Weed Management from Green to Rough

Roch Gaussoin, Extension Turfgrass Specialist, University of Nebraska

CONFERENCE & TRADE SHOW
FEBRUARY 22-24, 2022

N EXTENSION

1

APRIL 1978

RESEARCH REPORT 352 FARM SCIENCE

FROM THE MICHIGAN STATE UNIVERSITY AGRICULTURAL EXPERIMENT STATION EAST LANSING

ANNUAL BLUEGRASS (*Poa annua* L.)

DESCRIPTION, ADAPTATION, CULTURE AND CONTROL

BY J. B. Beard, P. E. Rieke, A. J. Turgeon, and J. M. Vargas, Jr.

2

TABLE OF CONTENTS

3

TURFGRASS SPECIES	HERBICIDE	TYPE OF APPLICATION	COMMENTS
Kentucky bluegrass	benefin	preemergence	Apply early spring and late summer prior to germination of annual bluegrass.
	DCPA	preemergence	Apply early spring and late summer prior to germination of annual bluegrass.
	linuron[a]	postemergence	Apply spring and late summer to turf with small patches (4 in. dia.) of annual bluegrass for selective control.
	calcium arsenate[a]	pre/post	Apply early spring and late summer until selective control of annual bluegrass occurs.
	maleic hydrazide + chlorflurenol	postemergence	Apply early fall after seed germination of annual bluegrass for gradual removal.
	endothall	postemergence	Apply late summer; selective recovery of the Kentucky bluegrass requires 3 to 4 weeks.
Creeping bentgrass	bensulide	preemergence	Apply late summer prior to germination of annual bluegrass. Repeated use may result in bentgrass injury, especially during mid-summer.
	lead arsenate[a]	pre/post	Apply early spring and late summer until selective control of annual bluegrass occurs.

4

Published March, 1989 Crop Science

TURFGRASS SCIENCE

Influence of Cultural Factors on Species Dominance in a Mixed Stand of Annual Bluegrass/Creeping Bentgrass

R. E. Gaussoin and B. E. Branham*

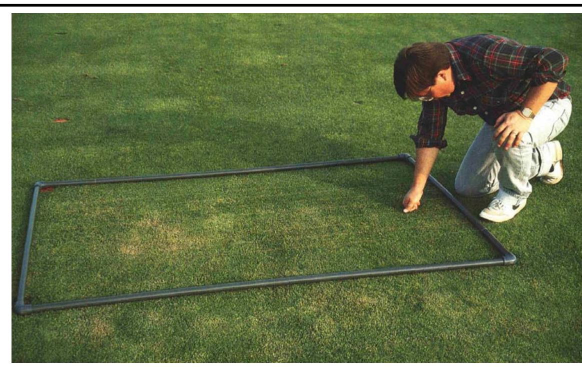
GCM August 1990

Influence Of Cultural Factors On Species Dominance In Annual Bluegrass / Creeping Bentgrass

The persistence of annual bluegrass cannot be easily isolated to any one management practice but depends on the overall cultural program.

PGR's, N fertility, overseeding, irrigation and clipping treatments for 3 years on a mixed stand of AB and CB.

5



6

Summary

- The results of this investigation indicate that cultural practices play a significant role in enhancing or deterring the encroachment of annual bluegrass into creeping bentgrass. Clipping removal reduced the encroachment of annual bluegrass into creeping bentgrass and also reduced the reservoir of annual bluegrass seed in the soil. High N fertility increased annual bluegrass in one year of the study but did not prove to be a significant factor over time. Treatment with mefluidide, in combination with high N fertility or when returning clippings, increased annual bluegrass populations.

7

Clipping removal

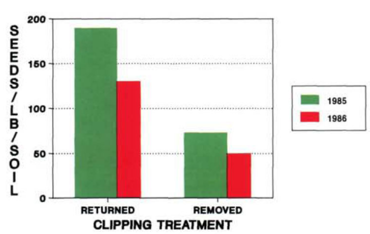
From Literature

- Removal of clippings from a polystand of AB and Kentucky bluegrass can significantly suppress AB invasion when compared to returning clippings (I). Pierce et al. (20) found clipping removal to significantly increase CB population in a mixed stand of AB and CB.

Dissertation results

- Significantly more viable AB seeds were found in the soil where clippings were returned. In 1985 clippings-returned plots had 420 viable AB seeds kg- 1 of soil compared to 160 seeds for the clippings-removed. In 1986 clipping-returned plots contained 130 seeds compared to 50 seeds kg-1 of soil for the clipping-removed plots. Although the amount of viable AB seeds where clippings were removed was still quite high, these plots, when averaged across years, contained 60% fewer viable AB seeds than where clippings were returned.

