

2019 Wisconsin Weed Science Research Report



Cropping Systems Weed Science
UNIVERSITY OF WISCONSIN-MADISON

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A3646, Pest Management in Wisconsin Field Crops
Available at: <https://learningstore.uwex.edu/>

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Predominant Weed Species in Trial: Color Coding		
 giant ragweed	 waterhemp	 common ragweed
		 velvetleaf

Project Goal: Gain exposure to Bayer corn herbicide product offerings and potential integrated weed control systems

Site Description:

Location:	Janesville, WI	Crop:	Corn
Field #:	4	Variety:	DKC 54-38 RIB
Soil type:	Plano silt loam	Planting Date:	5/14
% OM:	3.3	Emergence Date:	5/22
pH:	6.7	Population:	34,000 seeds/acre
Fertilization:	200 lbs N/acre 75 lbs potash/acre	Depth:	2 in
Previous crop:	Soybean	Row spacing:	30 in
Tillage:	conventional	Plot Size:	10 x 30 ft
Weed species:	giant ragweed (AMBTR), giant foxtail (SETFA), green foxtail (SETVI), barnyardgrass (ECHCG)		

Herbicide Application Information:

Date:	5/15	6/3	6/13
Treatment:	PRE (A)	EPOST (B)	POST (C)
Air Temp (°F):	74	65	70
2" Soil Temp (°F):	80	75	62
Soil moisture [surface]:	moist	moist	moist
RH %:	72	49	43
Cloud cover %	10	20	5
Wind speed (mph)/direction	2-4/W	3-11/SE	4-9/NW
GPA:	15	15	15
PSI:	19	35	35
Nozzle:	XR11002	TTI110015	TTI110015
Nozzle spacing (in):	20	20	20
Boom Height (in):	20	23	24

Crop and weed information at application:

	Date:	5/15	6/3	6/13
Corn	Height (in):	-	3	6
	Stage:	-	V2	V3/V4
AMBTR	Height (in):	-	2-4	1-6
	Density (m ²):	-	4-40	0-50

Trt #	Treatment	Formulation	SOA Group	Rate	App Timing	App Code
1	Harness Xtra 5.6L	5.6 lb/gal	5, 15	2.4 qt/a	A	PRE
2	Harness Xtra 5.6L	5.6 lb/gal	5, 15	2 qt/a	A	PRE
	Balance Flexx	2 lb/gal	27	3 fl oz/a	A	PRE
3	Harness Xtra 5.6L	5.6 lb/gal	5, 15	2 qt/a	A	PRE
	Corvus	2.62 lb/gal	2, 27	3.3 fl oz/a	A	PRE
4	Corvus	2.62 lb/gal	2, 27	4.5 fl oz/a	A	PRE
	atrazine	4 lb/gal	5	2 pt/a	A	PRE
5	Corvus	2.62 lb/gal	2, 27	4.5 fl oz/a	A	PRE
	Harness Xtra 5.6L	5.6 lb/gal	5, 15	1.6 qt/a	A	PRE
6	Harness MAX	3.85 lb/gal	15, 27	2 qt/a	A	PRE
	atrazine	4 lb/gal	5	2 pt/a	A	PRE
7	Acuron	3.44 lb/gal	5, 15, 27	2.5 qt/a	A	PRE
8	Resicore	3.35 lb/gal	4, 15, 27	2.5 qt/a	A	PRE
	atrazine	4 lb/gal	5	2 pt/a	A	PRE
9	Harness MAX	3.85 lb/gal	15, 27	2 qt/a	A	PRE
	atrazine	4 lb/gal	5	2 pt/a	A	PRE
	DiFlexx	4 lbae/gal	4	8 fl oz/a	C	POST
	MSO			1% v/v	C	POST
	AMS (liquid)			2.5% v/v	C	POST
10	Harness MAX	3.85 lb/gal	15, 27	2 qt/a	A	PRE
	atrazine	4 lb/gal	5	2 pt/a	A	PRE
	DiFlexx DUO	2.13 lb/gal	4, 27	24 fl oz/a	C	POST
	MSO			1% v/v	C	POST
	AMS (liquid)			2.5% v/v	C	POST
11	Harness MAX	3.85 lb/gal	15, 27	2 qt/a	A	PRE
	atrazine	4 lb/gal	5	2 pt/a	A	PRE
	Capreno	3.45 lb/gal	2, 27	3 fl oz/a	C	POST
	NIS			0.25% v/v	C	POST
	AMS (liquid)			2.5% v/v	C	POST
12	Corvus	2.62 lb/gal	2, 27	3.3 fl oz/a	A	PRE
	atrazine	4 lb/gal	5	2 pt/a	A	PRE
	Harness MAX	3.85 lb/gal	15, 27	1.75 qt/a	C	POST
	NIS			0.25% v/v	C	POST
	AMS (liquid)			2.5% v/v	C	POST
13	Harness Xtra 5.6L	5.6 lb/gal	5, 15	2 qt/a	A	PRE
	Balance Flexx	2 lb/gal	27	3 fl oz/a	A	PRE
	DiFlexx	4 lbae/gal	4	8 fl oz/a	C	POST
	MSO			1% v/v	C	POST
	AMS (liquid)			2.5% v/v	C	POST

Trt #	Treatment	Formulation	SOA Group	Rate	App Timing	App Code
14	Harness Xtra 5.6L	5.6 lb/gal	5, 15	2 qt/a	A	PRE
	Balance Flexx	2 lb/galB	27	3 fl oz/a	A	PRE
	Capreno	3.45 lb/gal	2, 27	3 fl oz/a	C	POST
	NIS			0.25% v/v	C	POST
	AMS (liquid)			2.5% v/v	C	POST
15	Harness MAX	3.85 lb/gal	15, 27	1.25 qt/a	B	EPOST
	NIS			0.25% v/v	B	EPOST
	AMS (liquid)			2.5% v/v	B	EPOST
16	Degree XTRA	4.04 lb/gal	5, 15	3 qt/a	B	EPOST
	Capreno	3.45 lb/gal	2, 27	3 fl oz/a	B	EPOST
	NIS			0.25% v/v	B	EPOST
	AMS (liquid)			2.5% v/v	B	EPOST
17	Halex GT	4.39 lb/gal	9, 15, 27	3.6 pt/a	B	EPOST
	atrazine	4 lb/gal	5	2 pt/a	B	EPOST
	NIS			0.25% v/v	B	EPOST
	AMS (liquid)			2.5% v/v	B	EPOST

Adjuvants: AMS = Amsol; NIS = Induce; MSO = Premium MSO

Trial Summary:

This trial evaluated the weed control and crop safety of various corn herbicide programs from an integrated Bayer portfolio. There was no visible corn injury from the PRE herbicides. There was minor leaf necrosis, less than 5%, from some of the herbicides applied at the EPOST and POST timings (data not shown). Control of grass weed species was excellent, greater than 97%, for all PRE and PRE + POST herbicide programs (data not shown). Grass control was fair to good (75-88%) for the EPOST herbicide programs at the last rating date on 6/26 (data not shown). Giant ragweed was the predominant species and in plots with heavy densities it largely outcompeted other species. The average control of giant ragweed was impacted by herbicide program (Figure 1). In general, the PRE treatments containing a group 27 herbicide (Trts 2-14) had better and more consistent giant ragweed control than without (Trt 1). All 2-pass herbicide programs provided at least 90% control of giant ragweed 13 days after the POST application; whereas, none of the 1-pass programs exceeded 90% at the same rating timing. Corn yield was significantly impacted by herbicide program, $p=0.0001$ (Figure 2). Averaged across all treatments, yields of the 2-pass programs were consistently higher, 233 bu/acre, than the 1-pass programs, EPOST = 204 bu/acre and PRE = 182 bu/acre.

