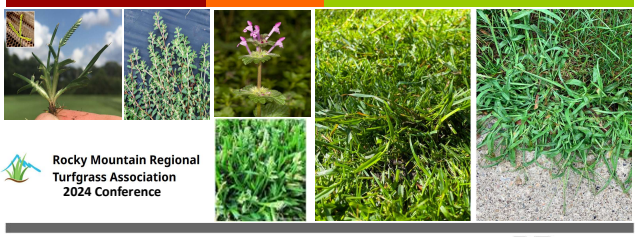
Pre, Post or Both For Better Annual Grass Control

Roch Gaussoin, Extension Turfgrass Specialist, University of Nebraska



Rocky Mountain Regional Turfgrass Association 2024 Conference

EXTENSION

1

When to apply preemergence herbicides

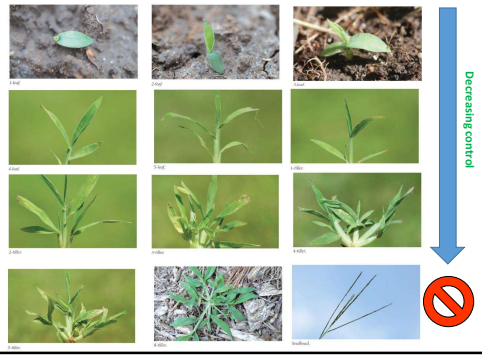
- Soil temperatures exceed 50˚F
- Occurs first:
  - In landscape beds
  - Thinned turfgrass
  - Near sidewalks
  - Better to apply early than late

3

Annual Grass Postemergence Weed Control

- Herbicide uptake and translocation vary
- Death of the weed may be slow
- Mature weeds may not be controlled completely
- Hit them hard and early

4



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Grassy Weeds

- ***Crabgrass****
- ***Foxtail****
- ***Goosegrass****(*)*
- ***Grassy sandbur****
- ***Barnyardgrass****
- Quackgrass
- Bromegrass
- Nimblewill

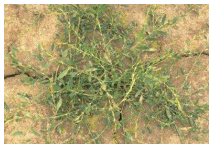
Preemergence control possible; ***preferred method***

6

Broadleaf Weeds

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

Preemergence control possible; ***preferred method***



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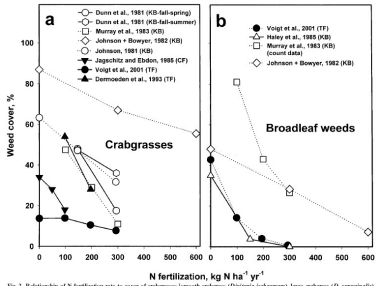
Management First

8

Effects of N fertilization on weed cover

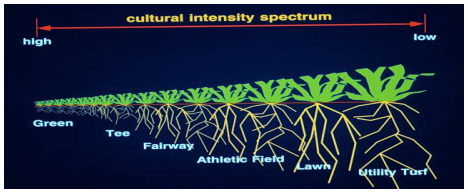


Busey, 2003

9

Mowing Height and Rooting Depth

- Shorter mowing heights result in:
  - Decreased rooting
  - Greater managment
  - Increased pest problems



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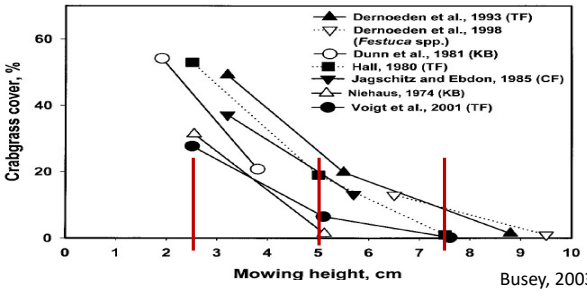
Effect of mowing height on crabgrass cover



Busey, 2003

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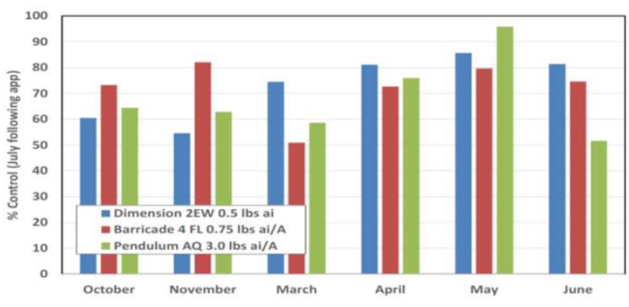
Crabgrass control on July 15 from PRE's applied on 6 different dates in fall/spring. (Averaged over three years, UNL 2013)