8

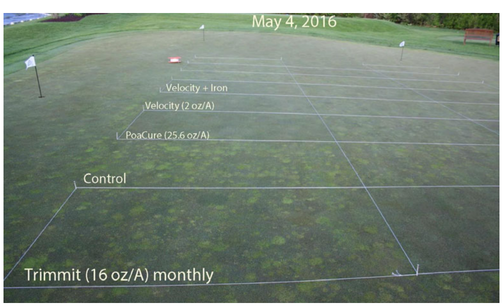


9

PoaCure

- methiozolin
- Provides PRE and POST control of *Poa annua*
- Controls *Poa trivialis (label approval pending)*
- Golf Course only at this point

10



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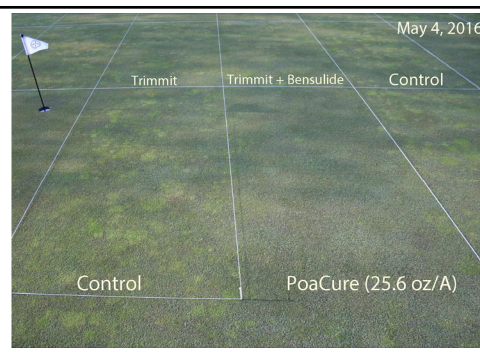

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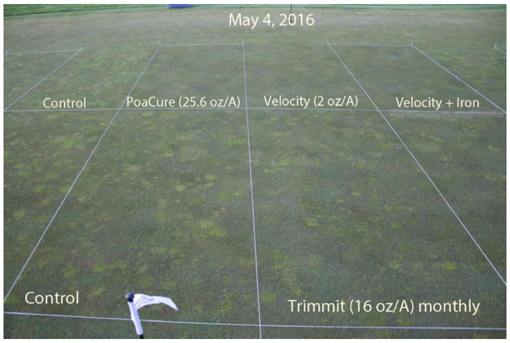


13

PoaCure Words of wisdom from Bruce Branham, Ph.D., University of Illinois

"I recommend starting with 2 apps in the fall at 0.6 oz/M {label recommends 1.2 oz/M} applied two weeks apart. Start between 9/15 and 10/15. Apply two more times the next spring. {some data indicate a spring start date results in better control}.

The following fall, you can repeat the program while potentially going to 3 fall applications depending on the level of control achieved the previous year and your level of comfort with the product. {lots of poa = lots of bare ground}.

I always like to start slowly. Remember, this is just like crabgrass, you'll have do to something every year, at least for quite awhile, until you've not only controlled the visible Poa but have knocked down the seed bank."

14

Cost:
$250/16 Fl oz or $5000 for 20-16 oz bottles = $15.63 oz.
Applying at 0.6 oz/M = $9.39/M per application
X 4 applications in a 12-month period = $37.50/M or $1,634/Acre

Other points of interest:
Be careful when using a single MOA approach to any pest. Rotation of chemistries with Poa is problematic.

15

Herbicide-Resistant Annual Bluegrass (*Poa annua*) Globally

Country	Active Ingredients	Site of Action
France, Belgium, USA, Japan, Czech Republic, United Kingdom, Netherlands, Norway	atrazine, simazine, diuron, cyanazine	Photosystem II
USA (Oregon)	ethofumesate	Lipid inhibitors
USA (North Carolina, Tennessee)	pendimethalin, prodiamine, dithopyr	Microtubule inhibitors
USA (California)	glyphosate	EPSP synthase inhibitors
Belgium	paraquat	PSI electron diverter

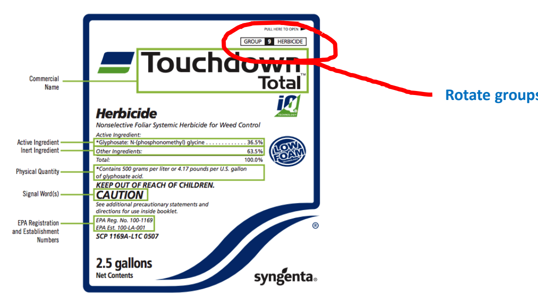
Ian Heap, International Survey of Herbicide Resistant Weeds, January, 2015. Weed Science Society of America.