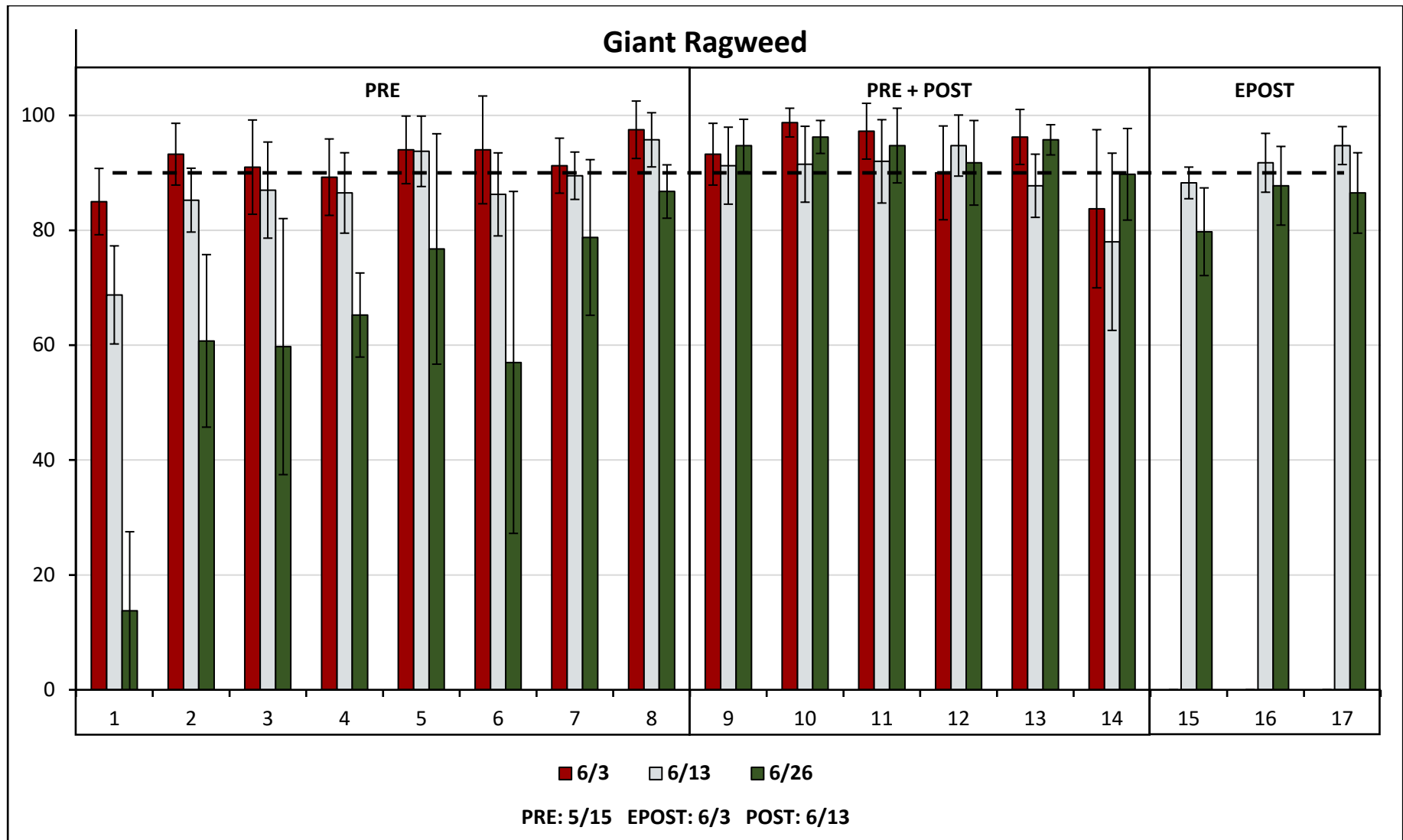


Figure 1: Giant ragweed efficacy ratings for trial #19-ROK-CN02. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. The dashed line indicates 90% control.

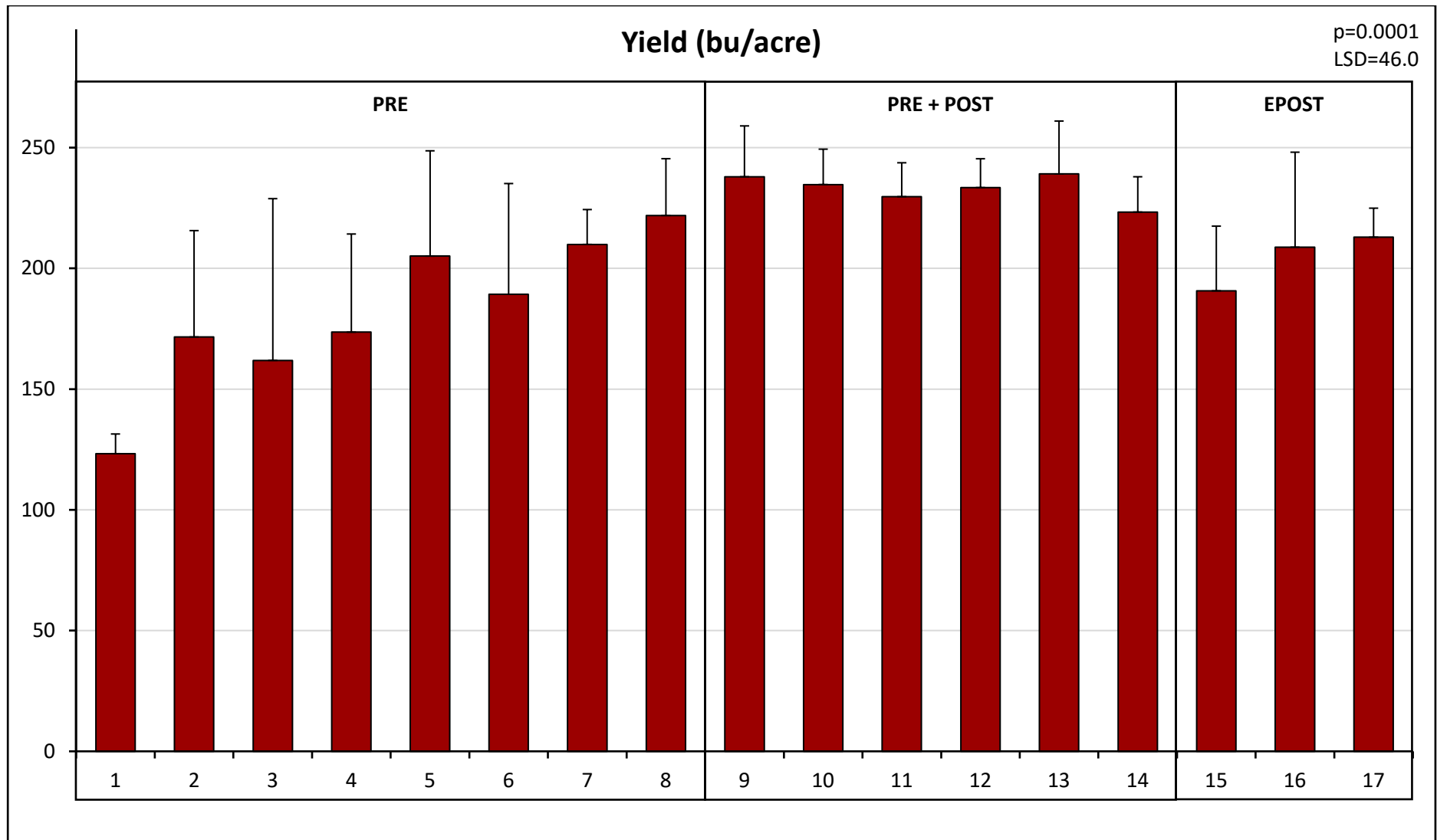


Figure 2. Grain yield for trial #19-ROK-CN02. Bars indicate the average yield in bushels per acre + the standard deviation of four replications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. Treatments are grouped according to application timing.

Project Goal: Evaluate various herbicide programs for season long weed control

Site Description:

Location:	Janesville, WI	Crop:	Corn
Field #:	4	Variety:	Wyfels W4358
Soil type:	Plano silt loam	Planting Date:	5/14
% OM:	3.3	Emergence Date:	5/22
pH:	6.7	Population:	34,000 seeds/acre
Fertilization:	200 lbs N/acre 75 lbs potash/acre	Depth:	2 in
Previous crop:	Soybean	Row spacing:	30 in
Tillage:	conventional	Plot Size:	10 x 30 ft
Weed species:	giant ragweed (AMBTR), common lambsquarters (CHEAL), velvetleaf (ABUTH), giant foxtail (SETFA), green foxtail (SETVI), barnyardgrass (ECHCG)		

Herbicide Application Information:

Date:	5/15	6/3	6/13
Treatment:	PRE (A)	EPOST (B)	POST (C)
Air Temp (°F):	74	65	70
2" Soil Temp (°F):	80	75	62
Soil moisture [surface]:	moist	moist	moist
RH %:	72	49	43
Cloud cover %	10	20	5
Wind speed (mph)/direction	2-4/W	3-11/SE	4-9/NW
GPA:	15	15	15
PSI:	24	38	39
Nozzle:	XR11002	TTI110015	TTI110015
Nozzle spacing (in):	20	20	20
Boom Height (in):	20	23	24

Crop and weed information at application:

