Reducing Cost While Maintaining Quality

Roch Gaussoin
rgaussoin1@unl.edu
@rockinsince57

Turfgrass Science
University of Nebraska

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RESEARCH LETTER

Estimating economic minimums of mowing, fertilizing, and irrigating turfgrass

COMMENTARY

A justification for continued management of turfgrass during economic contraction

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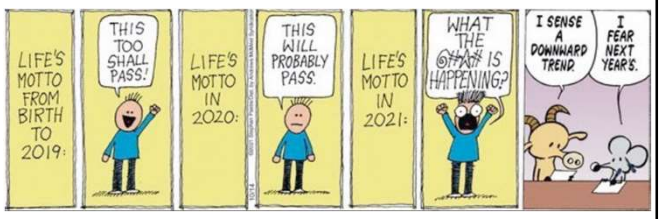

Pearls Before Swine by Stephan Pastis

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As we slide into 2022 what can we expect?

- Supply chain issues
- Increase cost, especially fertilizer

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- Strong demand and the high cost of raw materials have dramatically increased the price of fertilizer in 2021.
  - Trend will continue in 2022
- Just-in-time philosophy is causing shortages, and "rush" orders increase cost

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Raw Material	Nov 8. 2021	Nov 1, 2021	2020	Increase from 2020-2021
Urea Nitrogen – Import Prill U.S. Gulf NOLA	$723	$715	$263	**2.8X**
Diammonium Phosphate (DAP) U.S. Gulf NOLA	$672	$675	$357	**1.9X**
Monoammonium Phosphate (MAP) U.S. Gulf NOLA	$757	$763	$383	**2.0X**
Muriate of Potash (MOP) U.S. Gulf NOLA	$678	$668	$205	**3.3X**
Sulfate of Potash (SOP) Southeast	$775	$750	$575	**1.3X**

From: https://www.lebanonturf.com/blog/golf/the-latest-on-the-rising-fertilizer-market

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Shortage reasons for fertility and pesticide products

- **Reduced laborers to unload tanker ships at gulf ports**
- **Lack of truck transportation from the ports to get ingredients to U.S. formulation plants or formulated products to distributors**
- **Reduced supplies of inert ingredients**
- **Shortage of materials to make containers and packaging**
- **Production facilities in 2020 were not running at 100 percent because demand was low**
- **The uncertainty of the pandemic could not anticipate the increase in consumer demands for product and services**
- **Winter storms early in the year in Texas and across Louisiana increased transportation delays**

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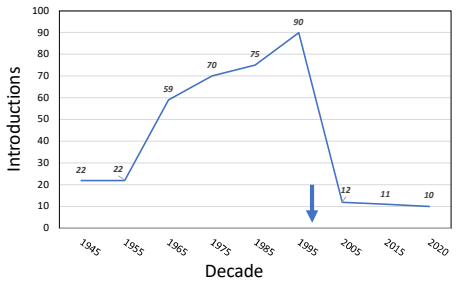
Herbicide Active Ingredient Introduction (US) by Decade



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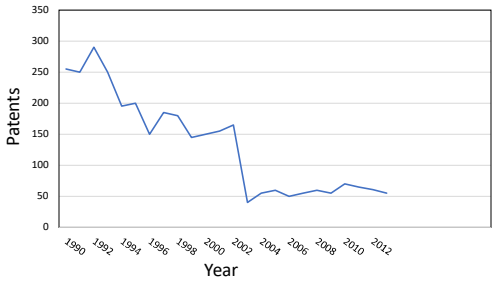
Herbicide Patent Approval (US) Since 1990



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Cost Offsetting

- **Take advantage of early order programs; calibrate; increase training; inventory**
- **Increase routing efficiencies; offer other services to increase margins per stop**
- **Apply less product or equally efficacious yet less expensive products**
- **May be more problematic in 2022 because prepay notices may have been sent out prior to increased costs**

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What are you willing to reduce?

- Mowing Requirement?
- Irrigation Requirement?
- Fertility Requirement
- Pesticide Requirement?
- All of the Above?

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What are you willing to sacrifice?

- Aesthetics?
  - Color, density, leaf texture etc.
- Function?
  - Playability, erosion abatement etc.

Should you have to sacrifice anything?

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"Conventional Wisdom" Low Maintenance Grasses

- Tall Fescue
- Buffalograss
- Fine Fescue(s)

Why is Kentucky bluegrass often excluded?