16

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 modes of action (MOA) in cohort with appropriate management

17



18

Long-Term Efficacy of Annual Bluegrass Control Strategies on Golf Course Putting Greens

Aaron J. Patton,* Ross C. Braun, Geoffrey P. Schortgen, Daniel V. Weisenberger, Bruce E. Branham, Bill Sharp, Matthew D. Sousek, Roch E. Gaussoin, and Zachary J. Reicher

Abstract
Annual bluegrass (*Poa annua* L.; ABG) is among the most common weeds of highly maintained turf in the United States. Though many labeled active ingredients exist for control in golf course fairways, few labeled options exist for putting greens. Further, ABG has demonstrated resistance to several herbicide modes of action commonly used on fairway turf. The use of a systems approach coupling cultural and chemical controls with diverse modes of action could limit the

Applied Turfgrass Science

Core Ideas
- Aerification of golf course putting greens in the summer rather than in the early fall does not decrease annual bluegrass cover.
- Monthly applications of iron sulfate were ineffective at reducing annual bluegrass.
- Methiozolin, paclobutrazol, or bispyribac-sodium provided the greatest reduction of annual bluegrass when used over multiple years.

Core Ideas
- Aerification of golf course putting greens in the summer rather than in the early fall does not decrease annual bluegrass cover.
- Monthly applications of iron sulfate were ineffective at reducing annual bluegrass.
- Methiozolin, paclobutrazol, or bispyribac-sodium provided the greatest reduction of annual bluegrass when used over multiple years.

"The effectiveness of season-long treatments will vary depending on location, but methiozolin (WSSA Group 30 herbicide), paclobutrazol (Type II, Class B PGR), or bispyribac-sodium (WSSA Group 2 herbicide) reduced ABG populations. These three options with diverse mechanisms could be incorporated into an integrated ABG management system that also included mechanical removal, interseeding of improved creeping bentgrass cultivars, the reduction of tree shade on putting greens, and careful management of N and P"

19

- **Bispyribac sodium (Velocity; Group 2) availability is in question (stopped being made in 2017)**
- **Amicarbazone (XONERATE; Group 6) or ethofumasate (Prograss; Group 16) are good *P. annua* herbicides and not labeled for greens…………**
- **Mesotrione (Tenacity; Group 27) is herbicidal on bentgrass**

20

Table 6. Annual bluegrass (ABG) cover at spring seedhead production during and after 4 years of season-long applications of herbicides, iron sulfate, growth regulators~~, or aerification treatments~~ to creeping bentgrass/ABG maintained at putting green height in West Lafayette, IN.

Treatment	Application/year and rate	May 2014†	May 2015	May 2016	April 2017	May 2018
		% cover‡				
Iron sulfate	6 @ 704 oz/acre	74 a§¶	49 a	22 ab	9 bc	27 a
Iron sulfate + bispyribac-sodium	6 @ 704 oz/acre + 4 @ 2 oz/acre	69 ab	32 bc	7 c	6 c	11 bc
Methiozolin	4 @ 25.6 oz/acre	66 b	26 c	7 c	6 c	6 c
Paclobutrazol	6 @ 16 oz/acre	63 b	31 bc	14 bc	12 ab	10 bc
Paclobutrazol + bensulide	6 @ 16 oz/acre + 2 @ 240 oz/acre	73 a	42 ab	17 ab	13 ab	14 b
Bispyribac-sodium	4 @ 2 oz/acre	70 ab	41 ab	15 bc	9 bc	8 c
Nontreated	–	65 b	51 a	24 a	14 a	22 a
P-value		0.0206	0.0005	0.0040	0.0037	< 0.0001

21

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APPLIED TURFGRASS SCIENCE—BRIEFS
Crop, Forage & Turfgrass Management

Field evaluation of preemergence activity of plant growth regulators on annual bluegrass

Luqi Li | Eric Chestnut | Michael Carlson | William Kreuser | Roch Gaussoin
Department of Agronomy and Horticulture, University of Nebraska-Lincoln, Lincoln, NE 68583, USA
Correspondence
Luqi Li, Dept. of Agronomy and Horticulture, University of Nebraska-Lincoln, Lincoln, NE 68583, USA
Email: luqi.li@unl.edu

1 | INTRODUCTION

Plant growth regulators (PGRs) have been widely used in the turfgrass industry for growth reduction of annual bluegrass (*Poa annua* L.; AB). Flurprimidol was found to have preemergence activity on AB in greenhouse studies (Bell, Danneberger, & McDonald, 1997; Gaussoin & Branham, 1987; Haley & Fermanian, 1989), but neither paclobutrazol nor prohexadione-Ca have been evaluated for preemergence activity in the greenhouse or in the field. The objective of this study was to determine if flurprimidol, paclobutrazol, and prohexadione-Ca reduce AB emergence under field conditions. If tested PGR treatments have preemergence activity, then AB cover may be reduced.