	Date:	5/15	6/3	6/13
Corn	Height (in):	-	3	6
	Stage:	-	V2	V3/V4
AMBTR	Height (in):	-	1-5	1-7
	Density (m ²):	-	10-90	10-40
ABUTH	Height (in):	-	.5-2	.5-1
	Density (m ²):	-	0-4	0-1
CHEAL	Height (in):	-	.5-1	-
	Density (m ²):	-	0-4	-
Grass	Height (in):	-	.5-3	-
	Density (m ²):	-	1-20	-

Trt #	Treatment	Formulation	SOA Group	Rate	App Timing	App Code
1	Check					
2	Acuron	3.44 lb/gal	5, 15, 27	3 qt/a	A	PRE
3	Acuron	3.44 lb/gal	5, 15, 27	1.5 qt/a	A	PRE
	Halex GT	4.39 lb/gal	9, 15, 27	3.6 pt/a	C	POST
	AAtrex	4 lb/gal	5	1 pt/a	C	POST
	NIS			0.25% v/v	C	POST
	AMS (liquid)			2.5% v/v	C	POST
4	Acuron	3.44 lb/gal	5, 15, 27	1.75 qt/a	A	PRE
	Callisto Xtra	3.7 lb/gal	5, 27	20 fl oz/a	C	POST
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	C	POST
	AMS (liquid)			2.5% v/v	C	POST
5	Halex GT	4.39 lb/gal	9, 15, 27	4 pt/a	B	EPOST
	AAtrex	4 lb/gal	5	1 pt/a	B	EPOST
	NIS			0.25% v/v	B	EPOST
	AMS (liquid)			2.5% v/v	B	EPOST
6	Corvus	2.63 lb/gal	2, 27	4.5 fl oz/a	A	PRE
	AAtrex	4 lb/gal	5	3 pt/a	A	PRE
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	C	POST
	AMS (liquid)			2.5% v/v	C	POST
7	Capreno	3.45 lb/gal	2, 27	3 fl oz/a	B	EPOST
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	B	EPOST
	Warrant	3 lb/gal	15	2 qt/a	B	EPOST
	Superb HC			0.5% v/v	B	EPOST
	AMS (liquid)			2.5% v/v	B	EPOST
8	Harness XTRA 5.6L	5.6 lb/gal	5, 15	1.6 qt/a	A	PRE
	ImpactZ	4.26 lb/gal	5, 27	10.7 fl oz/a	C	POST
	MSO			1% v/v	C	POST
	AMS (liquid)			2.5% v/v	C	POST
9	Impact	2.8 lb/gal	27	1 fl oz/a	B	EPOST
	AAtrex	4 lb/gal	5	1 pt/a	B	EPOST
	Harness	7 lb/gal	15	1.75 pt/a	B	EPOST
	MSO			0.5% v/v	B	EPOST
	AMS (liquid)			2.5% v/v	B	EPOST

Adjuvants: AMS = Amsol; NIS = Induce; MSO = Premium MSO

Trial Summary:

This trial evaluated the weed control and crop safety of various corn herbicide programs with atrazine from the Syngenta, Bayer, and AMVAC corn herbicide portfolios. There was no significant corn injury from the PRE herbicides. There was some corn leaf necrosis, less than 10%, from some of the herbicides applied at the EPOST and POST timings (data not shown). Control of common lambsquarters, velvetleaf, and all grass species was excellent for all treatments throughout the growing season (data not shown). Giant ragweed was the predominant species and in plots with heavy densities it mostly outcompeted other species. The average control of giant ragweed was impacted by herbicide program (Figure 3). All 2-pass herbicide programs provided comparable giant ragweed control 19 days after the POST application. Giant ragweed control fell below 80% for all 1-pass programs (PRE and EPOST) at the same rating timing. Corn yield was significantly impacted by herbicide program, $p=0.0001$ (Figure 4). In general, corn yields of the 2-pass programs were greater, 234 bu/acre, than either of the 1-pass programs, EPOST = 203 bu/acre and PRE = 201 bu/acre. Yield of the untreated check was only 18 bu/acre, indicating the heavy giant ragweed pressure in this trial.

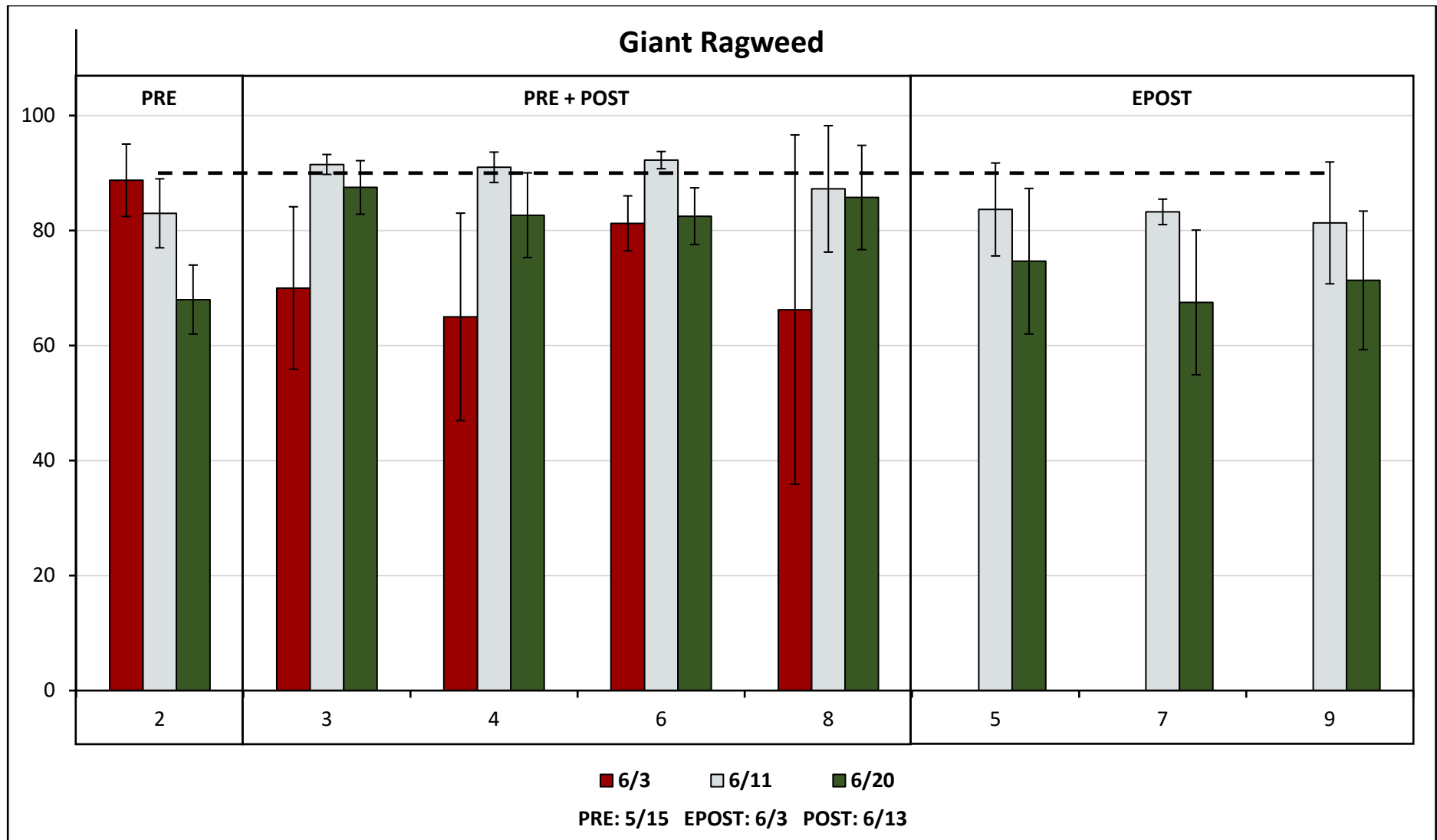


Figure 3. Giant ragweed efficacy ratings for trial #19-ROK-CN04. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. The dashed line indicates 90% control.