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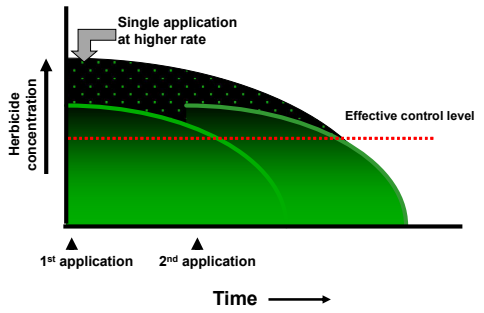
Split preemergence herbicide applications



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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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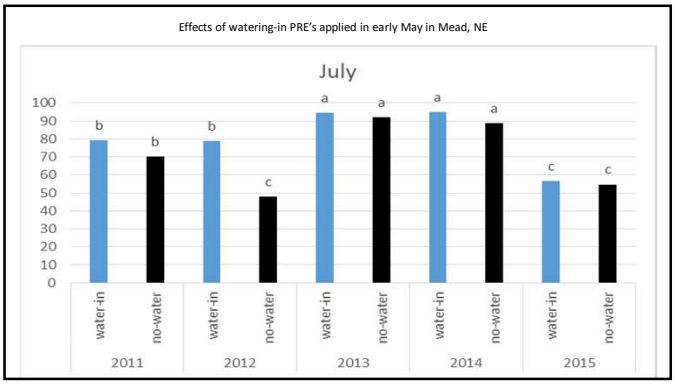

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Effective Use of Preemergence Herbicides

- 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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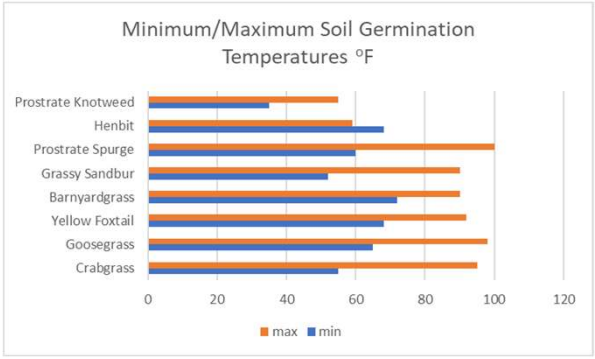

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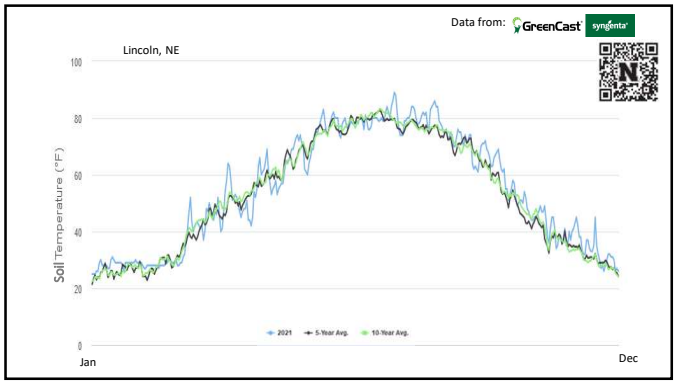

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Weed Seed Germination Soil Temperatures

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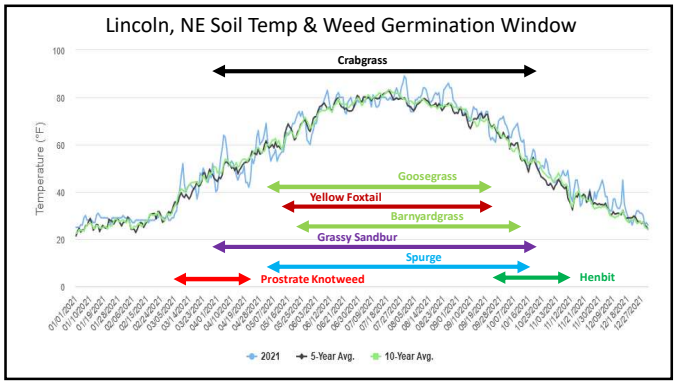