2 | MATERIALS AND METHODS

Experiments were conducted at the East Campus Turfgrass Research Facility (EC) and Jim Ager Memorial Junior

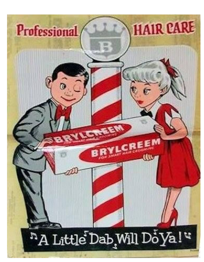
3.5% organic matter. The soil at Ager is a Kennebec complex (Fine-silty, mixed, superactive, mesic Cumulic Hapludolls) with a pH of 6.8 and 3.6% organic matter. The study was an incomplete-block design with five treatments across two locations. Plot size was 2 by 2 ft with three replications at each location. Glyphosate (Bayer Crop Science, Durham, NC) was applied on 28 June and 8 July at both locations to eliminate existing turfgrass vegetation. Post glyphosate application, plots were scalped to the soil surface with a Toro Greensmaster 1000 reel-mower (The Toro Company, Bloomington, MN) to remove above ground plant material. Experimental sites were mowed at 0.375 in. The emerging AB was below the height of cut throughout the study. The PGR applications were applied using growing degree day (GDD)-based intervals appropriate for CB fairways (Kreuser, Obear, Michael, & Soldat, 2018; Table 1). Applications were made using a fabricated CO_2-powered backpack sprayer at 40 psi, delivering 87 gal water ac^{-1} via a single nozzle (8002-VS flat fan, TeeJet Spraying Systems, Wheaton, IL) spray boom. Premeasured bottles were sprayed in a crosshatch pat-

"Results of this study suggest flurprimidol and paclobutrazol have preemergence activity on AB under field conditions, but not prohexadione-Ca. Despite the preemergence benefit of these PGRs, golf course superintendents should not use them exclusively to control AB. However, one may expect reduction in AB seed germination (15-18%) and reduced AB cover by incorporating Class-B PGRs, especially paclobutrazol, into the management program."

22

23

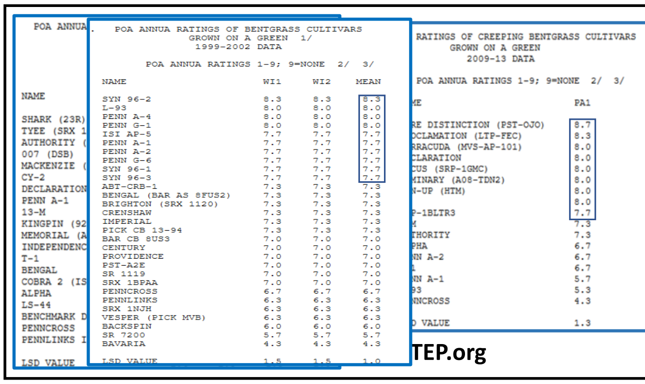
Smucker RWTD00 Drift Free Sponge Dauber



Fill with 2-4% solution of glyphosate

24

25



POA ANNUA ...

NAME
SHARK (23R)
TYEE (SRX 1
AUTHORITY (
007 (DSB)
MACKENZIE (
CY-2
DECLARATION
PENN A-1
13-M
KINGPIN (92
MEMORIAL (A
INDEPENDENC
T-1
BENGAL
COBRA 2 (IS
ALPHA
LS-44
BENCHMARK D
PENNCROSS
PENNLINKS I
LSD VALUE