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Rate of Establishment

- **Tall Fescue**
- **Ky. Bluegrass**
- **Buffalograss**
- **Fine Fescue(s)**

Fast

Slow

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Drought Response

- **Buffalograss**
- **Fine Fescue(s)**
- **Tall Fescue**
- **Ky. Bluegrass**

Best

Worst

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Drought Resistance

- Tolerance
- Avoidance
- Escape

J. Levitt, 1980

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Drought Escape

- Plant completes its life cycle prior to the onset of drought

Example: ***Poa annua var. annua***

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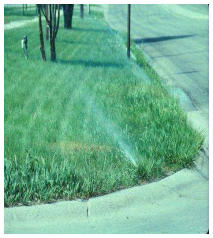
Drought Tolerance

- Increased tolerance of dehydration
- Osmotic adjustment
  - Na^+, K^+, Cl^-
- Recycling of CO_2
- Ability to recover

Example: Kentucky bluegrass



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Drought Avoidance Mechanisms

- Reduced ET
- Deep, Extensive Root System
- Root Plasticity
- High Root:Shoot
- Reduced radiation absorption
- Xeromorphic characteristics

Example: Tall Fescue

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Turfgrass water use

Total amount of water used for growth plus that lost by transpiration and evaporation from plant and soil surfaces.

J. B. Beard, 1973

May or may not be related to drought resistance

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Turfgrass ET Classification

Relative Ranking	ET mm day^{-1}
Very low	< 4.0
Low	4.0-4.9
Medium-low	5.0-5.9
Medium	6.0-6.9
Medium-high	7.0-7.9
High	8.0-8.9
Very high	>9.0

J. B. Beard, 1985

Tall fescue

Kentucky bluegrass, buffalograss

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Reported range of turfgrass ET by species:

Common Name	Scientific Name	ET* (mm day^{-1})	inch/wk
Tall Fescue	*Festuca arundinacea*	7-13	2.0-3.4
Perennial Ryegrass	*Lolium perenne*	7-11	1.8-3.1
St. Augustinegrass	*Stenotaphrum secundatum*	6-11	
Seashore Paspalum	*Paspalum vaginatum*	6-8	
Bahiagrass	*Paspalum notatum*	6-8	
Kikuyugrass	*Pennisetum clandestinum*	6-9	
Creeping Bentgrass	*Agrostis Palustris*	6-10	
Centipedegrass	*Eremochloa ophiuroides*	5-9	
Bermudagrass	*Cynodon spp.*	4-9	
Zoysiagrass	*Zoysia spp.*	5-8	
Kentucky Bluegrass	*Poa pratensis*	4-7	1.1-1.8
Buffalograss	*Buchloe dactyloides*	3-6	1.0-2.0

*Field grown under high evaporative demand conditions

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Supra-optimal Temperature Tolerance

- Buffalograss
- Tall Fescue
- Ky. Bluegrass
- Fine Fescue(s)

Best

Worst

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Relative Rooting Depth

- Buffalograss
- Tall Fescue
- Fine Fescue(s)
- Ky. Bluegrass

Deepest

Shallowest

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pH Optimums

• Tall Fescue	5-8.5
• Fine Fescue	4.5-6.5
• Ky. Bluegrass	5-7.5
• Buffalograss	6-8.5

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Shade Tolerance

- Fine Fescue
- Tall Fescue
- Ky. Bluegrass
- Buffalograss

Best

Worst

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Select Adapted Grasses

- Environment
- Soil conditions
- Intensity of use
- Intensity of culture
- Pest problems

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Kentucky bluegrass summer patch susceptibility

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Mid-Atlantic ecotype of Kentucky bluegrass showing excellent summer stress tolerance

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Kentucky bluegrass cultivars differ in spring green-up and winter color retention

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National Turfgrass Evaluation Program

www.ntep.org

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Proceed with caution…….