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First Attempt: 2022

- 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

23

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

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

24

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

				July 9, 2022		August 29, 2022	
				Crabgrass	Foxtail	Crabgrass	Foxtail
Untreated Check				**0 h**	**0 g**	**0 f**	**0 g**
Dimension 2EW	2	pt/a	1-May	**100 a**	**45 cde**	**94 a**	**51 bcd**
Dimension 2EW	1	pt/a	May 1-June 15	**92 ab**	**13 fg**	**68 a-d**	**13 fg**
Barricade 4FL	30	fl oz/a	May 1	**90 ab**	**18 efg**	**76 abc**	**42 b-f**
Barricade 4FL	15	fl oz/a	May 1-June 15	**44 efg**	**25 efg**	**37 de**	**48 b-e**
Pendulum Aquacap	4.2	pt/a	May 1	**95 ab**	**24 efg**	**89 a**	**43 b-f**

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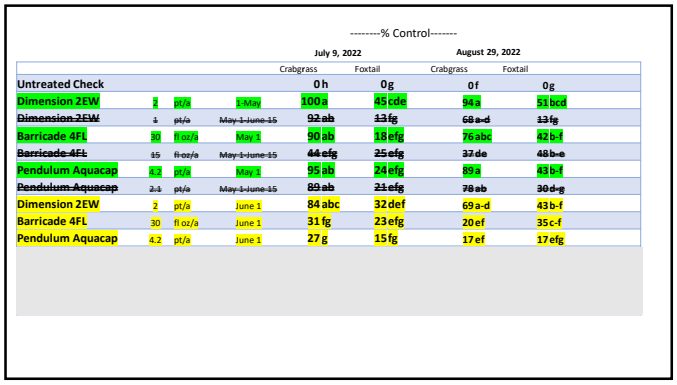

				--------% Control-------			
				July 9, 2022		August 29, 2022	
				Crabgrass	Foxtail	Crabgrass	Foxtail
Untreated Check				0 h	0 g	0 f	0 g
Dimension 2EW	2	pt/a	1-May	100 a	45 cde	94 a	51 bcd
~~Dimension 2EW~~	~~1~~	~~pt/a~~	~~May 1-June 15~~	~~92 ab~~	~~13 fg~~	~~68 a-d~~	~~13 fg~~
Barricade 4FL	30	fl oz/a	May 1	90 ab	18 efg	76 abc	42 b-f
~~Barricade 4FL~~	~~15~~	~~fl oz/a~~	~~May 1-June 15~~	~~44 efg~~	~~25 efg~~	~~37 de~~	~~48 b-e~~
Pendulum Aquacap	4.2	pt/a	May 1	95 ab	24 efg	89 a	43 b-f
~~Pendulum Aquacap~~	~~2.1~~	~~pt/a~~	~~May 1-June 15~~	~~89 ab~~	~~21 efg~~	~~78 ab~~	~~30 d-g~~
Dimension 2EW	2	pt/a	June 1	84 abc	32 def	69 a-d	43 b-f
Barricade 4FL	30	fl oz/a	June 1	31 fg	23 efg	20 ef	35 c-f
Pendulum Aquacap	4.2	pt/a	June 1	27 g	15 fg	17 ef	17 efg

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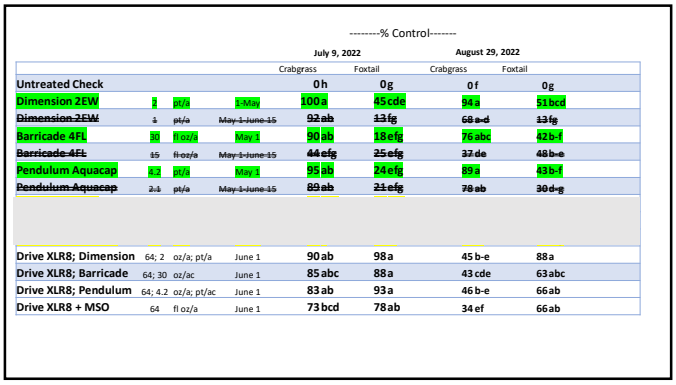