POA ANNUA RATINGS OF BENTGRASS CULTIVARS
GROWN ON A GREEN 1/
1999-2002 DATA

POA ANNUA RATINGS 1-9; 9=NONE 2/ 3/

NAME	WI1	WI2	MEAN
SYN 96-2	8.3	8.3	8.3
L-93	8.0	8.0	8.0
PENN A-4	8.0	8.0	8.0
PENN G-1	8.0	8.0	8.0
ISI AP-5	7.7	7.7	7.7
PENN A-1	7.7	7.7	7.7
PENN A-2	7.7	7.7	7.7
PENN G-6	7.7	7.7	7.7
SYN 96-1	7.7	7.7	7.7
SYN 96-3	7.7	7.7	7.7
ABT-CRB-1	7.3	7.3	7.3
BENGAL (BAR AS 8FUS2)	7.3	7.3	7.3
BRIGHTON (SRX 1120)	7.3	7.3	7.3
CRENSHAW	7.3	7.3	7.3
IMPERIAL	7.3	7.3	7.3
PICK CB 13-94	7.3	7.3	7.3
BAR CB 8US3	7.0	7.0	7.0
CENTURY	7.0	7.0	7.0
PROVIDENCE	7.0	7.0	7.0
PST-A2E	7.0	7.0	7.0
SR 1119	7.0	7.0	7.0
SRX 1BPAA	7.0	7.0	7.0
PENNCROSS	6.7	6.7	6.7
PENNLINKS	6.3	6.3	6.3
SRX 1NJH	6.3	6.3	6.3
VESPER (PICK MVB)	6.3	6.3	6.3
BACKSPIN	6.0	6.0	6.0
SR 7200	5.7	5.7	5.7
BAVARIA	4.3	4.3	4.3
LSD VALUE	1.5	1.5	1.0

RATINGS OF CREEPING BENTGRASS CULTIVARS
GROWN ON A GREEN
2009-13 DATA

POA ANNUA RATINGS 1-9; 9=NONE 2/ 3/

ME	PA1
RE DISTINCTION (PST-OJO)	8.7
OCLAMATION (LTP-FEC)	8.3
RRACUDA (MVS-AP-101)	8.0
CLARATION	8.0
CUS (SRP-1GMC)	8.0
MINARY (A08-TDN2)	8.0
N-UP (HTM)	8.0
	8.0
P-1BLTR3	7.7
M	7.3
THORITY	7.3
PHA	6.7
NN A-2	6.7
1	6.7
NN A-1	5.7
93	5.3
NNCROSS	4.3
D VALUE	1.3

TEP.org

26

27

Annual bluegrass populations in mixed stands with bentgrass cultivars seeded September 2013 (NJ)

		-----------------------2014-------------------------		--2015--
		30 Jun **	10 Oct ***	May 1 ***
Cultivar	Species			
Proclamation	A. stolonifera	17 d	13 de	16 de
Shark	A. stolonifera	18 cde	17 cd	16 de
007	A. stolonifera	28 ab	20 c	22 cd
Pinup	A. stolonifera	26 abc	22 c	21 cd
Barracuda	A. stolonifera	24 bcd	28 b	32 bc
L-93	A. stolonifera	26 abc	36 a	48 a
Penncross	A. stolonifera	32 a	39.4 a	49 a
$LSD_{0.05}$		8	5	13

28

Response of annual bluegrass populations Post traffic (NJ)

		----2015 ---	-------------2016--------		------------2017-----		----------2018----	
		Nov 2	Apr-27	Nov-04	Apr 14	Nov 3	May 7	Oct 30
Cultivar	Species							
Proclamation	A. stolonifera	36 c	30 e	13 bc	16 c	5 c	14 d	3 c
Shark	A. stolonifera	43 bc	34 cde	8 cd	12 c	5 c	12 d	2 c
007	A. stolonifera	37 c	32 de	7 cd	14 c	5 c	14 d	2 c
Pinup	A. stolonifera	37 c	30 e	8 cd	20 c	9 bc	14 d	2 c
Barracuda	A. stolonifera	52 b	41 cd	12 bc	20 c	8 bc	20 cd	4 c
L-93	A. stolonifera	55 b	53 ab	17 b	34 b	15 b	41.3 b	13 b
Penncross	A. stolonifera	76 a	63 a	16 b	43 b	16 b	47 b	15 b
$LSD_{0.05}$		12	11	8	11	9	10	8

29

Crop Science / Volume 61, Issue 3 / p. 1527-1537
REVIEW AND INTERPRETATION PAPERS | Open Access

Current understanding of the *Poa annua* life cycle

Devon E. Carroll, James T. Brosnan, Robert N. Trigiano, Brandon J. Horvath, Avat Shekoofa, Thomas C. Mueller

First published: 06 January 2021
https://doi.org/10.1002/csc2.20441
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Associate Editor: Bradley S Bushman

About | Sections

Abstract

Poa annua L. is a common component of turfgrass systems both as a weed and a desirable species. Since first classified by Carl von Linné in 1753, nearly 50 taxa of *P. annua* have been described, with delineations made on the basis of plant morphology and not life cycle. Yet, peer-reviewed turfgrass literature has recognized only two of these taxa over the past 50 yr, *P. annua* L. var.

