

Purdue University Weed Science

Influence of Tough on Waterhemp and Palmer Amaranth Control in Corn

Trial ID: 19-WIN-Tough Location: Winamac Trial Year: 2019
 Protocol ID: 19-WIN-Tough Investigator (Creator): Dr. Bryan Young
 Project ID: Study Director:
 Sponsor Contact: Dennis Long

General Trial Information

Investigator: Dr. Bryan Young **Title:** Professor

Discipline: H herbicide
Trial Status: E established

ARM Trial Created On: Mar-29-2019

Initiation Date: May-1-2019

Trial Location

City: Winamac **Country:** USA United States
State/Prov.: Indiana
Postal Code: 46996

Latitude of LL Corner °: 41.1156622 N
Longitude of LL Corner °: -86.6892905 W

Conducted Under GLP: No

Conducted Under GEP: No

Role: INVEST investigator
Investigator: Dr. Bryan Young **Title:** Professor
Organization: Purdue University
Address 1: 915 W, State Street
Country: USA United States **E-mail:** BryanYoung@purdue.edu
City: West Lafayette **Postal Code:** 47907

Role: SPONSR sponsor
Sponsor: Dennis Long

Crop Description

Crop 1: C ZEAMD Zea mays indentata Dent corn
Entry Date: Jun-26-2019
Variety: DKC 62-52RIB
Planting Date: May-15-2019 **Planting Rate:** 32000 S/A
Depth: 2 IN
Rows per Plot: 4 **Planting Method:** SEEDED seeded
Row Spacing: 30 IN **Planting Equipment:** PP plot planter

Pest Description

Pest 1 Type: W **Code:** AMAPA Amaranthus palmeri **Entry Date:** Jun-26-2019
Common Name: amaranth, Palmer **Stage Scale:** BBCH
Attributes: glyphosate-resistant

Pest 2 Type: W **Code:** CHEAL Chenopodium album **Entry Date:** Jun-26-2019
Common Name: lambsquarters, common **Stage Scale:** BBCH

Pest 3 Type: W **Code:** DIGSA Digitaria sanguinalis **Entry Date:** Jun-26-2019
Common Name: crabgrass, large **Stage Scale:** BBCH

Site and Design

Treated Plot Width: 6.67 FT **Site Type:** FIELD field
Treated Plot Length: 25 FT **Experimental Unit:** 1 PLOT plot
Treated Plot Area: 166.75 FT2 **Treatments:** 12 **Tillage Type:** REDTIL reduced-till
Replications: 4 **Study Design:** RACOB L Randomized Complete Block (RCB)

Field Prep./Maintenance:

Spring 2019 fertilizer application: 150 lb potash 100 lb AMS, 50 lb DAP
 Equivalent to 30 lb N, 23 lb P2O5, 93 lb K2O, plus some sulfur

5/6/19: Sprayed Roundup PowerMax (32oz/A) plus 2,4-D LV4 (1 pt/A) to entire area

5/14/19: Sprayed 28% UAN @ 60 GPA to corn area (~180 lb N/A)

5/14/19: Sprayed Gramoxone @ 2 pt/A to entire area

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Soil Description

Description Name: Winamac 17
% Sand: 83 **% OM:** 2.8 **Texture:** LS loamy sand
% Silt: 10 **pH:** 6.1
% Clay: 7 **CEC:** 9.4 **Fert. Level:** G good

Weather Conditions

Overall Moisture Conditions: WEWEDR wet-wet-dry
Closest Weather Station: K9WKK NW Kokomo **Distance:** 58 MI

No.	Date	Moisture Total	Unit
1.	May-1-2019	0.04	IN
2.	May-2-2019	0.06	IN
3.	May-3-2019	0.45	IN
4.	May-4-2019	0.03	IN
5.	May-5-2019	0.21	IN
6.	May-13-2019	0.29	IN
7.	May-20-2019	0.48	IN
8.	May-22-2019	0.24	IN
9.	May-23-2019	0.24	IN
10.	May-25-2019	0.59	IN
11.	May-27-2019	0.1	IN
12.	May-28-2019	0.36	IN
13.	May-29-2019	0.63	IN
14.	May-30-2019	0.6	IN
15.	May-31-2019	0.29	IN
16.	Jun-2-2019	0.54	IN
17.	Jun-6-2019	0.35	IN
18.	Jun-9-2019	0.1	IN
19.	Jun-10-2019	0.43	IN
20.	Jun-11-2019	0.02	IN
21.	Jun-13-2019	0.01	IN
22.	Jun-14-2019	0.06	IN
23.	Jun-15-2019	0.09	IN
24.	Jun-16-2019	0.5	IN
25.	Jun-18-2019	2.46	IN
26.	Jun-20-2019	2.5	IN
27.	Jun-21-2019	0.06	IN
28.	Jun-24-2019	0.1	IN
29.	Jun-25-2019	0.01	IN
30.	Jul-6-2019	0.25	IN
31.	Jul-11-2019	0.15	IN
32.	Jul-15-2019	0.93	IN
33.	Jul-17-2019	0.92	IN
34.	Jul-18-2019	0.08	IN
35.	Jul-22-2019	0.05	IN
36.	Jul-23-2019	0.03	IN
37.	Jul-30-2019	1.31	IN

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Application Description

	A	B	C
Application Date	May-15-2019	Jun-11-2019	Jun-18-2019
Appl. Start Time	12:30 PM	12:30 PM	11:30 AM
Appl. Stop Time	1:10 PM	12:45 PM	12:00 PM
Application Method	SPRAY	SPRAY	SPRAY
Application Timing	PRE	<12"CN	4-6"W
Application Placement	BROADC	BROADC	BROADC
Applied By	MO	BW	BW
Appl. Entry Date	Jun-26-2019	Jun-26-2019	Jun-26-2019
Air Temperature Start, Stop	78 78 F	86 86 F	78 78 F
% Relative Humidity Start, Stop	45 45	26 26	64 64
Wind Velocity+Dir. Start	3 MPH SSW	1.5 MPH SSW	1 MPH SSW
Wind Velocity+Dir. Stop	5 MPH SSW	3 MPH SSW	2 MPH SSW
Wind Velocity+Dir. Max	5 MPH SSW	3 MPH SSW	2 MPH SSW
Wet Leaves (Y/N)	N no	N no	N no
Soil Temperature	68 F	81 F	70 F
Soil Moisture	NORMAL	NORMAL	NORMAL
% Cloud Cover	40	5	30

Crop Stage At Each Application

	A	B	C
Crop 1 Code, BBCH Scale	ZEAMD BCOR	ZEAMD BCOR	ZEAMD BCOR
Stage Scale Used		BBCH	BBCH
Stage Majority, Percent	00	13	14
Stage Minimum, Percent		13	14
Stage Maximum, Percent		14	15
Height Average		9.5 IN	12 IN
Height Minimum, Maximum		8 10	10 13