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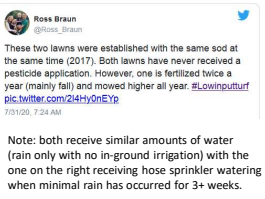

Management matters (KB in Indiana)

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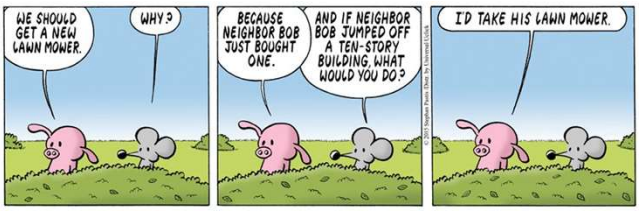

Pearls Before Swine by Stephan Pastis

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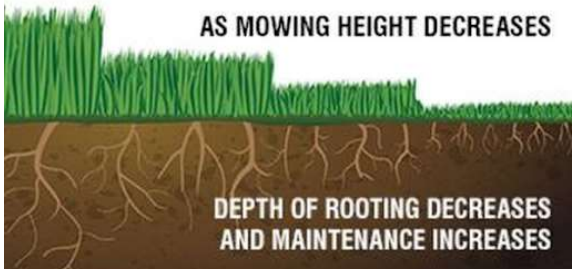

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Height effects on rhizome development

Mowing Height	1″	1.75″	2.5″
	rhizome	weight	(mg)
Kentucky bluegrass	1.0	64	656

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Height effects on leaf area & photosynthetic capacity

Mowing Height	1″	2″	3″
	relative	change	(%)
turfgrass	1.0	240	5760

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Height Effects on Turfgrass Quality

Mowing Height	1.5″	2.5″	4″
species	quality	1-9,	9=best
tall fescue	5.7	6.6	7.4
Kentucky bluegrass	5.2	6.4	6.8
perennial ryegrass	5.2	5.8	5.5

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Effects of deeper rooting and increased photosynthesis

- root pathogens & insects
  - increased tolerance
- Drought
  - deeper water harvesting
  - better recovery
- Traffic
  - better cushion
  - better recovery

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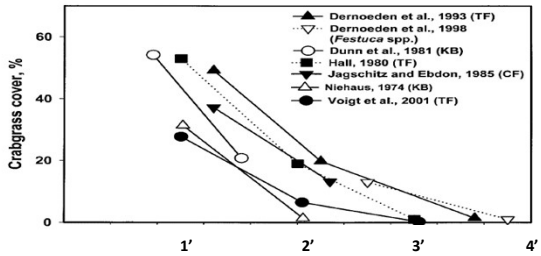
Effects of mowing height on crabgrass cover Busey, 2003



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Height Effects on Weed Pressure

Mowing Height	1.5"	2.5"	4"
species	weed	infestation	(%)
tall fescue	45	23	2
Kentucky bluegrass	55	25	7
perennial ryegrass	57	58	52

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Height effects on crabgrass pressure

Mowing Height	1.25"	2"	3.5"
	crabgrass	cover	(%)*
Kentucky bluegrass	49	20	2

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Mowing Facts & Tips

- Reducing height and increasing frequency results in smaller plants, increased density and a shorter root system.
- Increasing height reduces surface temperature, increases rooting, and decreases frequency.
- Turf mowed at =>2.5" will tolerate occasional scalping better than turf mowed at <2".
- In drought or unirrigated areas, water conservation is best served increasing height.
- A dull mower increases water use and disease and insect pressure.
- Mowing and removing clippings harvests 0.06 – 0.14 lbs. of nitrogen/week.
- ***Mow it high and leave it lie***

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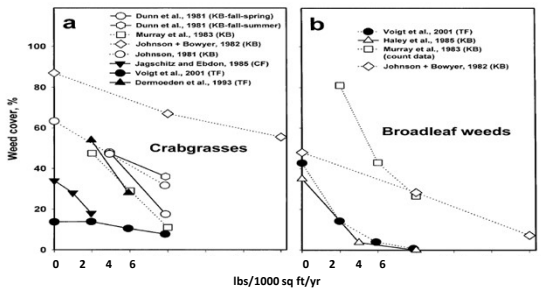
Effects of N fertilization on weed cover Busey, 2003



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Nitrogen Fertilization Considerations

- Don't fertilize turf that isn't actively growing.
- Eliminate late fall fertility.
- Older lawns need less fertilizer and fewer applications annually than newer stands. Eliminate applications during high mineralization periods such as mid-summer or spring.
- Over-fertilized turf wastes money, can lead to excessive thatch accumulation, increased diseases and nitrate leaching to groundwater.
- Different fertilizer sources have different release characteristics.