				--------% Control-------			
				July 9, 2022		August 29, 2022	
				Crabgrass	Foxtail	Crabgrass	Foxtail
Untreated Check				0 h	0 g	0 f	0 g
Dimension 2EW	2	pt/a	1-May	100 a	45 cde	94 a	51 bcd
~~Dimension 2EW~~	~~1~~	~~pt/a~~	~~May 1-June 15~~	~~92 ab~~	~~13 fg~~	~~68 a-d~~	~~13 fg~~
Barricade 4FL	30	fl oz/a	May 1	90 ab	18 efg	76 abc	42 b-f
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Drive XLR8; Barricade	64; 30	oz/ac	June 1	85 abc	88 a	43 cde	63 abc
Drive XLR8; Pendulum	64; 4.2	oz/a; pt/ac	June 1	83 ab	93 a	46 b-e	66 ab
Drive XLR8 + MSO	64	fl oz/a	June 1	73 bcd	78 ab	34 ef	66 ab

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Summary 2022

- 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) provides added benefit in timing flexibility and broadleaf activity

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Second Attempt: 2023

- More treatments; more products
- **Foxtail** only
- 2 locations, one managed as utility turf (monthly mow at 4" HOC, no irrigation, 50-60% foxtail) or irrigated rough/lawn (3.5 HOC weekly, irrigated, 25-30% foxtail)

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Untreated Check			
Dimension 2ew	2	pt/a	May 1
Dimension 2ew	1	pt/a	May 1 June 1
Barricade 4fl	30	fl oz/a	May 1
Barricade 4fl	15	fl oz/a	May 1 June 1
Pendulum Aquacap	4.2	pt/a	May 1
Pendulum Aquacap	2.1	pt/a	May 1 June 1
Specticle	6	oz/a	May 1
Specticle	3	oz/a	May1 June 1
Dimension 2ew	2	pt/a	June 1
Barricade 4fl	30	fl oz/a	June 1
Pendulum Aquacap	4.2	pt/a	June 1
Specticle	6	oz/a	June 1

4 pre's, early & late apps, split apps-½ rate

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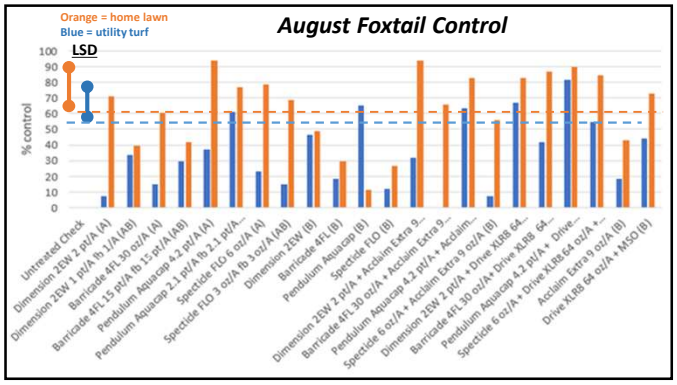
Dimension 2ew	2 pt/a	June 1
Acclaim Extra	9 oz/a	June 1
Barricade 4fl	30 fl oz/a	June 1
Acclaim Extra	9 oz/a	June 1
Pendulum Aquacap	4.2 pt/a	June 1
Acclaim Extra	9 oz/a	June 1
Specticle	6 oz/a	June 1
Acclaim Extra	9 oz/a	June 1
Dimension 2ew	2 pt/a	June 1
Drive XLR8 + MSO	64 oz/a	June 1
Barricade 4fl	30 fl oz/a	June 1
Drive XLR8 + MSO	1 oz/a	June 1
Pendulum Aquacap	4.2 fl oz/a	June 1
Drive XLR8 + MSO	64 fl oz/a	June 1
Specticle	6 oz/a	June 1
Drive XLR8 + MSO	64 fl oz/a	June 1
Acclaim Extra	9 oz/a	June 1
Drive XLR8 + MSO	64 oz/a	June 1