Pest Stage At Each Application

	A	B	C
Pest 1 Code, Type, Scale	AMAPA W BBCH	AMAPA W BBCH	AMAPA W BBCH
Stage Majority, Percent	00	14	18
Stage Minimum, Percent		12	16
Stage Maximum, Percent		16	19
Height Average		1.5 IN	5 IN
Height Minimum, Maximum		0.5 2	3 6
Density Average		4 FT2	4 FT2
Pest 2 Code, Type, Scale	CHEAL W BBCH	CHEAL W BBCH	CHEAL W BBCH
Stage Majority, Percent	00	14	18
Stage Minimum, Percent		12	16
Stage Maximum, Percent		16	19
Height Average		1.5 IN	4 IN
Height Minimum, Maximum		0.5 3	2 5
Density Average		2 FT2	2 FT2
Pest 3 Code, Type, Scale	DIGSA W BBCH	DIGSA W BBCH	DIGSA W BBCH
Stage Majority, Percent	00	18	19
Stage Minimum, Percent		12	14
Stage Maximum, Percent		19	19
Height Average		2.25 IN	4 IN
Height Minimum, Maximum		0.5 4	1 6
Density Average		10 FT2	10 FT2

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 Sponsor Contact: Dennis Long

Application Equipment

	A	B	C
Appl. Equipment		XR8002-25FT	
Equipment Type	SPRBAC	SPRBAC	SPRBAC
Operation Pressure	26 PSI	25 PSI	25 PSI
Nozzle Type	XR	XR	XR
Nozzle Size	8002	8002	8002
Nozzle Spacing	20 IN	20 IN	20 IN
Boom Length	6.67 FT	6.67 FT	6.67 FT
Carrier	WATER	WATER	WATER
Application Amount	15 GAL/AC	15 GAL/AC	15 GAL/AC
Mix Size	0.2497 GAL	0.2497 GAL	0.2497 GAL
Propellant	COMCO2	COMCO2	COMCO2

Context	Date	By	Notes
STATUS	Mar-29-2019	Dr. Bryan Young	Automatically added by ARM: Trial Status updated to 'S' during trial creation.
STATUS	Jun-26-2019	Dr. Bryan Young	Automatically added by ARM: Trial Status updated to 'E' when Initiation Date entered.

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								C ZEAMD Dent corn Jun-17-2019 PHYGEN % 1 AT POST (C) 33 6 -1 DA-C	W Weed AMAPA Palmer amaranth Jun-17-2019 CONTRO % 1 AT POST (C) 33 6 -1 DA-C	W Weed DIGSA large crabgrass Jun-17-2019 CONTRO % 1 AT POST (C) 33 6 -1 DA-C	
Trt No.	Treatment Name	Form Conc	Form Unit	Form Type	Rate Rate	Other Rate	Other Unit	Appl Code	1	2	3
1	BICEP II MAGNUM ROUNDUP POWERMAX N-PAK	5.5 LB/GAL 4.5 LBAE/GAL 3.4 LB/GAL	L SL SL	L	1.38 lb ai/a 1.13 lb ai/a 2.5 % v/v	1 qt/a 32 fl oz/a 2.5 % v/v	A C C		0.0 c	78.8 bc	82.5 bc
2	BICEP II MAGNUM ROUNDUP POWERMAX TOUGH N-PAK	5.5 LB/GAL 4.5 LBAE/GAL 5 LB/GAL 3.4 LB/GAL	L SL EC SL	L	1.38 lb ai/a 1.13 lb ai/a 0.313 lb ai/a 2.5 % v/v	1 qt/a 32 fl oz/a 8 fl oz/a 2.5 % v/v	A C C C		0.0 c	76.3 cd	80.0 bc
3	BICEP II MAGNUM ROUNDUP POWERMAX CALLISTO N-PAK	5.5 LB/GAL 4.5 LBAE/GAL 4 LB/GAL 3.4 LB/GAL	L SL L SL	L	1.38 lb ai/a 1.13 lb ai/a 0.094 lb ai/a 2.5 % v/v	1 qt/a 32 fl oz/a 3 fl oz/a 2.5 % v/v	A C C C		0.0 c	82.5 b	83.8 b
4	BICEP II MAGNUM ROUNDUP POWERMAX STATUS N-PAK	5.5 LB/GAL 4.5 LBAE/GAL 56 % 3.4 LB/GAL	L SL WG SL	L	1.38 lb ai/a 1.13 lb ai/a 0.0875 lb ai/a 2.5 % v/v	1 qt/a 32 fl oz/a 2.5 oz/a 2.5 % v/v	A C C C		0.0 c	76.3 cd	78.8 bc
5	BICEP II MAGNUM HALEX GT N-PAK	5.5 LB/GAL 4.389 LBAE/GAL 3.4 LB/GAL	L CS SL	L	1.38 lb ai/a 1.98 lb ai/a 2.5 % v/v	1 qt/a 3.6 pt/a 2.5 % v/v	A C C		0.0 c	81.3 bc	83.8 b
6	BICEP II MAGNUM HALEX GT STATUS N-PAK	5.5 LB/GAL 4.389 LBAE/GAL 56 % 3.4 LB/GAL	L CS WG SL	L	1.38 lb ai/a 1.98 lb ai/a 0.0875 lb ai/a 2.5 % v/v	1 qt/a 3.6 pt/a 2.5 oz/a 2.5 % v/v	A C C C		0.0 c	80.0 bc	80.5 bc
7	BICEP II MAGNUM HALEX GT TOUGH N-PAK	5.5 LB/GAL 4.389 LBAE/GAL 5 LB/GAL 3.4 LB/GAL	L CS EC SL	L	1.38 lb ai/a 1.98 lb ai/a 0.313 lb ai/a 2.5 % v/v	1 qt/a 3.6 pt/a 8 fl oz/a 2.5 % v/v	A C C C		0.0 c	72.5 d	77.5 c
8	BICEP II MAGNUM ROUNDUP POWERMAX TOUGH AATREX N-PAK	5.5 LB/GAL 4.5 LBAE/GAL 5 LB/GAL 4 LB/GAL 3.4 LB/GAL	L SL EC L SL	L	1.38 lb ai/a 1.13 lb ai/a 0.313 lb ai/a 0.5 lb ai/a 2.5 % v/v	1 qt/a 32 fl oz/a 8 fl oz/a 1 pt/a 2.5 % v/v	A B B B B		6.8 a	96.5 a	94.8 a
9	BICEP II MAGNUM ROUNDUP POWERMAX TOUGH AATREX CALLISTO N-PAK	5.5 LB/GAL 4.5 LBAE/GAL 5 LB/GAL 4 LB/GAL 4 LB/GAL 3.4 LB/GAL	L SL EC L L SL	L	1.38 lb ai/a 1.13 lb ai/a 0.313 lb ai/a 0.5 lb ai/a 0.094 lb ai/a 2.5 % v/v	1 qt/a 32 fl oz/a 8 fl oz/a 1 pt/a 3 fl oz/a 2.5 % v/v	A B B B B B		4.5 b	97.0 a	96.0 a
10	BICEP II MAGNUM ROUNDUP POWERMAX SHIELDDEX N-PAK	5.5 LB/GAL 4.5 LBAE/GAL 100 % 3.4 LB/GAL	L SL L SL	L	1.38 lb ai/a 1.13 lb ai/a 1.35 fl oz/a 2.5 % v/v	1 qt/a 32 fl oz/a 1.35 fl oz/a 2.5 % v/v	A C C C		0.0 c	81.3 bc	82.5 bc
11	BICEP II MAGNUM ROUNDUP POWERMAX SHIELDDEX TOUGH N-PAK	5.5 LB/GAL 4.5 LBAE/GAL 100 % 5 LB/GAL 3.4 LB/GAL	L SL L EC SL	L	1.38 lb ai/a 1.13 lb ai/a 1.35 fl oz/a 0.313 lb ai/a 2.5 % v/v	1 qt/a 32 fl oz/a 1.35 fl oz/a 8 fl oz/a 2.5 % v/v	A C C C C		0.0 c	82.5 b	83.8 b