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Compacted Soil = Prostrate knotweed, goosegrass, and crabgrass

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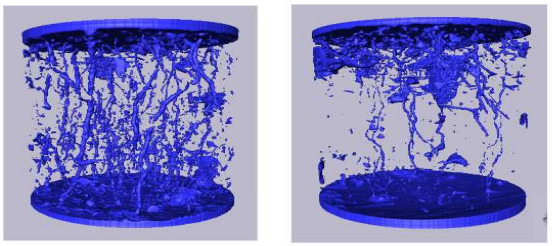

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Cultivation Practices

- Core cultivation
- Slicing
- Spiking
- Deep-tine cultivation
- Drilling
- Solid-tine cultivation

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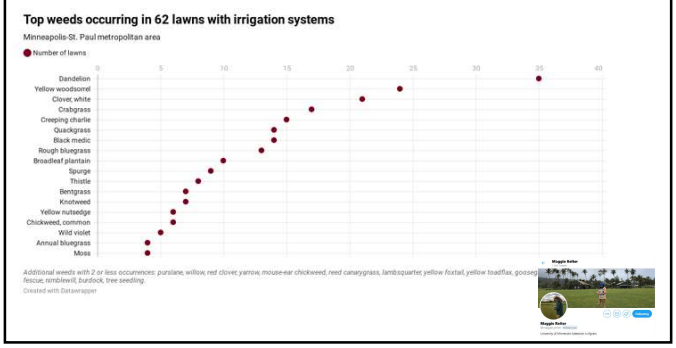

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"low impact pesticides" (herbicide) options

- Preemergence
  - Corn gluten meal
  - Distiller grains
- Postemergence
  - multiple
- Non-selective
  - multiple

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Corn Gluten Meal

- Multiple years required to attain equivalent synthetic control (cumulative effect)
- Significant N input in first year
- Available mail order and limited retail

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Dried distiller grains (DDGs)

- Dried distiller grains (DDGs) are a co-product of the dry milling process, which currently accounts for approx 75 percent of the domestic ethanol production
- DDGs are used almost exclusively used as animal feed
- Much like corn gluten meal, weed control ,and fertilizer value has been documented
- DDGs contain an estimated 10% fatty oils that causes the byproduct to go rancid if not used in a relatively short time period
- Research by the USDA has been ongoing since 2008

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Selective postemergence trial

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Materials and Methods

Spring Applications: May 4 and May 31, 2018 (4 weeks after initial treatment)
Fall Applications: September 13 and October 5, 2018

Product	Active Ingredient	Rate
Untreated Check	N/A	N/A
Iron X	26.52% Iron HEDTA	25.2 oz/M
A.D.I.O.S.	Sodium chloride + NIS	1 lb product/gallon
ICT Halo	Eugenol, Clove Oil	10 oz/M
Fiesta Weed Killer	26.52% Iron HEDTA	12.6 fl oz/M or 25.2 fl oz/M
Fiesta Weed Killer + Xiameter OFX-0309	26.52% Iron HEDTA and Silicon Adjuvant	12.6 oz/M
Natria Lawn Weed and Disease Control	26.52% Iron HEDTA	25.2 fl oz/M
Trimec Classic	2,4-D	4 pt/A
Borax	Boric Acid	Spray to runoff
EcoSmart Weed & Grass Killer	Rosemary Oil	Spray to runoff
AgraLawn Weed and Crab Killer	Cinnamon	Shake on foliage

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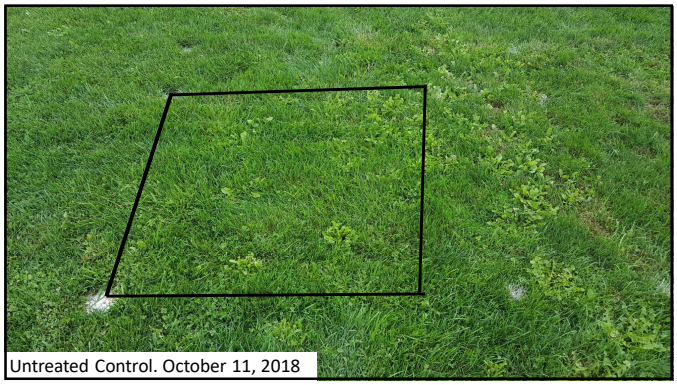
Untreated Control. October 11, 2018