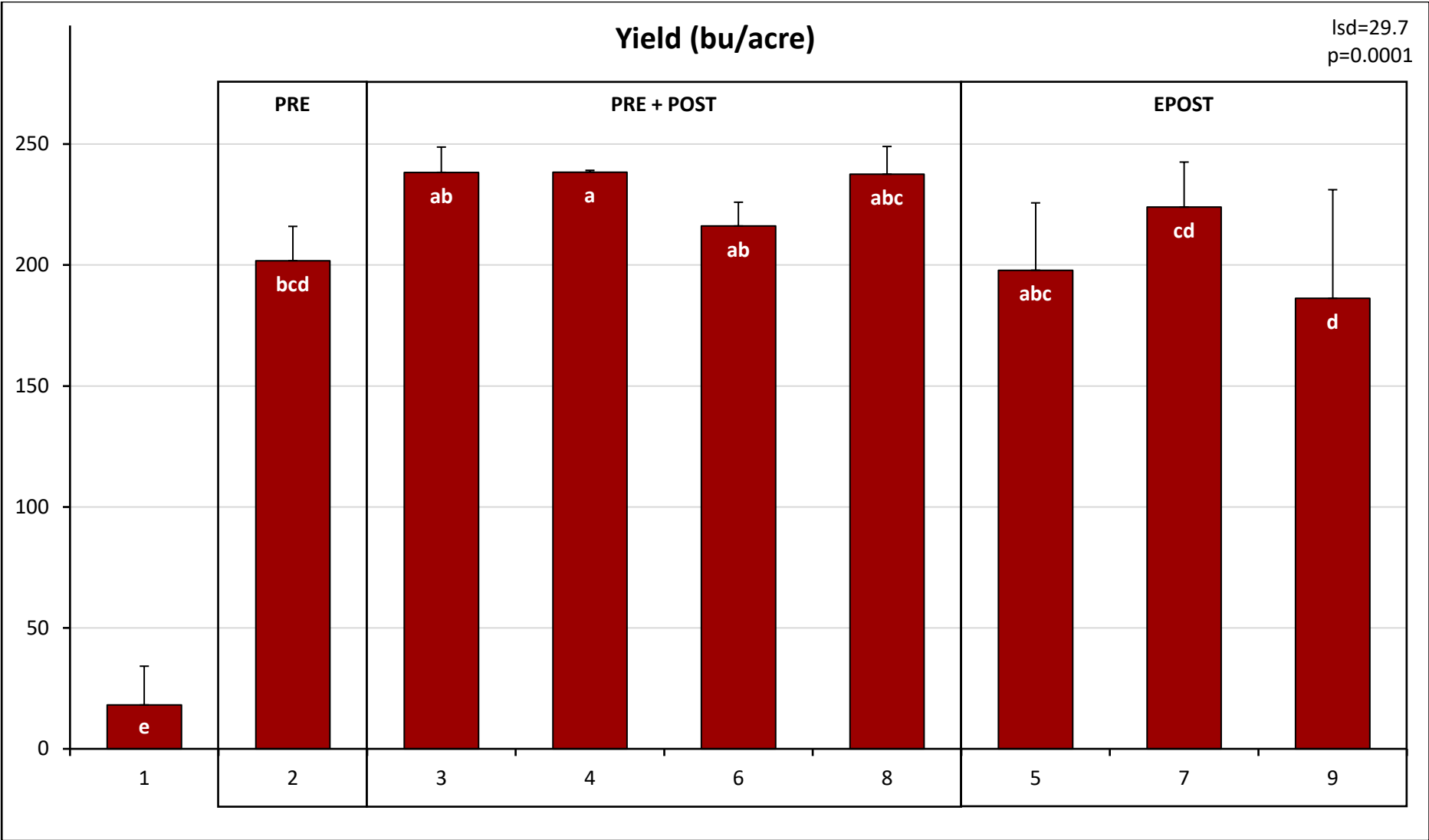


Figure 4. Grain yield for trial #19-ROK-CN04. Bars indicate the average yield in bushels per acre + the standard deviation of four replications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. Treatments are grouped according to application timing. Bars with the same letter are not significantly different (p=0.0001).

Project Goal: Evaluate various herbicide programs for season long-weed control.

Site Description:

Location:	Arlington, WI	Crop:	Corn
Field #:	455	Variety:	NK 0142-3120-EZ1
Soil type:	Plano silt loam	Planting Date:	5/4
% OM:	2.8	Emergence Date:	5/22
pH:	6.4	Population:	36,000 seeds/acre
Fertilization:	150 lb N/acre	Depth:	2 in
Previous crop:	Soybean	Row spacing:	30 in
Tillage:	conventional	Plot Size:	10 x 25 ft
Weed species:	common ragweed (AMBEL), common lambsquarters (CHEAL), velvetleaf (ABUTH), giant foxtail (SETFA), woolly cupgrass (ERBVI)		

Herbicide Application Information:

Date:	5/5	6/4	6/20
Treatment:	PRE	EPOST	POST
Air Temp (°F):	70	75	75
2" Soil Temp (°F):	60	72	70
Soil moisture [surface]:	moist	moist	moist
RH %:	45	63	56
Cloud cover %	5	35	75
Wind speed (mph)/direction	7-12/SW	2-10/SE	2-9/SE
Rainfall (in) 1 wk after APP:	1.41	0.14	1.24
GPA:	15	15	15
PSI:	24	40	40
Nozzle:	XR 11002	TTI 110015	TTI 110015
Nozzle spacing (in):	20	20	20
Boom Height (in):	20	23	24

Crop and weed information at application:

	Date:	5/5	6/4	6/20
Corn	Height (in):	-	2.5	7
	Stage:	-	V2	V5/V6
AMBEL	Height (in):	-	1-2	.5-1
	Density (m ²):	-	0-2	0-1
CHEAL	Height (in):	-	.5-1	-
	Density (m ²):	-	2-8	-
ABUTH	Height (in):	-	.5-1	.5-1
	Density (m ²):	-	7-19	0-1
Grass	Height (in):	-	1	1-2
	Density (m ²):	-	5-80	0-30

Trt #	Treatment	Formulation	SOA Group	Rate	App Timing	App Code
1	Check					
2	Acuron Flexi	3.26 lb/gal	15, 27	2.25 qt/a	A	PRE
	Princep 4L	4 lb/gal	5	1 qt/a	A	PRE
3	Acuron Flexi	3.26 lb/gal	15, 27	1 qt/a	A	PRE
	Halex GT	4.29 lb/gal	9, 15, 27	3.6 pt/a	C	POST
	NIS			0.25% v/v	C	POST
	AMS			8.5 lb/100 gal	C	POST
4	Acuron Flexi	3.26 lb/gal	15, 27	1.3 qt/a	A	PRE
	Callisto	4 lb/gal	27	3 fl oz/a	C	POST
	Status	56%	4	2.5 oz/a	C	POST
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	C	POST
	AMS			8.5 lb/100 gal	C	POST
5	Halex GT	4.29 lb/gal	9, 15, 27	4 pt/a	B	EPOST
	NIS			0.25% v/v	B	EPOST
	AMS			8.5 lb/100 gal	B	EPOST
6	Corvus	2.63 lb/gal	2, 27	4.5 fl oz/a	A	PRE
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	C	POST
	AMS			8.5 lb/100 gal	C	POST
7	Balance Flexx	2 lb/gal	27	5 fl oz/a	A	PRE
	TripleFlex II	4.25 lb/gal	2, 4, 15	2.5 pt/a	A	PRE
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	C	POST
	AMS			8.5 lb/100 gal	C	POST
8	Harness	7 lb/gal	15	2 pt/a	A	PRE
	Laudis	3.5 lb/gal	27	3 fl oz/a	C	POST
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	C	POST
	Destiny HC			0.5% v/v	C	POST
	AMS			8.5 lb/100 gal	C	POST
9	Capreno	3.45 lb/gal	2, 27	3 fl oz/a	B	EPOST
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	B	EPOST
	Warrant	3 lb/gal	15	2 qt/a	B	EPOST
	Superb HC			0.5% v/v	B	EPOST
	AMS			8.5 lb/100 gal	B	EPOST

Adjuvants: NIS = Prefer 90

Trial Summary:

This trial evaluated the weed control and crop safety of various corn herbicide programs without atrazine from the Syngenta and Bayer portfolio. There was no significant corn injury from the PRE herbicides. There was minor leaf necrosis, less than 5%, from some of the herbicides applied at the EPOST and POST timings (data not shown). Control of common lambsquarters and common ragweed was excellent for all treatment throughout the growing season (data not shown). Velvetleaf control was excellent for all treatments except for the PRE Harness treatment (Trt 8), as control fell below 90% on the 6/21 rating. Grass control was affected by herbicide program throughout the growing season (Figure 5). All treatments with a POST application had greater than 90% control on the 7/9 rating; whereas, the PRE only treatment (Trt 2) had 85% grass control. Corn yield did not significantly differ among herbicide treatments ($p=0.6814$) as all treatments were effective at controlling most weeds (data not shown). Yield of the untreated check was reduced by 37 bu/acre (15%) when compared to the average across all herbicide treatments. Although not significantly different, a small yield reduction of the EPOST programs was observed. Yields of the various herbicide programs were as follows: untreated check = 204 bu/acre, PRE only = 244 bu/acre, EPOST = 236 bu/acre, and PRE+POST = 243 bu/acre. This suggests that there may have been some yield loss potential by allowing weeds to compete with the crop early in the growing season.