Means followed by same letter or symbol do not significantly differ (P=.05, LSD).
 Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.
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Pest Type			W Weed	W Weed						
Pest Code			AMAPA	DIGSA						
Pest Name			Palmer amaranth	large crabgrass						
Crop Type, Code	C ZEAMD									
Crop Name	Dent corn									
Rating Date	Jun-17-2019		Jun-17-2019	Jun-17-2019						
Rating Type	PHYGEN		CONTRO	CONTRO						
Rating Unit	%		%	%						
Number of Subsamples	1		1	1						
Rating Timing	AT POST (C)		AT POST (C)	AT POST (C)						
Days After First/Last Applic.	33 6		33 6	33 6						
Trt-Eval Interval	-1 DA-C		-1 DA-C	-1 DA-C						
Trt Treatment No. Name	Form Conc	Form Unit	Form Type	Rate Rate	Other Rate	Other Rate	Appl Unit Code	1	2	3
12 NONTREATED								0.0 c	0.0 e	0.0 d
LSD P=.05				1.05	6.09	5.10				
Standard Deviation				0.73	4.24	3.54				
CV				77.72	5.62	4.6				
Grand Mean				0.94	75.40	76.98				
Levene's F				3.881	1.861	0.739				
Levene's Prob(F)				0.001*	0.079	0.695				
Rank X2				.	.	.				
P(Rank X2)				.	.	.				
Skewness				2.4468*	-2.5023*	-2.6555*				
Kurtosis				5.5533*	5.8189*	6.2966*				
Replicate F				1.400	0.552	13.161				
Replicate Prob(F)				0.2603	0.6501	0.0001				
Treatment F				37.851	138.004	197.789				
Treatment Prob(F)				0.0001	0.0001	0.0001				

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								W Weed CHEAL common lambsqua>	C ZEAMD Dent corn Jun-17-2019 CONTR0 % 1 AT POST (C) 33 6 -1 DA-C	W Weed AMAPA Palmer amaranth Jun-25-2019 CONTR0 % 1 41 7 7 DA-C	
Trt No.	Treatment Name	Form Conc	Form Unit	Form Type	Rate Rate	Other Rate	Other Rate	Appl Unit Code	4	5	6
1	BICEP II MAGNUM ROUNDUP POWERMAX N-PAK	5.5 LB/GAL 4.5 LBAE/GAL 3.4 LB/GAL	L SL SL	L SL SL	1.38 lb ai/a 1.13 lb ai/a 2.5 % v/v	1 qt/a 32 fl oz/a 2.5 % v/v		A C C	77.5 bc	0.0 c	84.3 g
2	BICEP II MAGNUM ROUNDUP POWERMAX TOUGH N-PAK	5.5 LB/GAL 4.5 LBAE/GAL 5 LB/GAL 3.4 LB/GAL	L SL EC SL	L SL EC SL	1.38 lb ai/a 1.13 lb ai/a 0.313 lb ai/a 2.5 % v/v	1 qt/a 32 fl oz/a 8 fl oz/a 2.5 % v/v		A C C C	73.8 c	2.0 b	88.0 ef
3	BICEP II MAGNUM ROUNDUP POWERMAX CALLISTO N-PAK	5.5 LB/GAL 4.5 LBAE/GAL 4 LB/GAL 3.4 LB/GAL	L SL L SL	L SL L SL	1.38 lb ai/a 1.13 lb ai/a 0.094 lb ai/a 2.5 % v/v	1 qt/a 32 fl oz/a 3 fl oz/a 2.5 % v/v		A C C C	78.8 bc	0.0 c	91.3 de
4	BICEP II MAGNUM ROUNDUP POWERMAX STATUS N-PAK	5.5 LB/GAL 4.5 LBAE/GAL 56 % 3.4 LB/GAL	L SL WG SL	L SL WG SL	1.38 lb ai/a 1.13 lb ai/a 0.0875 lb ai/a 2.5 % v/v	1 qt/a 32 fl oz/a 2.5 oz/a 2.5 % v/v		A C C C	77.5 bc	0.0 c	88.0 ef
5	BICEP II MAGNUM HALEX GT N-PAK	5.5 LB/GAL 4.389 LBAE/GAL 3.4 LB/GAL	L CS SL	L CS SL	1.38 lb ai/a 1.98 lb ai/a 2.5 % v/v	1 qt/a 3.6 pt/a 2.5 % v/v		A C C	78.8 bc	0.0 c	85.0 fg
6	BICEP II MAGNUM HALEX GT STATUS N-PAK	5.5 LB/GAL 4.389 LBAE/GAL 56 % 3.4 LB/GAL	L CS WG SL	L CS WG SL	1.38 lb ai/a 1.98 lb ai/a 0.0875 lb ai/a 2.5 % v/v	1 qt/a 3.6 pt/a 2.5 oz/a 2.5 % v/v		A C C C	75.0 bc	0.0 c	91.3 de
7	BICEP II MAGNUM HALEX GT TOUGH N-PAK	5.5 LB/GAL 4.389 LBAE/GAL 5 LB/GAL 3.4 LB/GAL	L CS EC SL	L CS EC SL	1.38 lb ai/a 1.98 lb ai/a 0.313 lb ai/a 2.5 % v/v	1 qt/a 3.6 pt/a 8 fl oz/a 2.5 % v/v		A C C C	78.8 bc	0.8 c	94.3 cd
8	BICEP II MAGNUM ROUNDUP POWERMAX TOUGH AATREX N-PAK	5.5 LB/GAL 4.5 LBAE/GAL 5 LB/GAL 4 LB/GAL 3.4 LB/GAL	L SL EC L SL	L SL EC L SL	1.38 lb ai/a 1.13 lb ai/a 0.313 lb ai/a 0.5 lb ai/a 2.5 % v/v	1 qt/a 32 fl oz/a 8 fl oz/a 1 pt/a 2.5 % v/v		A B B B B	98.8 a	3.0 ab	98.0 ab
9	BICEP II MAGNUM ROUNDUP POWERMAX TOUGH AATREX CALLISTO N-PAK	5.5 LB/GAL 4.5 LBAE/GAL 5 LB/GAL 4 LB/GAL 4 LB/GAL 3.4 LB/GAL	L SL EC L L SL	L SL EC L L SL	1.38 lb ai/a 1.13 lb ai/a 0.313 lb ai/a 0.5 lb ai/a 0.094 lb ai/a 2.5 % v/v	1 qt/a 32 fl oz/a 8 fl oz/a 1 pt/a 3 fl oz/a 2.5 % v/v		A B B B B B	98.5 a	3.5 a	99.0 a
10	BICEP II MAGNUM ROUNDUP POWERMAX SHIELDDEX N-PAK	5.5 LB/GAL 4.5 LBAE/GAL 100 % 3.4 LB/GAL	L SL L SL	L SL L SL	1.38 lb ai/a 1.13 lb ai/a 1.35 fl oz/a 2.5 % v/v	1 qt/a 32 fl oz/a 1.35 fl oz/a 2.5 % v/v		A C C C	80.0 b	0.0 c	93.0 cd
11	BICEP II MAGNUM ROUNDUP POWERMAX SHIELDDEX TOUGH N-PAK	5.5 LB/GAL 4.5 LBAE/GAL 100 % 5 LB/GAL 3.4 LB/GAL	L SL L EC SL	L SL L EC SL	1.38 lb ai/a 1.13 lb ai/a 1.35 fl oz/a 0.313 lb ai/a 2.5 % v/v	1 qt/a 32 fl oz/a 1.35 fl oz/a 8 fl oz/a 2.5 % v/v		A C C C C	80.0 b	3.0 ab	95.5 bc