30

31

New (or modified) weed control products 2018-2021

- Sure Power (2,4-D ester + triclopyr + fluroxypyr + flumioxazin)
- Boulder 6.3 (triclopyr ester)
- SUREPYC (sulfentrazone)
- SedgeMaster (halosulfuron)
- Vexis (pyrimsulfan)
- NativeKlean (2,4-D + aminopyralid)
- GameOn (2,4-D + fluroxypyr + halauxifen-methyl)

32

Sure Power

- 2,4-D ester + triclopyr + fluroxypyr + flumioxazin
- Cool season turf
- 250 broadleaf weeds, including ground ivy and wild violet
- Spray residue should be completely dry prior to entering treated areas as accumulation on tires can lead to tracking
- Avoid applications during conditions of fog, high moisture, and wet foliage
- Avoid applications for at least 14 days following freezing conditions or frost
- Optimal timing: June 15 – September 15

33

Boulder 6.3

- triclopyr ester
- Cool season turf except bentgrass
- Good broadleaf spectrum, low cost

34

35

Interference Between Kentucky Bluegrass (*Poa pratensis*) and Yellow Nutsedge (*Cyperus esculentus*) in a Home Lawn

Luqi Li and Roch Gaussoin
University of Nebraska-Lincoln

36

<6,700 VS. > 44,500 tubers per 1000 sq ft

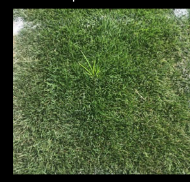
From 8" dia soil core

Polyculture Sample **Monoculture Sample**

37

Summary:

- The presence of an actively growing turf impedes tuber and shoot production of yellow nutsedge from 65 to 98 %
- The non-irrigated plots had less yellow nutsedge than ET or overwatered plots in mono- and polyculture
- The non-fertilized plots had less yellow nutsedge than the fertilized plots



38

SUREPYC (sulfentrazone)
SedgeMaster (halosulfuron)

- SUREPYC
  - Same AI as Dismiss, similar properties
- SedgeMaster
  - Same AI as SedgeHammer, similar properties

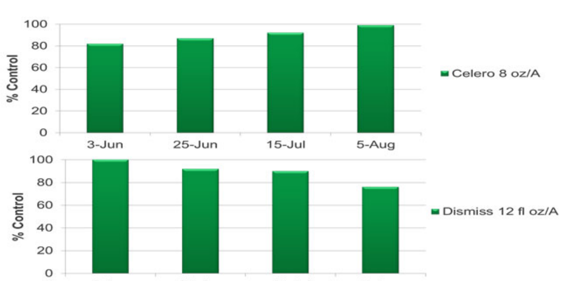
39

Celero (imazosulfuron)

- Add NIS at 0.25% (v/v)
- Repeat application 21 days after the initial application if needed
- Do not apply to moist or wet turf
- Do not apply to golf course putting greens

40

UNL-Mead Site



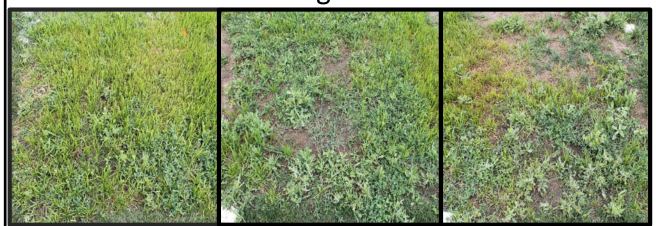
41

Vexis

- pyrimsulfan
- Targets nutsedge
- "shake and bake"
- Granular product
- Does not require watering in
- Convenience

42

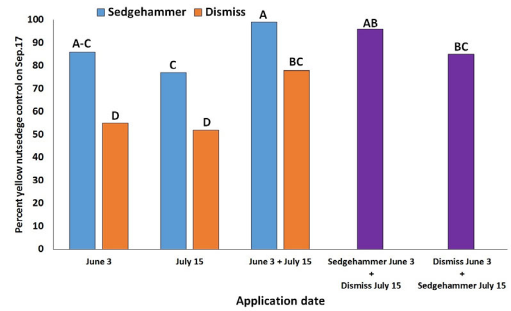
Vexis Testing at UNL-2020



Control | 1 app 3 tiller 40 dait | 2X app 3 tiller 40dait 10dat (2nd)

43

Effect of application timing on yellow nutsedge control when Sedgehammer (1 oz/A) and/or Dismiss (4 oz/A) was applied on June 3 and/or July 15.