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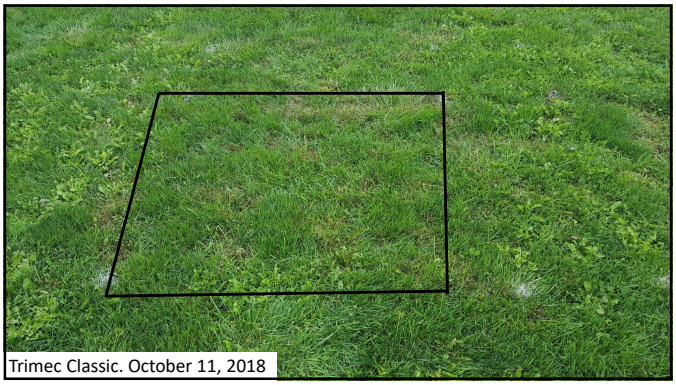
Trimec Classic. October 11, 2018

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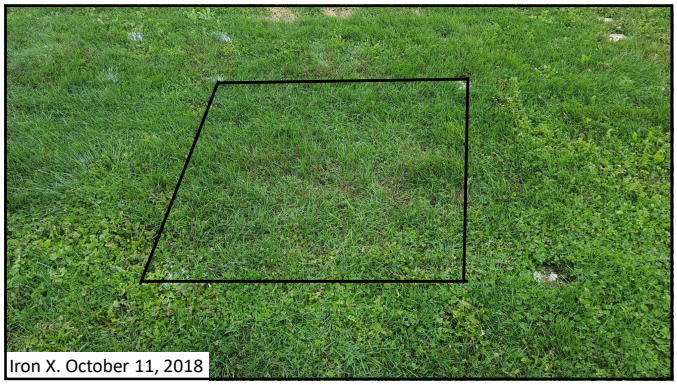
Iron X. October 11, 2018

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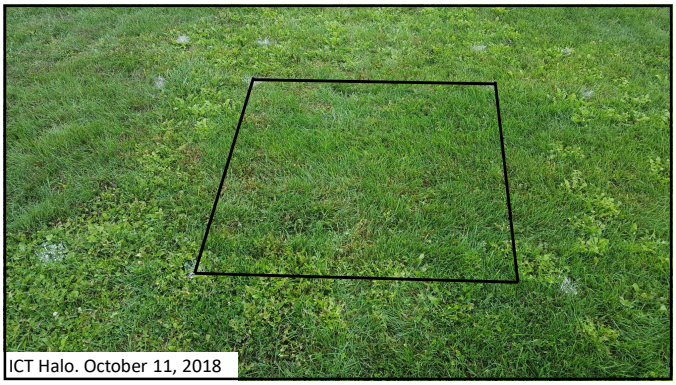
ICT Halo. October 11, 2018

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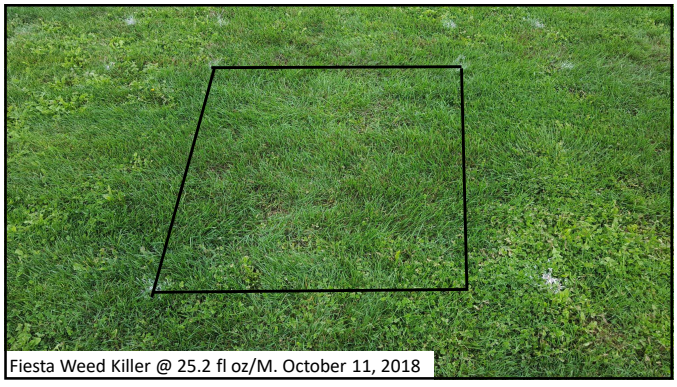
Fiesta Weed Killer @ 25.2 fl oz/M. October 11, 2018

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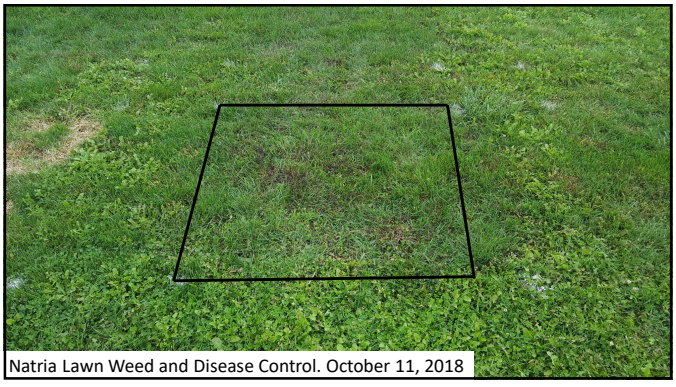
Natria Lawn Weed and Disease Control. October 11, 2018