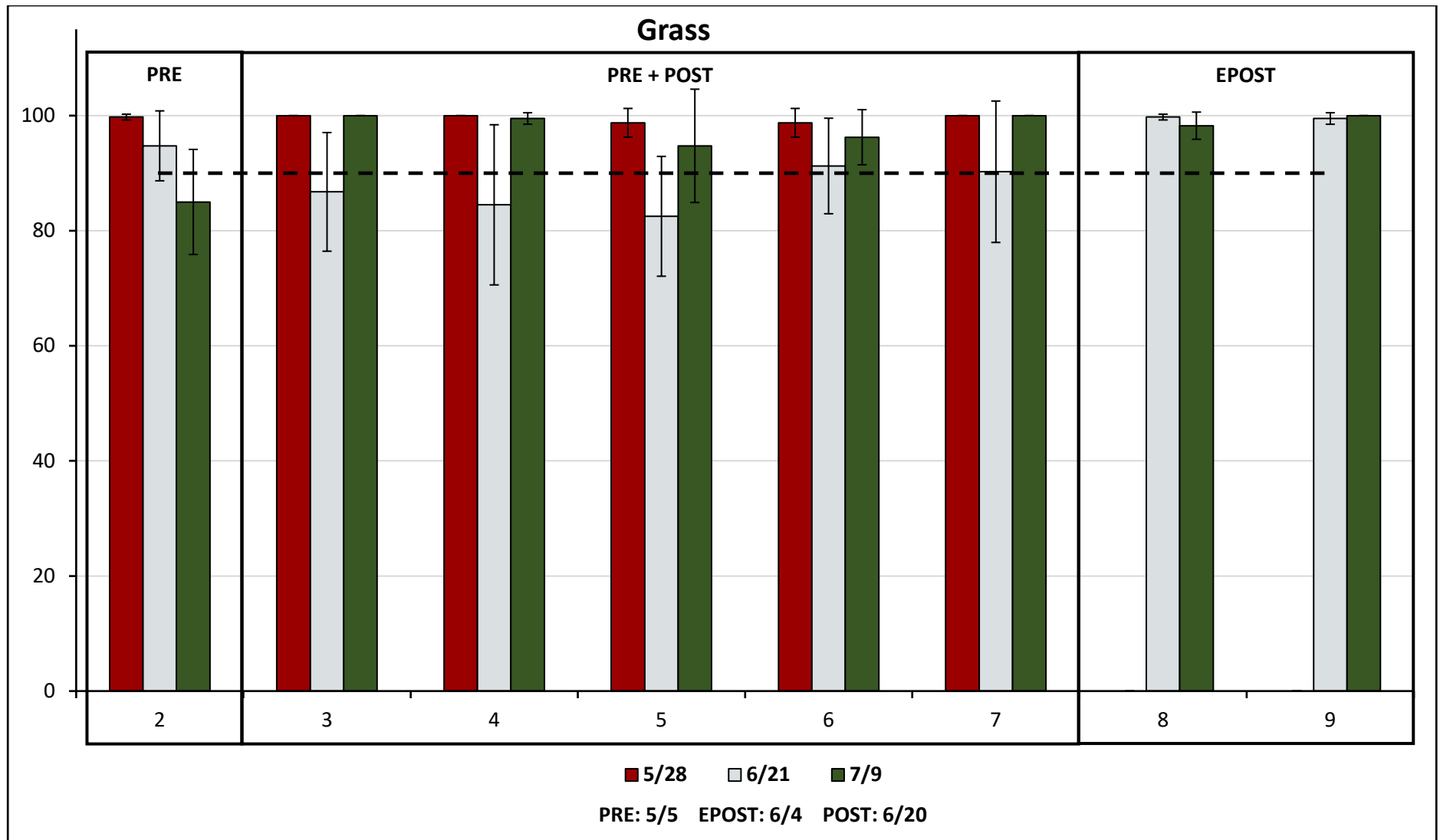


Figure 5. Giant foxtail efficacy ratings for trial #19-ARL-CN05. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. The dashed line indicates 90% control.

Project Goal: Evaluate the season long weed control of 1 and 2 pass herbicide programs containing multiple effective sites of action from 3 different companies

Site Description:

Location:	Janesville, WI	Crop:	Corn
Field #:	4	Variety:	DKC 54-38 RIB
Soil type:	Plano silt loam	Planting Date:	5/14
% OM:	3.3	Emergence Date:	5/22
pH:	6.7	Population:	34,000 seeds/acre
Fertilization:	200 lbs N/acre 75 lbs potash/acre	Depth:	2 in
Previous crop:	Soybean	Row spacing:	30 in
Tillage:	conventional	Plot Size:	10 x 30 ft
Weed species:	giant ragweed (AMBTR), common lambsquarters (CHEAL), velvetleaf (ABUTH), redroot pigweed (AMARE), giant foxtail (SETFA), green foxtail (SETVI), barnyardgrass (ECHCG)		

Herbicide Application Information:

Date:	5/15	6/3	6/13
Treatment:	PRE (A)	EPOST (B)	POST (C)
Air Temp (°F):	74	65	70
2" Soil Temp (°F):	80	75	62
Soil moisture [surface]:	moist	moist	moist
RH %:	72	49	43
Cloud cover %	10	20	5
Wind speed (mph)/direction	2-4/W	3-11/SE	4-9/NW
Rainfall (in) 1 wk after APP:	1.26	1.57	0.42
GPA:	15	15	15
PSI:	24	38	38
Nozzle:	XR11002	TTI110015	TTI110015
Nozzle spacing (in):	20	20	20
Boom Height (in):	20	23	24

Crop and weed information at application:

	Date:	5/8	6/3	6/13
Corn	Height (in):	-	3	6
	Stage:	-	V2	V3/V4
AMBTR	Height (in):	-	2-4	1-6
	Density (m ²):	-	5-100	2-60
ABUTH	Height (in):	-	2	-
	Density (m ²):	-	2-7	-
AMARE	Height (in):	-	.5-1	-
	Density (m ²):	-	0-3	-
CHEAL	Height (in):	-	.5-1	-
	Density (m ²):	-	0-2	-
Grass	Height (in):	-	.5-3	-
	Density (m ²):	-	1-6	-

Project Goal: Evaluate the season long weed control of 1 and 2 pass herbicide programs containing multiple effective sites of action from 3 different companies

Site Description:

Location:	Arlington, WI	Crop:	Corn
Field #:	455	Variety:	DKC 54-38 RIB
Soil type:	Plano silt loam	Planting Date:	5/4
% OM:	2.8	Emergence Date:	5/22
pH:	6.4	Population:	36,000 seeds/acre
Fertilization:	150 lb N/acre	Depth:	2 in
Previous crop:	Soybean	Row spacing:	30 in
Tillage:	conventional	Plot Size:	10 x 25 ft
Weed species:	common ragweed (AMBEL), common lambsquarters (CHEAL), velvetleaf (ABUTH), giant foxtail (SETFA), woolly cupgrass (ERBVI)		

Herbicide Application Information:

Date:	5/5	6/3	6/17
Treatment:	PRE (A)	EPOST (B)	POST (C)
Air Temp (°F):	70	67	78
2" Soil Temp (°F):	60	70	75
Soil moisture [surface]:	moist	dry	moist
RH %:	45	53	66
Cloud cover %	5	75	60
Wind speed (mph)/direction	7-12/SW	4-10/S	0-3/NE
Rainfall (in) 1 wk after APP:	1.41	0.18	1.07
GPA:	15	15	15
PSI:	38	38	38
Nozzle:	TTI110015	TTI110015	TTI110015
Nozzle spacing (in):	20	20	20
Boom Height (in):	20	22	24

Crop and weed information at application:

	Date:	5/5	6/3	6/17
Corn	Height (in):	-	2.5	10
	Stage:	-	V2	V4/V5
AMBEL	Height (in):	-	-	.5-2
	Density (m ²):	-	-	.4
ABUTH	Height (in):	-	1-3	.5-2
	Density (m ²):	-	10	3.5
CHEAL	Height (in):	-	.5-2.5	.5-1
	Density (m ²):	-	8	.1
Grass	Height (in):	-	.5-3	.5-3
	Density (m ²):	-	30	2.5

Project Goal: Evaluate the season long weed control of 1 and 2 pass herbicide programs containing multiple effective sites of action from 3 different companies

Site Description:

Location:	Brooklyn, WI	Crop:	Corn
Field #:	K-1	Variety:	DKC 54-38 RIB
Soil type:	Sebewa silt loam	Planting Date:	5/31
% OM:	4.3	Emergence Date:	6/6
pH:	6.4	Population:	35,000 seeds/acre
Fertilization:	178 lb N/acre	Depth:	2 in
Previous crop:	Soybean	Row spacing:	30 in
Tillage:	conventional	Plot Size:	10 x 30 ft
Weed species:	common lambsquarters (CHEAL), velvetleaf (ABUTH)		