44

Rotating MOA's for Resistance Management

- Resistance in yellow nutsedge has been reported (Tehranchian et al., 2015)
- Rotate halosulfuron, imazosulfuron or pyrimisulfan (***Group 2***) with mesotrione (***Group 27***) or sulfentrazone (***Group 14***) or bentazon (***Group 8***) for postemergence yellow nutsedge control

45

How to control yellow nutsedge

- Yellow nutsedge herbicide control programs should be implemented early in the season and in consecutive years
- As early as it is visible – early June
  - Tubers are immature
  - Controls/suppresses tuber formation
  - 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 for most herbicides
  - Rotate modes of action

46

NativeKlean

- 2,4-D + aminopyralid
- targets broadleaf weeds, including invasive and noxious weeds and woody plants, in native or natural grass areas that are not regularly mowed or maintained
- residual control for more than three months
- native or natural forbs will be injured or controlled
- Economical niche product

47

GameOn

- 2,4-D + fluroxypyr + halauxifen-methyl
- broad spectrum, fast acting
- reduced non target injury - 2,4-D choline

48

Trial Info

- Location: Mead, NE (John Seaton Anderson Turf Research Farm)
- Kentucky bluegrass with heavy dandelion and white clover
- GameOn Specialty Herbicide @3, 3.5 and 4.0 pt/A
  - 2 Industry standards
  - 1 experimental
- UTC

- Application date: October 2
- Image taken in the spring

49

Treatments

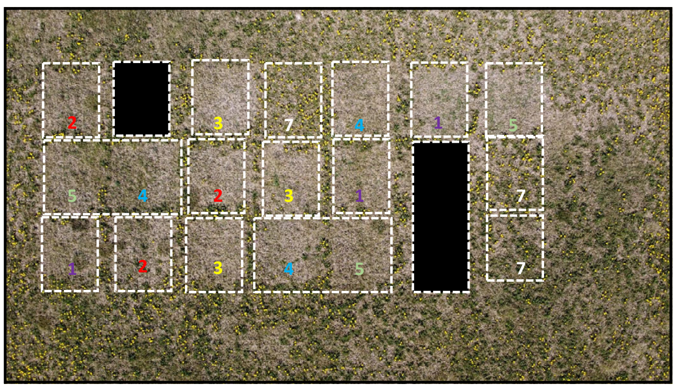
GameOn Specialty Herbicide @3, 3.5 and 4.0 pt/A

2 Industry Standards

I experimental

UTC

50



51

Mature Prostrate Knotweed Control 2019

		6 WAT	9 WAT	13 WAT	17 WAT
GameOn	2pt/a	88.8a	96.3a	100a	100a
GameOn	3pt/a	96.3a	100a	100a	100a
GameOn	4pt/a	96.3a	100a	100a	100a
Untreated		0c	0c	0c	0c

52

Change-Up (MCPA, fluroxypyr and Dicamba) Efficacy on Prostrate Knotweed

Spring and Summer, 2019

53

Visual percent control of prostrate knotweed following treatment with Change-Up. Initiated April 20, 2019.

	13 DAA May 3	26 DAA May 16	41 DAA May 31	55 DAA June 14	68 DAA June 27
Change-Up[2]	42.5 A	81.3 A	81.3 A	77.5 A	72.5 A

1 Change-Up applied at 3 pt/A

54

April 20
Day of
Application

May 16
26 DAA

Control

June27
68 DAA

55

April 20
Day of
Application

May 16
26 DAA

Change-Up

June27
68 DAA

56

Table 2. Percent control of prostrate knotweed following treatment with Change-Up applied at 3 pt/A . Initiated July 12, 2019.

	14 DAA July 25	22 DAA August 2	36 DAA August 16	42 DAA August 22	49 DAA August 29	64 DAA September 13
Change-Up[2]	92.5 A	100 A	100 A	100 A	100 A	100 A

1 Change-Up applied at 3 pt/A

57

Summary

- **Spring:** Change-Up reduced prostrate knotweed populations up to 41 DAA
  - Change-Up provided >70% control, but efficacy was reduced
  - Make multiple applications if applying early in the spring to compensate for germination post application
- **Summer:** Knotweed control was increased when applied in the summer
  - Change-Up provided 100% control

58

Organic/natural weed control options

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

59

Selective postemergence trial

60

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

61

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

62

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
  - 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 no reapplication is made