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Materials and Methods

Spring Applications: May 4 and May 31, 2018 (4 weeks after initial treatment)
Fall Applications: September 13 and October 5, 2018

Product	Active Ingredient	Rate
Untreated Check	N/A	N/A
Iron X	26.52% Iron HEDTA	25.2 oz/M
A.D.I.O.S.	Sodium chloride + NIS	1 lb product
ICT Halo	Eugenol, Clove Oil	10 oz/M
Fiesta Weed Killer	26.52% Iron HEDTA	25.2 fl oz/M
Fiesta Weed Killer + Xiameter OFX-0309	26.52% Iron HEDTA and Silicon Adjuvant	12.6 oz/M
Natria Lawn Weed and Disease Control	26.52% Iron HEDTA	25.2 fl oz/M
Trimec Classic	2,4-D	4 pt/A
Borax	Boric Acid	Spray to runoff
EcoSmart Weed & Grass Killer	Rosemary Oil	Spray to runoff
AgraLawn Weed and Crab Killer	Cinnamon	Shake on foliage
Fiesta Weed Killer	26.52% Iron HEDTA	12.6 fl oz/M

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Conclusions

- Trimec Classic was always numerically the top performer for both trials
- Products containing iron HEDTA and ICT Halo often were statistically as effective as Trimec Classic short term.
  - Iron X
  - Fiesta Weed Killer (full rate or w/ Xiameter)
  - Natria Lawn Weed and Disease Control
- When using most organics, multiple applications will be required
  - Unpublished UNL study showed significantly diminished effectiveness if reapplications (<3X) are not made

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Cost Analysis

Product	Rate	Cost per 1000 sq. ft.
Untreated Check	N/A	--
Iron X	25.2 oz/M	$102.00
A.D.I.O.S.	1 lb product/gallon	$202.74
ICT Halo (name changed to Branch Creek Weed Shield)	10 oz/M	$6.58
Fiesta Weed Killer	25.2 fl oz/M	$16.73
Fiesta Weed Killer + Xiameter OFX-0309	12.6 oz/M	$38.78
Natria Lawn Weed and Disease Control	25.2 fl oz/M	$17.85
Trimec Classic	4 pt/A	$0.61
Borax	Spray to runoff	$5.00/ 64 oz
EcoSmart Weed & Grass Killer	Spray to runoff	$25/ 64 oz
AgraLawn Weed and Crab Killer	Shake on foliage	$23/ 2 lb
Fiesta Weed Killer	12.6 fl oz/M	$8.37

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Organic glyphosate alternatives (non-selective)

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Organic alternatives to glyphosate applied to hybrid bermudagrass in central California

Credit: Maggie Reiter
@maggie_reiter
University of California
Cooperative Extension

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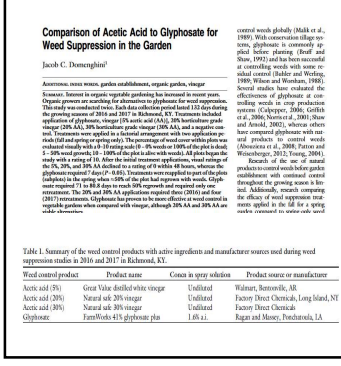

Comparison of Acetic Acid to Glyphosate for Weed Suppression in the Garden

Jacob C. Domenghini[1]

Table 1. Summary of the weed control products with active ingredients and manufacturer sources used during weed suppression studies in 2016 and 2017 in Richmond, KY.

Weed control product	Product name	Conc. in spray solution	Product source or manufacturer
Acetic acid (5%)	Great Value distilled white vinegar	Undiluted	Walmart, Bentonville, AR
Acetic acid (20%)	Natural ade 20% vinegar	Undiluted	Factory Direct Chemicals, Long Island, NY
Acetic acid (30%)	Natural ade 30% vinegar	Undiluted	Factory Direct Chemicals
Glyphosate	FarmWorks 41% glyphosate plus	1.6% a.i.	Regan and Massey, Ponchatoula, LA

- Results indicated that glyphosate, when compared with AA, is the more effective weed suppression method.
- Although all three AA treatments (5%, 20%, and 30%) initially damaged weeds faster than glyphosate, AA did not control weeds for an extended period like glyphosate.
- The 20% and 30% AA applications required 3 to 4 treatments for equivalent control to glyphosate.