late apps, full rate pre's, w post, post alone

31



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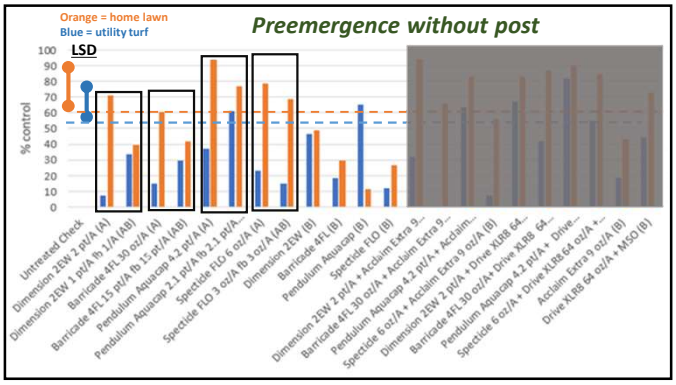

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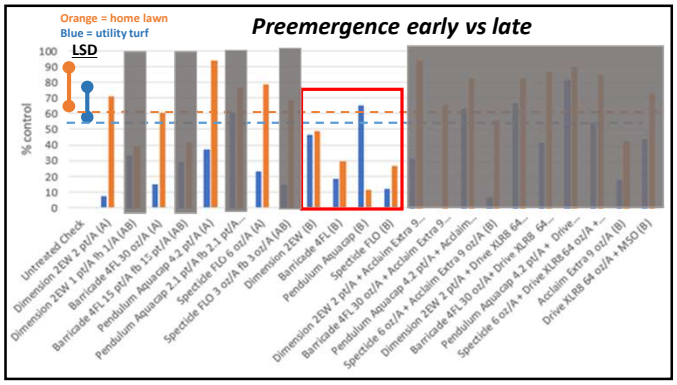

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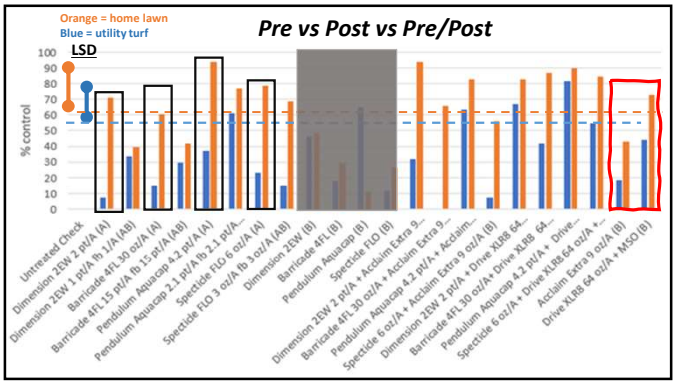

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Summary 2022/2023

- Apply early rather than later ***in both years***
- Split apps with lower rates were problematic ***in both years***
- Foxtail populations were near 100% resulting in poor control and questionable data for objective; ***similar in 2023 in one location***
- Use of post emergence annual grass herbicides (quinclorac (Drive XLR8); mesotrione (Tenacity); topramezone (Pylex) provides added benefit in timing flexibility and broadleaf activity; ***Acclaim and Drive XLR8 in 2023 with similar results***

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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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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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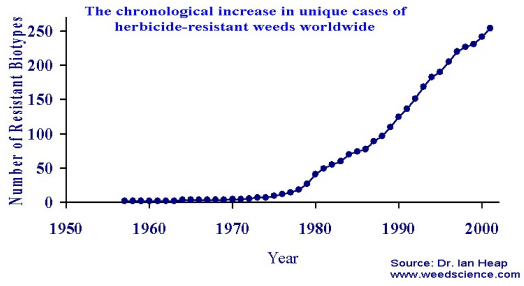

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Weed Characteristics That Favor Resistance

- 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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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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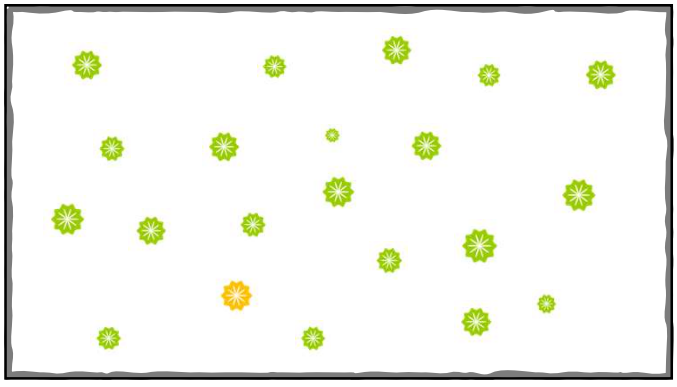