Means followed by same letter or symbol do not significantly differ (P=.05, LSD).
 Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.
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								C ZEAMD Dent corn		
								Jun-17-2019	Jun-25-2019	Jun-25-2019
								CONTRO	PHYGEN	CONTRO
								%	%	%
								1	1	1
								AT POST (C)		
								33 6	41 7	41 7
								-1 DA-C	7 DA-C	7 DA-C
Trt Treatment	Form	Form	Form	Rate	Other	Other	Appl			
No. Name	Conc	Unit	Type	Rate	Unit	Rate	Rate	Unit	Code	
12 NONTREATED								4		5
										6
LSD P=.05								0.0 d		0.0 c
Standard Deviation								5.25		1.18
CV								3.65		0.82
Grand Mean								4.88		80.32
Levene's F								74.77		1.02
Levene's Prob(F)								2.257		4.037
Rank X2								0.033*		0.001*
P(Rank X2)								.		.
Skewness								-2.3922*		1.0838*
Kurtosis								5.5815*		-0.3264
Replicate F								0.973		2.758
Replicate Prob(F)								0.4173		0.0578
Treatment F								186.796		12.065
Treatment Prob(F)								0.0001		0.0001

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							W Weed DIGSA large crabgrass	W Weed CHEAL common lambsqua>	C ZEAMD Dent corn Jul-2-2019 PHYGEN		
							Jun-25-2019 CONTRO %	Jun-25-2019 CONTRO %	1 %		
							1	1	1		
							41 7 7 DA-C	41 7 7 DA-C	48 14 14 DA-C		
Trt No.	Treatment Name	Form Conc	Form Unit	Form Type	Rate Rate	Other Rate	Other Rate	Appl Unit Code	7	8	9
1	BICEP II MAGNUM ROUNDUP POWERMAX N-PAK	5.5 LB/GAL 4.5 LBAE/GAL 3.4 LB/GAL	L SL SL	L	1.38 lb ai/a 1.13 lb ai/a 2.5 % v/v	1 qt/a 32 fl oz/a 2.5 % v/v		A C C	95.5 cd	98.0 abc	0.0 -
2	BICEP II MAGNUM ROUNDUP POWERMAX TOUGH N-PAK	5.5 LB/GAL 4.5 LBAE/GAL 5 LB/GAL 3.4 LB/GAL	L SL EC SL	L	1.38 lb ai/a 1.13 lb ai/a 0.313 lb ai/a 2.5 % v/v	1 qt/a 32 fl oz/a 8 fl oz/a 2.5 % v/v		A C C C	93.3 e	98.8 ab	0.0 -
3	BICEP II MAGNUM ROUNDUP POWERMAX CALLISTO N-PAK	5.5 LB/GAL 4.5 LBAE/GAL 4 LB/GAL 3.4 LB/GAL	L SL L SL	L	1.38 lb ai/a 1.13 lb ai/a 0.094 lb ai/a 2.5 % v/v	1 qt/a 32 fl oz/a 3 fl oz/a 2.5 % v/v		A C C C	96.5 bcd	97.5 bcd	0.0 -
4	BICEP II MAGNUM ROUNDUP POWERMAX STATUS N-PAK	5.5 LB/GAL 4.5 LBAE/GAL 56 % 3.4 LB/GAL	L SL WG SL	L	1.38 lb ai/a 1.13 lb ai/a 0.0875 lb ai/a 2.5 % v/v	1 qt/a 32 fl oz/a 2.5 oz/a 2.5 % v/v		A C C C	95.8 cd	98.3 ab	0.0 -
5	BICEP II MAGNUM HALEX GT N-PAK	5.5 LB/GAL 4.389 LBAE/GAL 3.4 LB/GAL	L CS SL	L	1.38 lb ai/a 1.98 lb ai/a 2.5 % v/v	1 qt/a 3.6 pt/a 2.5 % v/v		A C C	95.8 cd	96.5 d	0.0 -
6	BICEP II MAGNUM HALEX GT STATUS N-PAK	5.5 LB/GAL 4.389 LBAE/GAL 56 % 3.4 LB/GAL	L CS WG SL	L	1.38 lb ai/a 1.98 lb ai/a 0.0875 lb ai/a 2.5 % v/v	1 qt/a 3.6 pt/a 2.5 oz/a 2.5 % v/v		A C C C	95.0 de	96.8 cd	0.0 -
7	BICEP II MAGNUM HALEX GT TOUGH N-PAK	5.5 LB/GAL 4.389 LBAE/GAL 5 LB/GAL 3.4 LB/GAL	L CS EC SL	L	1.38 lb ai/a 1.98 lb ai/a 0.313 lb ai/a 2.5 % v/v	1 qt/a 3.6 pt/a 8 fl oz/a 2.5 % v/v		A C C C	94.8 de	98.0 abc	0.0 -
8	BICEP II MAGNUM ROUNDUP POWERMAX TOUGH AATREX N-PAK	5.5 LB/GAL 4.5 LBAE/GAL 5 LB/GAL 4 LB/GAL 3.4 LB/GAL	L SL EC L SL	L	1.38 lb ai/a 1.13 lb ai/a 0.313 lb ai/a 0.5 lb ai/a 2.5 % v/v	1 qt/a 32 fl oz/a 8 fl oz/a 1 pt/a 2.5 % v/v		A B B B B	98.0 ab	99.0 a	0.0 -
9	BICEP II MAGNUM ROUNDUP POWERMAX TOUGH AATREX CALLISTO N-PAK	5.5 LB/GAL 4.5 LBAE/GAL 5 LB/GAL 4 LB/GAL 4 LB/GAL 3.4 LB/GAL	L SL EC L L SL	L	1.38 lb ai/a 1.13 lb ai/a 0.313 lb ai/a 0.5 lb ai/a 0.094 lb ai/a 2.5 % v/v	1 qt/a 32 fl oz/a 8 fl oz/a 1 pt/a 3 fl oz/a 2.5 % v/v		A B B B B B	98.5 a	99.0 a	0.0 -
10	BICEP II MAGNUM ROUNDUP POWERMAX SHIELDDEX N-PAK	5.5 LB/GAL 4.5 LBAE/GAL 100 % 3.4 LB/GAL	L SL L SL	L	1.38 lb ai/a 1.13 lb ai/a 1.35 fl oz/a 2.5 % v/v	1 qt/a 32 fl oz/a 1.35 fl oz/a 2.5 % v/v		A C C C	97.0 abc	98.5 ab	0.0 -
11	BICEP II MAGNUM ROUNDUP POWERMAX SHIELDDEX TOUGH N-PAK	5.5 LB/GAL 4.5 LBAE/GAL 100 % 5 LB/GAL 3.4 LB/GAL	L SL L EC SL	L	1.38 lb ai/a 1.13 lb ai/a 1.35 fl oz/a 0.313 lb ai/a 2.5 % v/v	1 qt/a 32 fl oz/a 1.35 fl oz/a 8 fl oz/a 2.5 % v/v		A C C C C	96.0 cd	98.0 abc	0.0 -

Means followed by same letter or symbol do not significantly differ (P=.05, LSD).
 Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.
 Could not calculate LSD (% mean diff) for columns 9,12,13,16,17,20 because error mean square = 0.