63

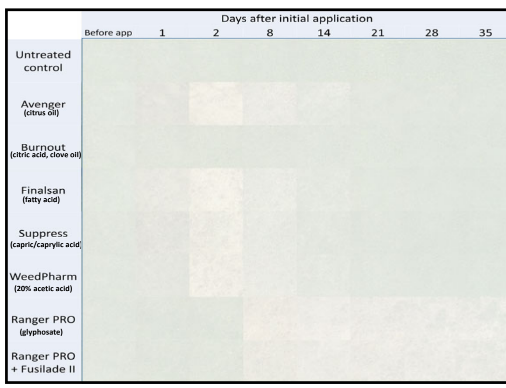
Cost Analysis

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	25.2/12.6 fl oz/M	$16.73/$8.37
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

64

Organic glyphosate alternatives (non-selective)

65



Organic alternatives to glyphosate applied to hybrid bermudagrass in central California

Credit: Maggie Reiter
@maggie_reiter
University of California Cooperative Extension

66

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

Jacob C. Domenghini[1]

ADDITIONAL INDEX WORDS. garden establishment, organic garden, vinegar

SUMMARY. Interest in organic vegetable gardening has increased in recent years. Organic growers are searching for alternatives to glyphosate for weed suppression. This study was conducted twice. Each data collection period lasted 132 days during the growing seasons of 2016 and 2017 in Richmond, KY. Treatments included application of glyphosate, vinegar [5% acetic acid (AA)], 20% horticulture grade vinegar (20% AA), 30% horticulture grade vinegar (30% AA), and a negative control. Treatments were applied in a factorial arrangement with two application periods (fall and spring or spring only). The percentage of weed cover within plots was evaluated visually with a 0–10 rating scale (0 = 0% weeds or 100% of the plot is dead; 5 = 50% weed growth; 10 = 100% of the plot is alive with weeds). All plots began the study with a rating of 10. After the initial treatment applications, visual ratings of the 5%, 20%, and 30% AA declined to a rating of 0 within 48 hours, whereas the glyphosate required 7 days ($P = 0.05$). Treatments were reapplied to part of the plots (subplots) in the spring when ≈50% of the plot had regrown with weeds. Glyphosate required 71 to 80.8 days to reach 50% regrowth and required only one retreatment. The 20% and 30% AA applications required three (2016) and four (2017) retreatments. Glyphosate has proven to be more effective at weed control in vegetable gardens when compared with vinegar, although 20% AA and 30% AA are viable alternatives

control weeds globally (Malik et al., 1989). With conservation tillage systems, glyphosate is commonly applied before planting (Bruff and Shaw, 1992) and has been successful at controlling weeds with some residual control (Buhler and Werling, 1989; Wilson and Worsham, 1988). Several studies have evaluated the effectiveness of glyphosate at controlling weeds in crop production systems (Culpepper, 2006; Griffith et al., 2006; Norris et al., 2001; Shaw and Arnold, 2002), whereas others have compared glyphosate with natural products to control weeds (Abouziena et al., 2008; Patton and Weisenberger, 2012; Young, 2004).

Research of the use of natural products to control weeds before garden establishment with continued control throughout the growing season is limited. Additionally, research comparing the efficacy of weed suppression treatments applied in the fall for a spring garden compared to spring-only weed

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	Concn in spray solution	Product source or manufacturer
Acetic acid (5%)	Great Value distilled white vinegar	Undiluted	Walmart, Bentonville, AR
Acetic acid (20%)	Natural safe 20% vinegar	Undiluted	Factory Direct Chemicals, Long Island, NY
Acetic acid (30%)	Natural safe 30% vinegar	Undiluted	Factory Direct Chemicals
Glyphosate	FarmWorks 41% glyphosate plus	1.6% a.i.	Ragan 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.

67

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

68

Turfgrass Weed Control for Professionals

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

69

Format: Book.

70

Sedge Control Herbicides

From - Turfgrass Weed Control for Professionals

Sedge Control and Turfgrass Tolerance Ratings

	Sedge Control				Turf Tolerance								
	Sedges and Kyllinga				Cool-season						Warm-season		
Herbicide	annual sedge	false-green kyllinga	purple nutsedge	yellow nutsedge	annual bluegrass	creeping bentgrass	fine fescue	Kentucky bluegrass	perennial ryegrass	tall fescue	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
metolachlor (Pennant MAGNUM)	G	F	F	G	NR	NR	NR	NR	NR	NR	S	NR	S

71

Other resources:

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

72

Contact Information

- Roch Gaussoin
- rgaussoin1@unl.edu

@rockinsince57

73