs) and phenylpyrazolin (DENs) herbicides inhibit the enzyme acetyl-CoA carboxylase (ACCase), the enzyme catalyzing the first committed step in *de novo* fatty acid synthesis (Burton 1989; Focke and Lichtenthaler 1987). Inhibition of fatty acid synthesis presumably blocks the production of phospholipids used in building new membranes required for cell growth. Broadleaf species are naturally resistant to cyclohexanedione and aryloxyphenoxy propionate herbicides because of an insensitive ACCase enzyme. Similarly, natural tolerance of some grasses appears to be due to a less sensitive ACCase (Stoltenberg 1989). An alternative mechanism of action has been proposed involving destruction of the electrochemical potential of the cell membrane, but the contribution of this hypothesis remains in question.

2 **Acetolactate Synthase (ALS) or Acetohydroxy Acid Synthase (AHAS) Inhibitors**

Imidazolinones, pyrimidinylthiobenzoates, sulfonylaminocarbonyltriazolinones, sulfonylureas, and triazolopyrimidines are herbicides that inhibit acetolactate synthase (ALS), also called acetohydroxyacid synthase (AHAS), a key enzyme in the biosynthesis of the branched-chain amino acids isoleucine, leucine, and valine (LaRossa and Schloss 1984). Plant death results from events occurring in response to ALS inhibition and low branched-chain amino acid production, but the actual sequence of phytotoxic processes is unclear.

3 **15** **23** **Mitosis Inhibitors**

Benzamide, benzoic acid (DCPA), dinitroaniline, phosphoramidate, and pyridine herbicides (Group 3) are examples of herbicides that bind to tubulin, the major microtubule protein. The herbicide-tubulin complex inhibits polymerization of microtubules at the assembly end of the protein-based microtubule but has no effect on depolymerization of the tubule on the other end (Vaughn and Lehnen 1991), leading to a loss of

Sample Partial Page

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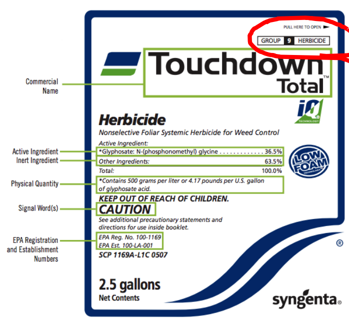
Commercial Name
Active Ingredient
Inert Ingredient
Physical Quantity
Signal Word(s)
EPA Registration and Establishment Numbers
PULL HERE TO OPEN
GROUP 9 HERBICIDE
Touchdown Total™
Herbicide
Nonselective Foliar Systemic Herbicide for Weed Control
Active Ingredient:
*Glyphosate: N-(phosphonomethyl) glycine 36.5%
Other Ingredients: 63.5%
Total: 100.0%
*Contains 500 grams per liter or 4.17 pounds per U.S. gallon of glyphosate acid.
KEEP OUT OF REACH OF CHILDREN.
CAUTION
See additional precautionary statements and directions for use inside booklet.
EPA Reg. No. 100-1169
EPA Est. 100-LA-001
SCP 1169A-L1C 0507
LOW FOAM
2.5 gallons
Net Contents
syngenta

Mechanism/Mode of Action

Be Aware: **Generic pesticides may not have the designation on the label**

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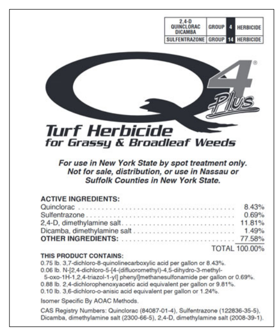
2,4-D QUINCLORAC DICAMBA GROUP 4 HERBICIDE
SULFENTRAZONE GROUP 14 HERBICIDE
Q4 Plus
Turf Herbicide
for Grassy & Broadleaf Weeds
For use in New York State by spot treatment only.
Not for sale, distribution, or use in Nassau or Suffolk Counties in New York State.
ACTIVE INGREDIENTS:
Quinclorac 8.43%
Sulfentrazone 0.69%
2,4-D, dimethylamine salt 11.81%
Dicamba, dimethylamine salt 1.49%
OTHER INGREDIENTS: 77.58%
TOTAL 100.00%
THIS PRODUCT CONTAINS:
0.75 lb. 3,7-dichloro-8-quinolinecarboxylic acid per gallon or 8.43%.
0.06 lb. N-[2,4-dichloro-5-[4-(difluoromethyl)-4,5-dihydro-3-methyl-5-oxo-1H-1,2,4-triazol-1-yl] phenyl]methanesulfonamide per gallon or 0.69%.
0.88 lb. 2,4-dichlorophenoxyacetic acid equivalent per gallon or 9.81%.
0.10 lb. 3,6-dichloro-o-anisic acid equivalent per gallon or 1.24%.
Isomer Specific By AOAC Methods.
CAS Registry Numbers: Quinclorac (84087-01-4), Sulfentrazone (122836-35-5), Dicamba, dimethylamine salt (2300-66-5), 2,4-D, dimethylamine salt (2008-39-1).

4 active ingredients;
3 are Group 4
1 is Group 14

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Examples

- Rotate halosulfuron (***Group 2***) with mesotrione (***Group 27***) or sulfentrazone (***Group 14***) or bentazon (***Group 8***) for postemergence yellow nutsedge control
- Rotate pendimethalin, prodiamine, dacthal, dithopyr, benefin, oryzalin (***Group 3***) with mesotrione (***Group 27***) or oxadiazon (***Group 14***) or bensulide (***Group 8***) or siduron (***Group 7***) for pre-emergence annual grass control
- Rotate 2,4-D, dicamba, MCPA, clopyralid, fluroxypyr (***Group 4***) with carfentrazone (***Group 14***) or mesotrione (***Group 27***) or quinclorac (***Group 26 {also 4?}***) for postemergence broadleaf weed control

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Pesticide resistance can be reduced by:

1. Using a pesticide until resistance develops than switch to another one
2. Rotate different pesticides
3. Rotate pesticides with different mode/mechanism of action (MOA) in cohort with appropriate management

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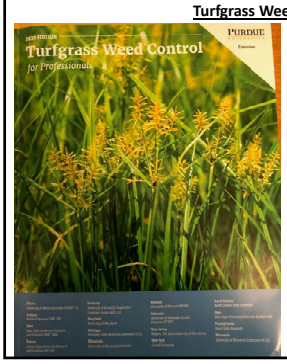
Turfgrass Weed Control for Professionals



https://mdc.itap.purdue.edu/item.asp?Item_Number=TURF-100

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Other resources:

- http://www.mobileweedmanual.com/ Jim Brosnan, Ph.D.

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Contact Information

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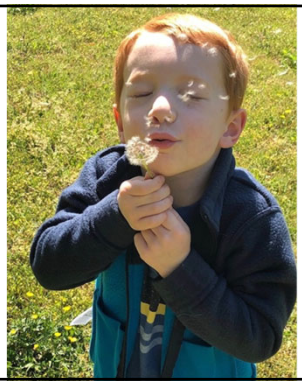
- rgaussoin1@unl.edu
- @rockinsince57

Thank you!



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