Herbicide Application Information:

Date:	5/31	6/26
Treatment:	PRE (A)	POST
Air Temp (°F):	82	77
2" Soil Temp (°F):	71	70
Soil moisture [surface]:	moist	moist
RH %:	53	65
Cloud cover %	50	5
Wind speed (mph)/direction	3-9/SW	0-0.5/N
Rainfall (in) 1 wk after APP:	0.95	1.68
GPA:	15	15
PSI:	24	38
Nozzle:	XR11002	TTI110015
Nozzle spacing (in):	20	20
Boom Height (in):	20	24

Crop and weed information at application:

	Date:	5/31	6/26
Corn	Height (in):	-	9
	Stage:	-	V4/V5
CHEAL	Height (in):	-	.25-2
	Density (m ²):	-	6
ABUTH	Height (in):	-	.25-2
	Density (m ²):	-	1

Project Goal: Evaluate the season long weed control of 1 and 2 pass herbicide programs containing multiple effective sites of action from 3 different companies

Site Description:

Location:	Lancaster, WI	Crop:	Corn
Field #:	SIDS-SE	Variety:	DKC 56-45 RIB
Soil type:	Fayette silt loam	Planting Date:	5/23
% OM:	2.5	Emergence Date:	-
pH:	6.8	Population:	32,500 seeds/acre
Fertilization:	260 lbs/a urea 110 lbs 4-19-38	Depth:	1.5
Previous crop:	Soybean	Row spacing:	30 in
Tillage:	conventional	Plot Size:	10 x 30 ft
Weed species:	common lambsquarters (CHEAL), waterhemp (AMATA), giant foxtail (SETFA)		

Herbicide Application Information:

Date:	5/23	6/11	6/25
Treatment:	PRE (A)	EPOST (B)	POST (C)
Air Temp (°F):	71	70	75
2" Soil Temp (°F):	66	72	74
Soil moisture [surface]:	moist	dry	wet
RH %:	53	58	66
Cloud cover %	10	10	40
Wind speed (mph)/direction	9/WNW	4/SW	4.5/SW
Rainfall (in) 1 wk after APP:	2.46	2.15	2.58
GPA:	15	15	15
PSI:	25	25	25
Nozzle:	XR11002	XR11002	XR11002
Nozzle spacing (in):	20	20	20
Boom Height (in):	20	22	24

Crop and weed information at application:

	Date:	5/23	6/11	6/25
Corn	Height (in):	-		17
	Stage:	-	V2	V5
AMATA	Height (in):	-	.25-.5	.25-1
	Density (m ²):	-	10	24
CHEAL	Height (in):	-	1-5	.5-4
	Density (m ²):	-	32	61
Grass	Height (in):	-	1-4	1-3
	Density (m ²):	-	4	9

Trt #	Treatment	Formulation	SOA Group	Rate	App Timing	App Code
1	Check					
2	Harness Max	3.85 lb/gal	15, 27	75 fl oz/a	PRE	A
3	Diflexx Duo	2.13 lb/gal	4, 27	28 fl oz/a	EPOST	B
	Roundup PowerMax	4.5 lbae/gal	9	30 fl oz/a	EPOST	B
	COC			0.5 % v/v	EPOST	B
	Ammonium Sulfate			8.5 lb/100 gal	EPOST	B
4	Harness Max	3.85 lb/gal	15, 27	64 fl oz/a	PRE	A
	Diflexx	4 lbae/gal	4	8 fl oz/a	EPOST	C
	Roundup PowerMax	4.5 lbae/gal	9	30 fl oz/a	EPOST	C
	NIS			0.25 % v/v	EPOST	C
	Ammonium Sulfate			8.5 lb/100 gal	EPOST	C
5	Harness Max	3.85 lb/gal	15, 27	64 fl oz/a	PRE	A
	Diflexx Duo	2.13 lb/gal	4, 27	28 fl oz/a	POST	C
	Roundup PowerMax	4.5 lbae/gal	9	30 fl oz/a	POST	C
	COC			0.25 % v/v	POST	C
	Ammonium Sulfate			8.5 lb/100 gal	POST	C
6	Acuron Flexi	3.26 lba/gal	15, 27	2.25 qt/a	PRE	A
7	Halex GT	4.39 lb/gal	9, 15, 27	4 pt/a	EPOST	B
	Clarity	4 lbae/gal	4	8 fl oz/a	EPOST	B
	NIS			0.25 % v/v	EPOST	B
	Ammonium Sulfate			8.5 lb/100 gal	EPOST	B
8	Acuron Flexi	3.26 lb/gal	15, 27	1.5 qt/a	PRE	A
	Roundup PowerMax	4.5 lbae/gal	9	30 fl oz/a	POST	C
	Clarity	4 lbae/gal	4	8 fl oz/a	POST	C
	NIS			0.25 % v/v	POST	C
	Ammonium Sulfate			8.5 lb/100 gal	POST	C
9	Acuron Flexi	3.26 lb/gal	15, 27	1.1 qt/a	PRE	A
	Halex GT	4.39 lb/gal	9, 15, 27	3.6 pt/a	POST	C
	Clarity	4 lbae/gal	4	8 fl oz/a	POST	C
	NIS			0.25 %	POST	C
	Ammonium Sulfate			8.5 lb/100 gal	POST	C
10	Surestart II	4.25 lb/gal	2, 4, 15	2.5 pt/a	PRE	A
11	Realm Q	38.75 %w/w	2, 27	4 oz/a	EPOST	B
	Roundup PowerMax	4.5 lbae/gal	9	30 fl oz/a	EPOST	B
	Clarity	4 lbae/gal	4	8 fl oz/a	EPOST	B
	COC			0.5 % v/v	EPOST	B
	Ammonium Sulfate			8.5 lb/100 gal	EPOST	B
12	Surestart II	4.25 lb/gal	2, 4, 15	2.5 pt/a	PRE	A
	Roundup PowerMax	4.5 lbae/gal	9	30 fl oz/a	POST	C
	Clarity	4 lbae/gal	4	8 fl oz/a	POST	C
	NIS			0.25 % v/v	POST	C
	Ammonium Sulfate			8.5 lb/100 gal	POST	C
13	Surestart II	4.25 lb/gal	2, 4, 15	2.5 pt/a	PRE	A
	Realm Q	38.75 %w/w	2, 27	4 oz/a	POST	C
	Roundup PowerMax	4.5 lbae/gal	9	30 fl oz/a	POST	C
	Clarity	4 lbae/gal	4	8 fl oz/a	POST	C
	COC			0.5 % v/v	POST	C
	Ammonium Sulfate			8.5 lb/100 gal	POST	C

Adjuvants: NIS=Activator 90; COC=Crop Oil

Trial Summary:

In 2019, we repeated our system trial from 2018 (18-ROK-CN14, 18-ARL-CN14). If interested in the 2018 results, they can be found in the [2018 WiscWeeds Research Report](#). In addition to our Janesville and Arlington research sites this trial was also placed at the Lancaster Agricultural Research Station and a grower's field south of Brooklyn, WI in 2019.

19-ROK-CN09 (Janesville): Giant ragweed was the predominant species at Janesville. None of the treatments evaluated provided >90% control at the final in-season ratings (6/26), which occurred 14 days after the final POST application (Figure 6). However, given the very heavy infestation, levels of control were generally acceptable (>80%) for the 2-pass systems. Percent control for the 1-pass systems (PRE, EPOST) ranged from 51-75% at the 6/26 rating. Giant ragweed control from the EPOST treatments was initially very good (>90%) 10 days after application. However, a new flush of giant ragweed emerged after application before the corn had canopied which resulted in poor control at the later rating. Corn yield was affected by herbicide treatments (Figure 7). There was not a significant difference between the EPOST and 2-pass programs; however, the EPOST treatments had numerically lower yields (9-16 bu/acre). Averages of each system were as follows: untreated check = 44 bu/acre; 1-pass PRE = 161 bu/acre, 1-pass EPOST = 202 bu/acre, 2-pass PRE + POST = 218 bu/acre, 2-pass PRE + POST with additional residual = 211 bu/acre.

19-ARL-CN09 (Arlington): Velvetleaf, common lambsquarters, common ragweed, giant foxtail, and woolly cupgrass were the predominant species at Arlington. All herbicide programs provided >90% control of common lambsquarters and common ragweed throughout the growing season (data not shown). Velvetleaf control was also >90%, except for the Surestart II treatment (Figure 8). Grass control was <90% in some of the treatments just prior to the final POST application (Figure 9). Corn yield was impacted by herbicide treatments (Figure 10).