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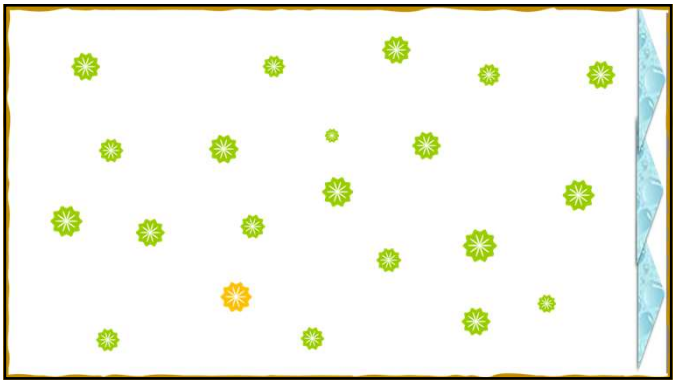

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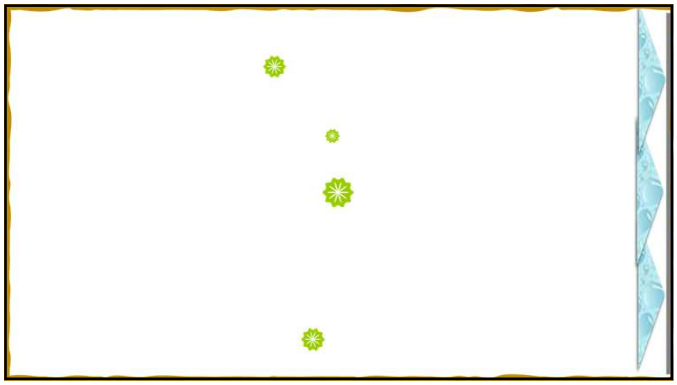

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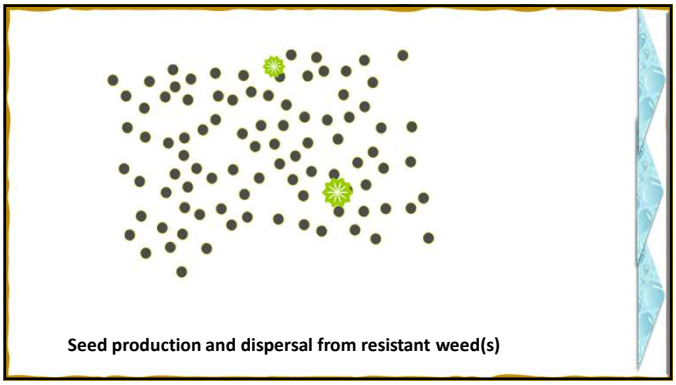

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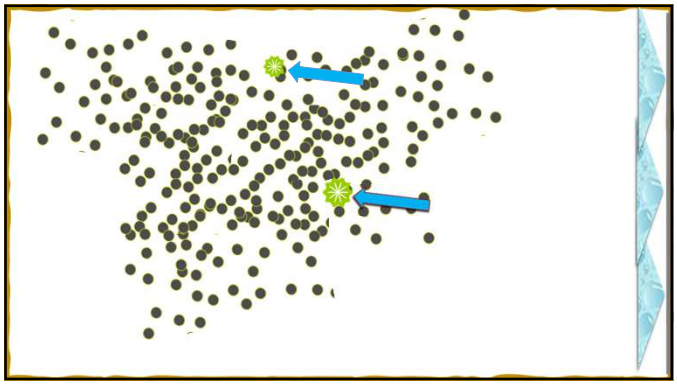

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Summary of Herbicide Mechanism of Action
Weed Science Society of America (WSSA)

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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) cyclohexanediones (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 invoking 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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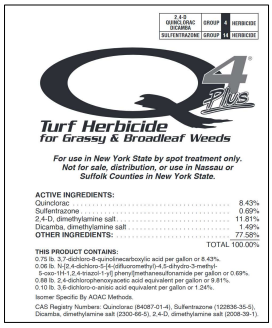

4 active ingredients;
3 are Group 4
1 is Group 14

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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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Thank you!

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