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Organic weed control synopsis

- Pro's
  - Viable options available, with research ongoing
  - Market or regulatory niche products
- Con's
  - Product cost
  - Labor cost
  - Contact vs systemic
  - More applications
  - Selectivity
  - Efficacy

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Turfgrass Weed Control for Professionals

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

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Sedge Control Herbicides

From - Turfgrass Weed Control for Professionals

Sedge Control and Turfgrass Tolerance Ratings

Herbicide	Sedge Control: Sedges and Kyllinga: annual sedge	fake-green kyllinga	purple nutsedge	yellow nutsedge	Turf Tolerance: Cool-season: annual bluegrass	creeping bentgrass	fine fescue	Kentucky bluegrass	perennial ryegrass	tall fescue	Warm-season: bermudagrass	buffalograss	zoysiagrass
2,4-D + fluroxypyr + triclopyr + sulfentrazone (Momentum 4-Score)	P	P	P	F	S	S	S	S	S	S	NR	NR	NR
2,4-D + MCPA + dicamba + sulfentrazone (Triad SFZ Select)	P	P	P	F	S	S	S	S	S	S	S	S	S
2,4-D + quinclorac + dicamba + sulfentrazone (Q4 Plus)	P	P	P	F	S	NR	S	S	S	S	S	NR	S
2,4-D + triclopyr + dicamba + sulfentrazone (Foundation)	P	P	P	F	S	NR	S	S	S	S	NR	NR	NR
bentazon (Basagran T/O)	G	F-G	P	F	S	S	S	S	S	S	S	S	S
dimethenamid (Tower[1])	G	G	F	F-G	NR	NR	NR	NR	NR	NR	S	S	S
dimethenamid + pendimethalin (FreeHand)	G	G	F	F-G	NR	NR	NR	NR	NR	NR	S	S	S
flazasulfuron (Katana)	G	G	G-E	G-E	NR	NR	NR	NR	NR	NR	S	S	S
halosulfuron (SedgeHammer)	G	F	G	G-E	NR	S	S	S	S	S	S	S	S
halosulfuron + dicamba (Yukon[2])	G	F	G	G-E	NR	S	S	S	S	S	S	S-I	S
imazapic (Plateau)	F	F	F	F	NR	NR	NR	NR	NR	NR	S	S	NR
imazaquin (Image 70DG)	G	G-E	G	F	NR	NR	NR	NR	NR	NR	S	NR	S
imazosulfuron (Celero)	G	E	G-E	G-E	NR	S	S	S	S	S	S	NR	S
mesotrione (Tenacity)	P	P	P	G	NR	NR	S	S	S	S	NR	S	NR
[illegible]	G	E	E	G	NR	NR	NR	NR	NR	NR	S	NR	S

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Other resources:

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

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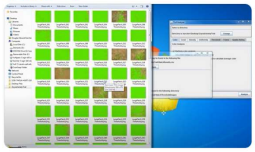
Doug Karcher
@Doug_Karcher

The Turf Analyzer software team is pleased to offer Turf Analyzer & Field Analyzer at no cost moving forward! We are grateful for all of your past support. Happy Holidays!

Free downloads, user manual, and how-to video at: turfanalyzer.com



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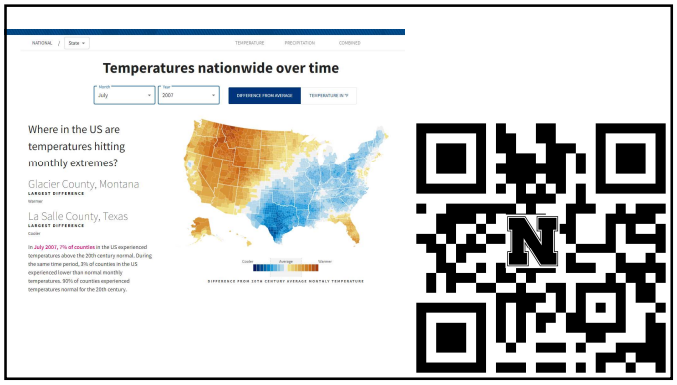

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https://turf.unl.edu/

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Contact Information

- Roch Gaussoin
- rgaussoin1@unl.edu
- @rockinsince57

Thank you!

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