19-BRO-CN09 (Brooklyn): Velvetleaf and common lambsquarters were the predominant species at Brooklyn. Weed pressure at this location was very low. All herbicide programs evaluated provided >90% control of common lambsquarters throughout the growing season (data not shown). Velvetleaf control was also >90%, except for the Surestart II treatment (Figure 11). Grain yield was not affected by herbicide programs (data not shown).

19-LAN-CN09 (Lancaster): Waterhemp and common lambsquarters were the predominant species at Lancaster. All herbicide programs provided >90% of waterhemp early in the season at the 6/20 rating; however, control fell below 90% at later ratings on 7/5 and 7/29 (Figure 12). Waterhemp control of the PRE only treatments ranged from 58-83%. All EPOST and POST herbicide programs were effective at controlling emerged waterhemp; however later flushes were not controlled by some treatments. Adding a herbicide with soil residual activity on waterhemp to the tank at the EPOST and POST application timings generally improved late season control. Corn yield was highly variable and did not significantly differ among the herbicide treatments (data not shown). Yield averaged across all herbicide treatments was 183 bu/acre, while the untreated check was 116 bu/acre, a 37% reduction.

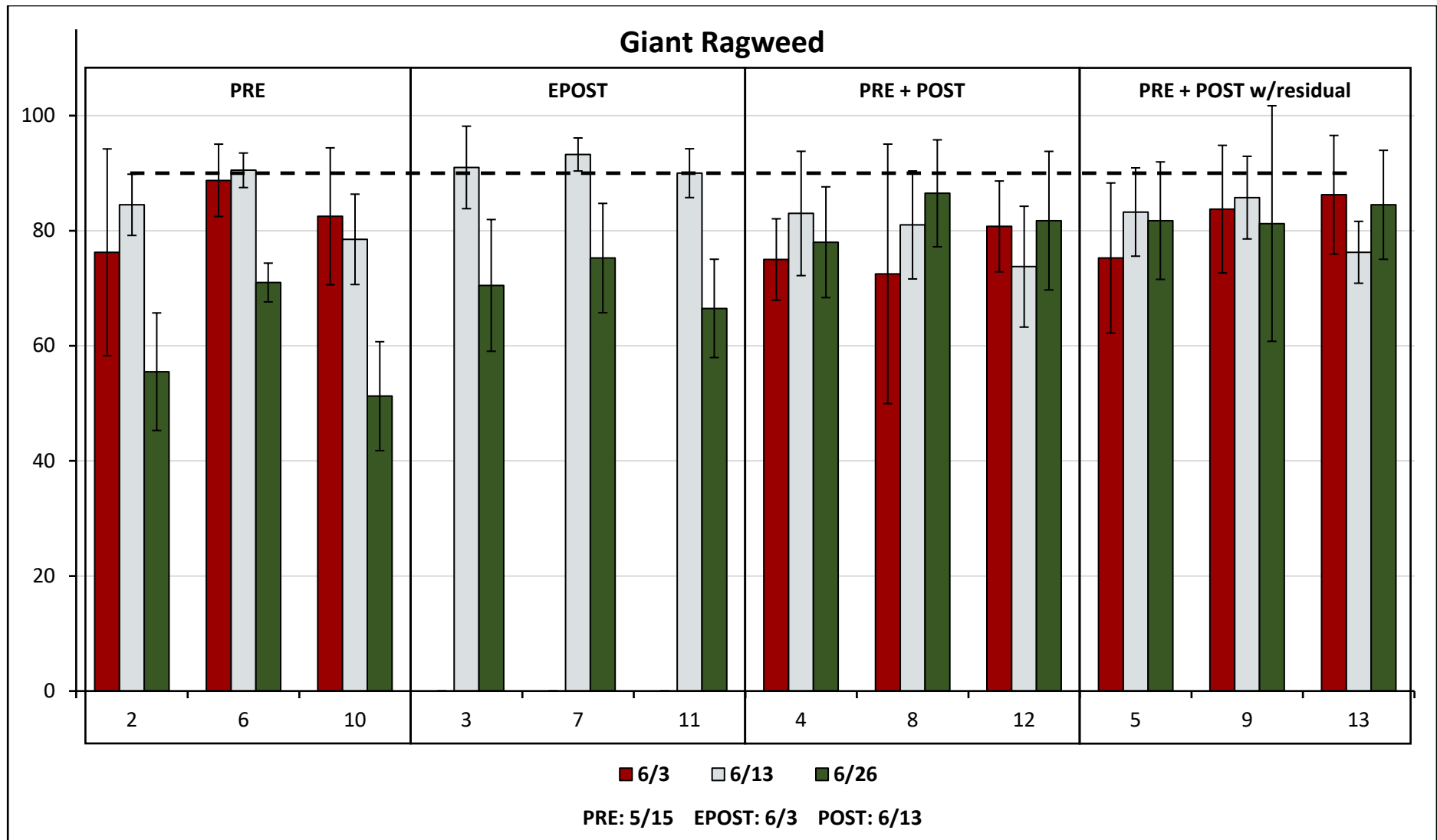


Figure 6. Giant ragweed efficacy ratings for trial #19-ROK-CN09. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. Treatments are grouped according to application timing. The dashed line indicates 90% control.

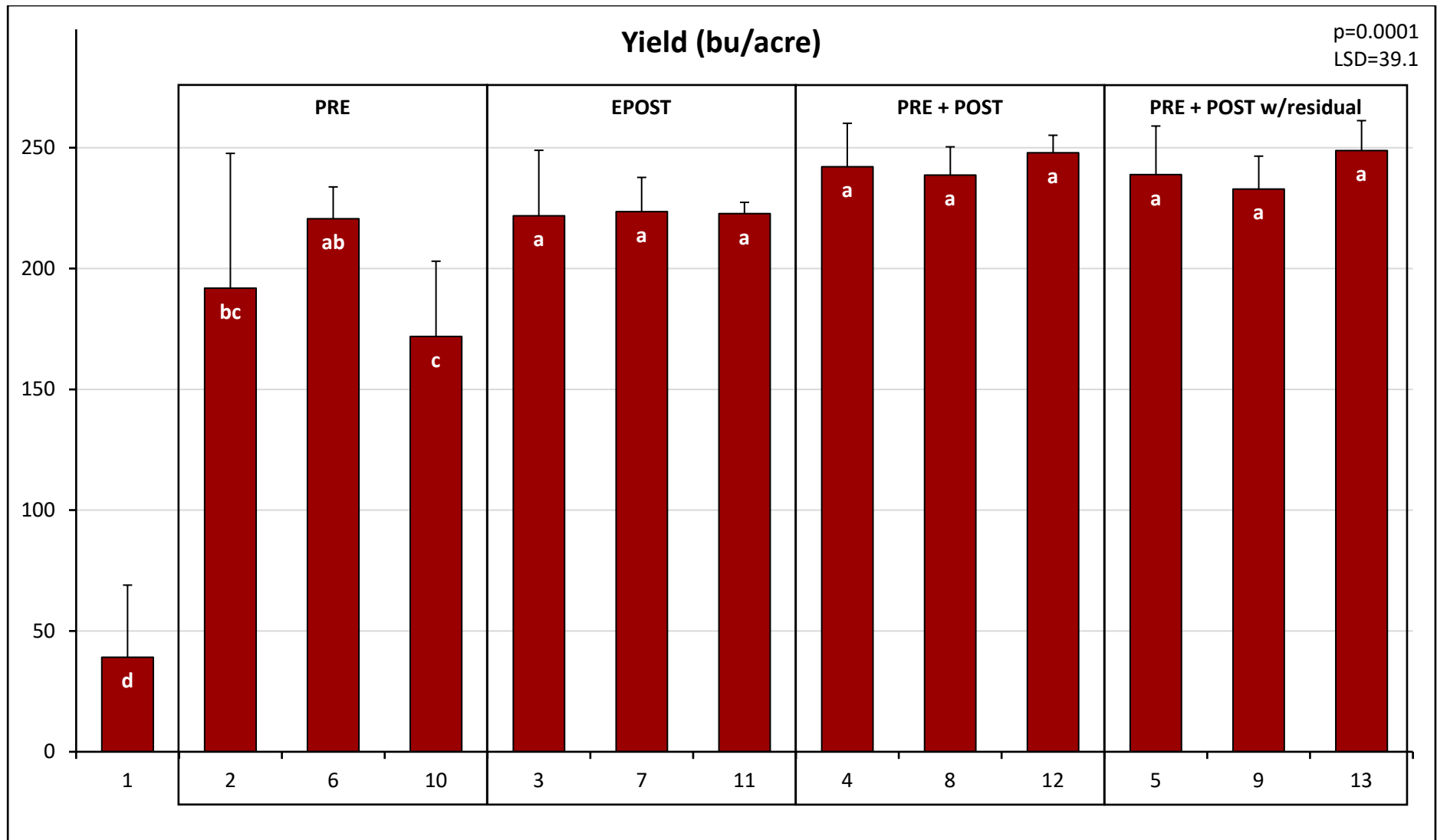


Figure 7. Grain yield for trial #19-ROK-CN09. Bars indicate the average yield in bushels per acre + the standard deviation of four replications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. Treatments are grouped according to application timing. Bars with the same letter are not significantly different (p=0.0001).