Purdue University Weed Science

Influence of Tough on Waterhemp and Palmer Amaranth Control in Corn

Trial ID: 19-WIN-Tough	Location: Winamac	Trial Year: 2019
Protocol ID: 19-WIN-Tough	Investigator (Creator): Dr. Bryan Young	
Project ID:	Study Director:	
	Sponsor Contact: Dennis Long	

	W Weed DIGSA large crabgrass	W Weed CHEAL common lambsqua>	C ZEAMD Dent corn
Pest Type			
Pest Code			
Pest Name			
Crop Type, Code			
Crop Name			
Rating Date	Jun-25-2019	Jun-25-2019	Jul-2-2019
Rating Type	CONTRO	CONTRO	PHYGEN
Rating Unit	%	%	%
Number of Subsamples	1	1	1
Rating Timing			
Days After First/Last Applic.	41 7	41 7	48 14
Trt-Eval Interval	7 DA-C	7 DA-C	14 DA-C
Trt Treatment No. Name	7	8	9
Form Conc			
Form Unit			
Form Type			
Rate Rate			
Other Rate			
Other Rate			
Appl Unit Code			
12 NONTREATED	0.0 f	0.0 e	0.0 -
LSD P=.05	1.80	1.25	.
Standard Deviation	1.25	0.87	0.00
CV	1.42	0.97	0.0
Grand Mean	88.00	89.85	0.00
Levene's F	1.909	1.662	0.00
Levene's Prob(F)	0.071	0.123	0.00*
Rank X2	.	.	.
P(Rank X2)	.	.	.
Skewness	-3.0873*	-3.1043*	.
Kurtosis	7.9222*	7.99*	.
Replicate F	4.280	1.859	0.000
Replicate Prob(F)	0.0117	0.1557	1.0000
Treatment F	1960.901	4227.525	0.000
Treatment Prob(F)	0.0001	0.0001	1.0000

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 Could not calculate LSD (% mean diff) for columns 9,12,13,16,17,20 because error mean square = 0.

Purdue University Weed Science

Influence of Tough on Waterhemp and Palmer Amaranth Control in Corn

Trial ID: 19-WIN-Tough Location: Winamac Trial Year: 2019
 Protocol ID: 19-WIN-Tough Investigator (Creator): Dr. Bryan Young
 Project ID: Study Director:
 Sponsor Contact: Dennis Long

								W Weed AMAPA Palmer amaranth	W Weed DIGSA large crabgrass	W Weed CHEAL common lambsqua>	
								Jul-2-2019 CONTRO	Jul-2-2019 CONTRO	Jul-2-2019 CONTRO	
								%	%	%	
								1	1	1	
								48 14 14 DA-C	48 14 14 DA-C	48 14 14 DA-C	
Trt No.	Treatment Name	Form Conc	Form Unit	Form Type	Rate Rate	Other Rate	Other Rate	Appl Unit Code	10	11	12
1	BICEP II MAGNUM	5.5 LB/GAL	L	L	1.38 lb ai/a	1 qt/a		A	88.0 c	96.8 c	99.0 a
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL	SL	1.13 lb ai/a	32 fl oz/a		C			
	N-PAK	3.4 LB/GAL	SL	SL	2.5 % v/v	2.5 % v/v		C			
2	BICEP II MAGNUM	5.5 LB/GAL	L	L	1.38 lb ai/a	1 qt/a		A	90.0 c	96.8 c	99.0 a
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL	SL	1.13 lb ai/a	32 fl oz/a		C			
	TOUGH	5 LB/GAL	EC	EC	0.313 lb ai/a	8 fl oz/a		C			
	N-PAK	3.4 LB/GAL	SL	SL	2.5 % v/v	2.5 % v/v		C			
3	BICEP II MAGNUM	5.5 LB/GAL	L	L	1.38 lb ai/a	1 qt/a		A	98.5 a	98.3 a	99.0 a
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL	SL	1.13 lb ai/a	32 fl oz/a		C			
	CALLISTO	4 LB/GAL	L	L	0.094 lb ai/a	3 fl oz/a		C			
	N-PAK	3.4 LB/GAL	SL	SL	2.5 % v/v	2.5 % v/v		C			
4	BICEP II MAGNUM	5.5 LB/GAL	L	L	1.38 lb ai/a	1 qt/a		A	97.3 a	97.0 bc	99.0 a
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL	SL	1.13 lb ai/a	32 fl oz/a		C			
	STATUS	56 %	WG	WG	0.0875 lb ai/a	2.5 oz/a		C			
	N-PAK	3.4 LB/GAL	SL	SL	2.5 % v/v	2.5 % v/v		C			
5	BICEP II MAGNUM	5.5 LB/GAL	L	L	1.38 lb ai/a	1 qt/a		A	93.0 b	97.0 bc	99.0 a
	HALEX GT	4.389 LBAE/GAL	CS	CS	1.98 lb ai/a	3.6 pt/a		C			
	N-PAK	3.4 LB/GAL	SL	SL	2.5 % v/v	2.5 % v/v		C			
6	BICEP II MAGNUM	5.5 LB/GAL	L	L	1.38 lb ai/a	1 qt/a		A	97.5 a	98.3 a	99.0 a
	HALEX GT	4.389 LBAE/GAL	CS	CS	1.98 lb ai/a	3.6 pt/a		C			
	STATUS	56 %	WG	WG	0.0875 lb ai/a	2.5 oz/a		C			
	N-PAK	3.4 LB/GAL	SL	SL	2.5 % v/v	2.5 % v/v		C			
7	BICEP II MAGNUM	5.5 LB/GAL	L	L	1.38 lb ai/a	1 qt/a		A	98.0 a	97.5 abc	99.0 a
	HALEX GT	4.389 LBAE/GAL	CS	CS	1.98 lb ai/a	3.6 pt/a		C			
	TOUGH	5 LB/GAL	EC	EC	0.313 lb ai/a	8 fl oz/a		C			
	N-PAK	3.4 LB/GAL	SL	SL	2.5 % v/v	2.5 % v/v		C			
8	BICEP II MAGNUM	5.5 LB/GAL	L	L	1.38 lb ai/a	1 qt/a		A	98.5 a	96.8 c	99.0 a
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL	SL	1.13 lb ai/a	32 fl oz/a		B			
	TOUGH	5 LB/GAL	EC	EC	0.313 lb ai/a	8 fl oz/a		B			
	AATREX	4 LB/GAL	L	L	0.5 lb ai/a	1 pt/a		B			
	N-PAK	3.4 LB/GAL	SL	SL	2.5 % v/v	2.5 % v/v		B			
9	BICEP II MAGNUM	5.5 LB/GAL	L	L	1.38 lb ai/a	1 qt/a		A	99.0 a	98.0 ab	99.0 a
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL	SL	1.13 lb ai/a	32 fl oz/a		B			
	TOUGH	5 LB/GAL	EC	EC	0.313 lb ai/a	8 fl oz/a		B			
	AATREX	4 LB/GAL	L	L	0.5 lb ai/a	1 pt/a		B			
	CALLISTO	4 LB/GAL	L	L	0.094 lb ai/a	3 fl oz/a		B			
	N-PAK	3.4 LB/GAL	SL	SL	2.5 % v/v	2.5 % v/v		B			
10	BICEP II MAGNUM	5.5 LB/GAL	L	L	1.38 lb ai/a	1 qt/a		A	98.3 a	97.5 abc	99.0 a
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL	SL	1.13 lb ai/a	32 fl oz/a		C			
	SHIELDDEX	100 %	L	L	1.35 fl oz/a	1.35 fl oz/a		C			
	N-PAK	3.4 LB/GAL	SL	SL	2.5 % v/v	2.5 % v/v		C			
11	BICEP II MAGNUM	5.5 LB/GAL	L	L	1.38 lb ai/a	1 qt/a		A	99.0 a	97.5 abc	99.0 a
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL	SL	1.13 lb ai/a	32 fl oz/a		C			
	SHIELDDEX	100 %	L	L	1.35 fl oz/a	1.35 fl oz/a		C			
	TOUGH	5 LB/GAL	EC	EC	0.313 lb ai/a	8 fl oz/a		C			
	N-PAK	3.4 LB/GAL	SL	SL	2.5 % v/v	2.5 % v/v		C			

Means followed by same letter or symbol do not significantly differ (P=.05, LSD).
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 Could not calculate LSD (% mean diff) for columns 9,12,13,16,17,20 because error mean square = 0.

Purdue University Weed Science

Influence of Tough on Waterhemp and Palmer Amaranth Control in Corn

Trial ID: 19-WIN-Tough Location: Winamac Trial Year: 2019
 Protocol ID: 19-WIN-Tough Investigator (Creator): Dr. Bryan Young
 Project ID: Study Director:
 Sponsor Contact: Dennis Long

								W Weed AMAPA	W Weed DIGSA	W Weed CHEAL	
								Palmer amaranth	large crabgrass	common lambsqua>	
								Jul-2-2019	Jul-2-2019	Jul-2-2019	
								CONTRO	CONTRO	CONTRO	
								%	%	%	
								1	1	1	
								48 14	48 14	48 14	
								14 DA-C	14 DA-C	14 DA-C	
Trt	Treatment	Form	Form	Form	Rate	Other	Other	Appl			
No.	Name	Conc	Unit	Type	Rate	Unit	Rate	Rate	Unit	Code	
12	NONTREATED								10	11	12
									0.0 d	0.0 d	0.0 b
	LSD P=.05								2.88	1.14	.
	Standard Deviation								2.00	0.79	0.00
	CV								2.27	0.89	0.0
	Grand Mean								88.08	89.27	90.75
	Levene's F								2.254	1.599	0.00
	Levene's Prob(F)								0.033*	0.141	0.00*
	Rank X2								.	.	.
	P(Rank X2)								.	.	.
	Skewness								-2.9959*	-3.1064*	-3.1133*
	Kurtosis								7.5454*	7.9987*	8.0253*
	Replicate F								1.676	4.287	0.000
	Replicate Prob(F)								0.1911	0.0116	1.0000
	Treatment F								781.326	5044.892	0.000
	Treatment Prob(F)								0.0001	0.0001	1.0000

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 Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.
 Could not calculate LSD (% mean diff) for columns 9,12,13,16,17,20 because error mean square = 0.

Purdue University Weed Science

Influence of Tough on Waterhemp and Palmer Amaranth Control in Corn

Trial ID: 19-WIN-Tough Location: Winamac Trial Year: 2019
 Protocol ID: 19-WIN-Tough Investigator (Creator): Dr. Bryan Young
 Project ID: Study Director:
 Sponsor Contact: Dennis Long

							C ZEAMD Dent corn Jul-16-2019 PHYGEN %	W Weed AMAPA Palmer amaranth Jul-16-2019 CONTRO %	W Weed DIGSA large crabgrass Jul-16-2019 CONTRO %		
							1	1	1		
							62 28 28 DA-C	62 28 28 DA-C	62 28 28 DA-C		
Trt No.	Treatment Name	Form Conc	Form Unit	Form Type	Rate Rate	Other Rate	Other Rate	Appl Unit Code	13	14	15
1	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	0.0 -	88.5 b	96.5 a
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL		1.13 lb ai/a	32 fl oz/a		C			
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C			
2	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	0.0 -	91.0 b	96.5 a
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL		1.13 lb ai/a	32 fl oz/a		C			
	TOUGH	5 LB/GAL	EC		0.313 lb ai/a	8 fl oz/a		C			
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C			
3	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	0.0 -	98.5 a	97.0 a
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL		1.13 lb ai/a	32 fl oz/a		C			
	CALLISTO	4 LB/GAL	L		0.094 lb ai/a	3 fl oz/a		C			
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C			
4	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	0.0 -	97.8 a	96.8 a
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL		1.13 lb ai/a	32 fl oz/a		C			
	STATUS	56 %	WG		0.0875 lb ai/a	2.5 oz/a		C			
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C			
5	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	0.0 -	96.0 a	97.0 a
	HALEX GT	4.389 LBAE/GAL	CS		1.98 lb ai/a	3.6 pt/a		C			
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C			
6	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	0.0 -	99.0 a	97.5 a
	HALEX GT	4.389 LBAE/GAL	CS		1.98 lb ai/a	3.6 pt/a		C			
	STATUS	56 %	WG		0.0875 lb ai/a	2.5 oz/a		C			
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C			
7	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	0.0 -	97.5 a	97.0 a
	HALEX GT	4.389 LBAE/GAL	CS		1.98 lb ai/a	3.6 pt/a		C			
	TOUGH	5 LB/GAL	EC		0.313 lb ai/a	8 fl oz/a		C			
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C			
8	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	0.0 -	97.5 a	96.5 a
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL		1.13 lb ai/a	32 fl oz/a		B			
	TOUGH	5 LB/GAL	EC		0.313 lb ai/a	8 fl oz/a		B			
	AATREX	4 LB/GAL	L		0.5 lb ai/a	1 pt/a		B			
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		B			
9	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	0.0 -	98.8 a	97.0 a
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL		1.13 lb ai/a	32 fl oz/a		B			
	TOUGH	5 LB/GAL	EC		0.313 lb ai/a	8 fl oz/a		B			
	AATREX	4 LB/GAL	L		0.5 lb ai/a	1 pt/a		B			
	CALLISTO	4 LB/GAL	L		0.094 lb ai/a	3 fl oz/a		B			
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		B			
10	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	0.0 -	99.0 a	96.8 a
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL		1.13 lb ai/a	32 fl oz/a		C			
	SHIELDDEX	100 %	L		1.35 fl oz/a	1.35 fl oz/a		C			
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C			
11	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	0.0 -	99.0 a	97.3 a
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL		1.13 lb ai/a	32 fl oz/a		C			
	SHIELDDEX	100 %	L		1.35 fl oz/a	1.35 fl oz/a		C			
	TOUGH	5 LB/GAL	EC		0.313 lb ai/a	8 fl oz/a		C			
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C			

Means followed by same letter or symbol do not significantly differ (P=.05, LSD).
 Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.
 Could not calculate LSD (% mean diff) for columns 9,12,13,16,17,20 because error mean square = 0.

Purdue University Weed Science

Influence of Tough on Waterhemp and Palmer Amaranth Control in Corn

Trial ID: 19-WIN-Tough	Location: Winamac	Trial Year: 2019
Protocol ID: 19-WIN-Tough	Investigator (Creator): Dr. Bryan Young	
Project ID:	Study Director:	
	Sponsor Contact: Dennis Long	

		W Weed AMAPA Palmer amaranth	W Weed DIGSA large crabgrass
Pest Type			
Pest Code			
Pest Name			
Crop Type, Code	C ZEAMD		
Crop Name	Dent corn		
Rating Date	Jul-16-2019	Jul-16-2019	Jul-16-2019
Rating Type	PHYGEN	CONTRO	CONTRO
Rating Unit	%	%	%
Number of Subsamples	1	1	1
Rating Timing			
Days After First/Last Applic.	62 28	62 28	62 28
Trt-Eval Interval	28 DA-C	28 DA-C	28 DA-C
Trt Treatment No. Name	Form Form Conc Unit	Form Type Rate	Other Rate
		Other Rate	Appl Unit Code
12 NONTREATED		13	14
		15	
LSD P=.05	0.0 -	0.0 c	0.0 b
Standard Deviation	.	3.52	1.19
CV	0.00	2.45	0.83
Grand Mean	0.0	2.77	0.93
Levene's F	0.00	88.54	88.81
Levene's Prob(F)	0.00	4.607	2.822
Rank X2	0.00*	0.001*	0.009*
P(Rank X2)	.	.	.
Skewness	.	-3.0051*	-3.108*
Kurtosis	.	7.5687*	8.0047*
Replicate F	0.000	1.533	2.798
Replicate Prob(F)	1.0000	0.2242	0.0553
Treatment F	0.000	526.167	4585.496
Treatment Prob(F)	1.0000	0.0001	0.0001

Means followed by same letter or symbol do not significantly differ (P=.05, LSD).
 Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.
 Could not calculate LSD (% mean diff) for columns 9,12,13,16,17,20 because error mean square = 0.

Purdue University Weed Science

Influence of Tough on Waterhemp and Palmer Amaranth Control in Corn

Trial ID: 19-WIN-Tough Location: Winamac Trial Year: 2019
 Protocol ID: 19-WIN-Tough Investigator (Creator): Dr. Bryan Young
 Project ID: Study Director:
 Sponsor Contact: Dennis Long

								W Weed CHEAL common lambsqua>	C ZEAMD Dent corn Jul-30-2019 PHYGEN	W Weed AMAPA Palmer amaranth Jul-30-2019 CONTRO	
								62 28 28 DA-C	76 42 42 DA-C	76 42 42 DA-C	
Trt No.	Treatment Name	Form Conc	Form Unit	Form Type	Rate Rate	Other Rate	Other Unit	Appl Code	16	17	18
1	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	99.0 a	0.0 -	91.8 b
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL		1.13 lb ai/a	32 fl oz/a		C			
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C			
2	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	99.0 a	0.0 -	89.3 b
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL		1.13 lb ai/a	32 fl oz/a		C			
	TOUGH	5 LB/GAL	EC		0.313 lb ai/a	8 fl oz/a		C			
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C			
3	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	99.0 a	0.0 -	99.0 a
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL		1.13 lb ai/a	32 fl oz/a		C			
	CALLISTO	4 LB/GAL	L		0.094 lb ai/a	3 fl oz/a		C			
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C			
4	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	99.0 a	0.0 -	98.5 a
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL		1.13 lb ai/a	32 fl oz/a		C			
	STATUS	56 %	WG		0.0875 lb ai/a	2.5 oz/a		C			
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C			
5	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	99.0 a	0.0 -	97.5 a
	HALEX GT	4.389 LBAE/GAL	CS		1.98 lb ai/a	3.6 pt/a		C			
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C			
6	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	99.0 a	0.0 -	99.0 a
	HALEX GT	4.389 LBAE/GAL	CS		1.98 lb ai/a	3.6 pt/a		C			
	STATUS	56 %	WG		0.0875 lb ai/a	2.5 oz/a		C			
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C			
7	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	99.0 a	0.0 -	99.0 a
	HALEX GT	4.389 LBAE/GAL	CS		1.98 lb ai/a	3.6 pt/a		C			
	TOUGH	5 LB/GAL	EC		0.313 lb ai/a	8 fl oz/a		C			
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C			
8	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	99.0 a	0.0 -	97.3 a
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL		1.13 lb ai/a	32 fl oz/a		B			
	TOUGH	5 LB/GAL	EC		0.313 lb ai/a	8 fl oz/a		B			
	AATREX	4 LB/GAL	L		0.5 lb ai/a	1 pt/a		B			
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		B			
9	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	99.0 a	0.0 -	99.0 a
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL		1.13 lb ai/a	32 fl oz/a		B			
	TOUGH	5 LB/GAL	EC		0.313 lb ai/a	8 fl oz/a		B			
	AATREX	4 LB/GAL	L		0.5 lb ai/a	1 pt/a		B			
	CALLISTO	4 LB/GAL	L		0.094 lb ai/a	3 fl oz/a		B			
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		B			
10	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	99.0 a	0.0 -	99.0 a
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL		1.13 lb ai/a	32 fl oz/a		C			
	SHIELDDEX	100 %	L		1.35 fl oz/a	1.35 fl oz/a		C			
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C			
11	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	99.0 a	0.0 -	99.0 a
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL		1.13 lb ai/a	32 fl oz/a		C			
	SHIELDDEX	100 %	L		1.35 fl oz/a	1.35 fl oz/a		C			
	TOUGH	5 LB/GAL	EC		0.313 lb ai/a	8 fl oz/a		C			
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C			

Means followed by same letter or symbol do not significantly differ (P=.05, LSD).
 Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.
 Could not calculate LSD (% mean diff) for columns 9,12,13,16,17,20 because error mean square = 0.

Purdue University Weed Science

Influence of Tough on Waterhemp and Palmer Amaranth Control in Corn

Trial ID: 19-WIN-Tough Location: Winamac Trial Year: 2019
 Protocol ID: 19-WIN-Tough Investigator (Creator): Dr. Bryan Young
 Project ID: Study Director:
 Sponsor Contact: Dennis Long

								W Weed CHEAL common lambsqua>	C ZEAMD Dent corn	W Weed AMAPA Palmer amaranth				
								Jul-16-2019	Jul-30-2019	Jul-30-2019				
								CONTRO	PHYGEN	CONTRO				
								%	%	%				
								1	1	1				
								62 28	76 42	76 42				
								28 DA-C	42 DA-C	42 DA-C				
Trt	Treatment	Form	Form	Form	Rate	Other	Other	Appl						
No.	Name	Conc	Unit	Type	Rate	Unit	Rate	Rate	Unit	Code				
	12	NONTREATED							16	17	18			
									0.0	b	0.0	-	0.0	c
		LSD P=.05							.	.	.	3.09		
		Standard Deviation							0.00	0.00	0.00	2.15		
		CV							0.0	0.0	0.0	2.41		
		Grand Mean							90.75	0.00	0.00	89.02		
		Levene's F							0.00	0.00	0.00	5.069		
		Levene's Prob(F)							0.00*	0.00*	0.00*	0.001*		
		Rank X2								
		P(Rank X2)								
		Skewness							-3.1133*	.	.	-3.0209*		
		Kurtosis							8.0253*	.	.	7.6401*		
		Replicate F							0.000	0.000	0.000	0.714		
		Replicate Prob(F)							1.0000	1.0000	1.0000	0.5504		
		Treatment F							0.000	0.000	0.000	689.907		
		Treatment Prob(F)							1.0000	1.0000	1.0000	0.0001		

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Purdue University Weed Science

Influence of Tough on Waterhemp and Palmer Amaranth Control in Corn

Trial ID: 19-WIN-Tough Location: Winamac Trial Year: 2019
 Protocol ID: 19-WIN-Tough Investigator (Creator): Dr. Bryan Young
 Project ID: Study Director:
 Sponsor Contact: Dennis Long

								W Weed DIGSA large crabgrass	W Weed CHEAL common lambsqua>
								Jul-30-2019 CONTRO % 1	Jul-30-2019 CONTRO % 1
								76 42 42 DA-C	76 42 42 DA-C
Trt No.	Treatment Name	Form Conc	Form Unit	Form Type	Rate Rate	Other Rate	Other Rate	Appl Unit Code	
1	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	95.0 cd
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL		1.13 lb ai/a	32 fl oz/a		C	
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C	99.0 a
2	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	93.8 d
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL		1.13 lb ai/a	32 fl oz/a		C	
	TOUGH	5 LB/GAL	EC		0.313 lb ai/a	8 fl oz/a		C	
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C	99.0 a
3	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	97.5 ab
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL		1.13 lb ai/a	32 fl oz/a		C	
	CALLISTO	4 LB/GAL	L		0.094 lb ai/a	3 fl oz/a		C	
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C	99.0 a
4	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	96.0 bc
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL		1.13 lb ai/a	32 fl oz/a		C	
	STATUS	56 %	WG		0.0875 lb ai/a	2.5 oz/a		C	
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C	99.0 a
5	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	97.0 ab
	HALEX GT	4.389 LBAE/GAL	CS		1.98 lb ai/a	3.6 pt/a		C	
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C	99.0 a
6	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	98.3 a
	HALEX GT	4.389 LBAE/GAL	CS		1.98 lb ai/a	3.6 pt/a		C	
	STATUS	56 %	WG		0.0875 lb ai/a	2.5 oz/a		C	
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C	99.0 a
7	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	97.3 ab
	HALEX GT	4.389 LBAE/GAL	CS		1.98 lb ai/a	3.6 pt/a		C	
	TOUGH	5 LB/GAL	EC		0.313 lb ai/a	8 fl oz/a		C	
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C	99.0 a
8	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	95.0 cd
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL		1.13 lb ai/a	32 fl oz/a		B	
	TOUGH	5 LB/GAL	EC		0.313 lb ai/a	8 fl oz/a		B	
	AATREX	4 LB/GAL	L		0.5 lb ai/a	1 pt/a		B	
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		B	99.0 a
9	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	96.0 bc
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL		1.13 lb ai/a	32 fl oz/a		B	
	TOUGH	5 LB/GAL	EC		0.313 lb ai/a	8 fl oz/a		B	
	AATREX	4 LB/GAL	L		0.5 lb ai/a	1 pt/a		B	
	CALLISTO	4 LB/GAL	L		0.094 lb ai/a	3 fl oz/a		B	
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		B	99.0 a
10	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	97.3 ab
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL		1.13 lb ai/a	32 fl oz/a		C	
	SHIELDDEX	100 %	L		1.35 fl oz/a	1.35 fl oz/a		C	
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C	99.0 a
11	BICEP II MAGNUM	5.5 LB/GAL	L		1.38 lb ai/a	1 qt/a		A	96.8 abc
	ROUNDUP POWERMAX	4.5 LBAE/GAL	SL		1.13 lb ai/a	32 fl oz/a		C	
	SHIELDDEX	100 %	L		1.35 fl oz/a	1.35 fl oz/a		C	
	TOUGH	5 LB/GAL	EC		0.313 lb ai/a	8 fl oz/a		C	
	N-PAK	3.4 LB/GAL	SL		2.5 % v/v	2.5 % v/v		C	99.0 a

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Trial ID: 19-WIN-Tough	Location: Winamac	Trial Year: 2019
Protocol ID: 19-WIN-Tough	Investigator (Creator): Dr. Bryan Young	
Project ID:	Study Director:	
	Sponsor Contact: Dennis Long	

	W Weed DIGSA large crabgrass	W Weed CHEAL common lambsqua>
Pest Type		
Pest Code		
Pest Name		
Crop Type, Code		
Crop Name		
Rating Date	Jul-30-2019	Jul-30-2019
Rating Type	CONTRO	CONTRO
Rating Unit	%	%
Number of Subsamples	1	1
Rating Timing		
Days After First/Last Applic.	76 42	76 42
Trt-Eval Interval	42 DA-C	42 DA-C
Trt Treatment No. Name	19	20
Form Form Conc Unit		
Form Type Rate		
Rate Unit		
Other Rate		
Other Rate		
Appl Unit Code		
12 NONTREATED	0.0 e	0.0 b
LSD P=.05	1.78	.
Standard Deviation	1.24	0.00
CV	1.4	0.0
Grand Mean	88.31	90.75
Levene's F	0.737	0.00
Levene's Prob(F)	0.696	0.00*
Rank X2	.	.
P(Rank X2)	.	.
Skewness	-3.0914*	-3.1133*
Kurtosis	7.9382*	8.0253*
Replicate F	3.098	0.000
Replicate Prob(F)	0.0400	1.0000
Treatment F	2025.119	0.000
Treatment Prob(F)	0.0001	1.0000

Means followed by same letter or symbol do not significantly differ (P=.05, LSD).
 Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.
 Could not calculate LSD (% mean diff) for columns 9,12,13,16,17,20 because error mean square = 0.

Purdue University Weed Science

Influence of Tough on Waterhemp and Palmer Amaranth Control in Corn

Trial ID: 19-WIN-Tough Location: Winamac Trial Year: 2019
Protocol ID: 19-WIN-Tough Investigator (Creator): Dr. Bryan Young
Project ID: Study Director:
Sponsor Contact: Dennis Long

Pest Type

W, Weed = Weed or volunteer crop

Pest Code

AMAPA, Amaranthus palmeri, Palmer amaranth = US

DIGSA, Digitaria sanguinalis, large crabgrass = US

CHEAL, Chenopodium album, common lambsquarters = US

Crop Type, Code

C = EPPPO species (Bayer) codes

ZEAMD, BCOR, Zea mays indentata, Dent corn = US

Rating Type

PHYGEN = phytotoxicity - general / injury

CONTRO = control / burndown or knockdown

Rating Unit

% = percent