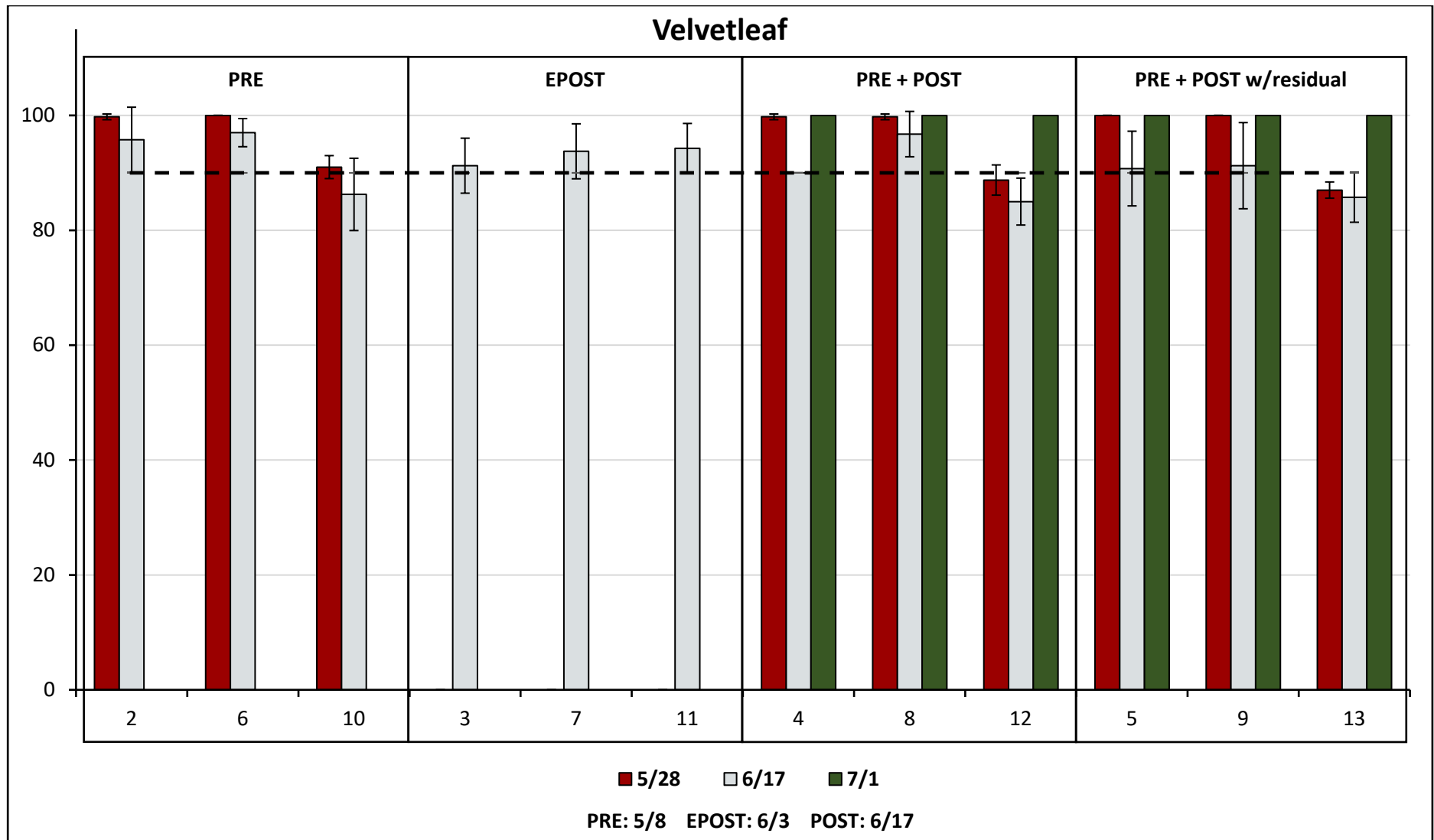


Figure 8. Velvetleaf efficacy ratings for trial #19-ARL-CN09. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. Treatments are grouped according to application timing. The dashed line indicates 90% control.

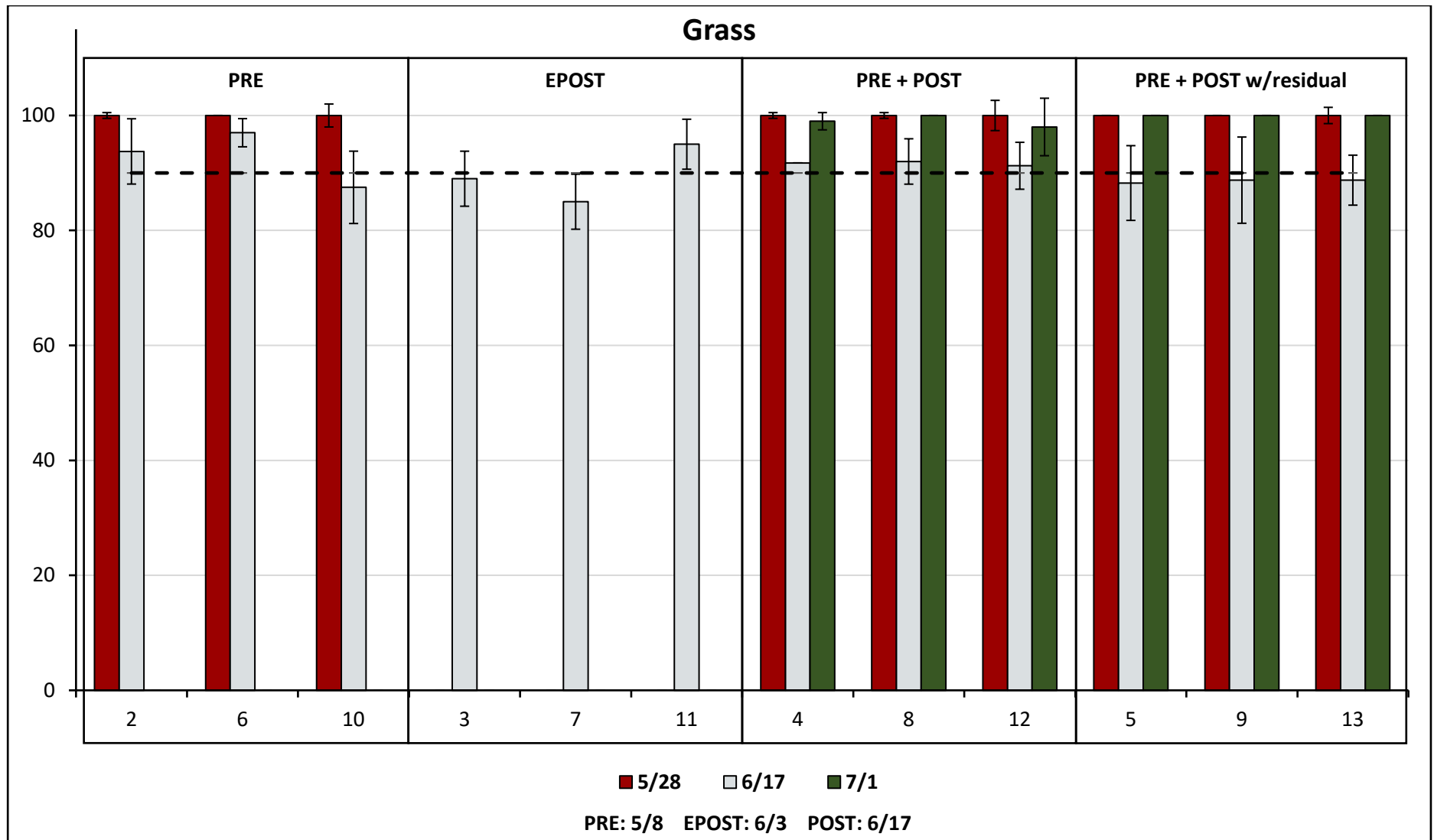


Figure 9. Annual grass efficacy ratings for trial #19-ARL-CN09. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. Treatments are grouped according to application timing. The dashed line indicates 90% control.

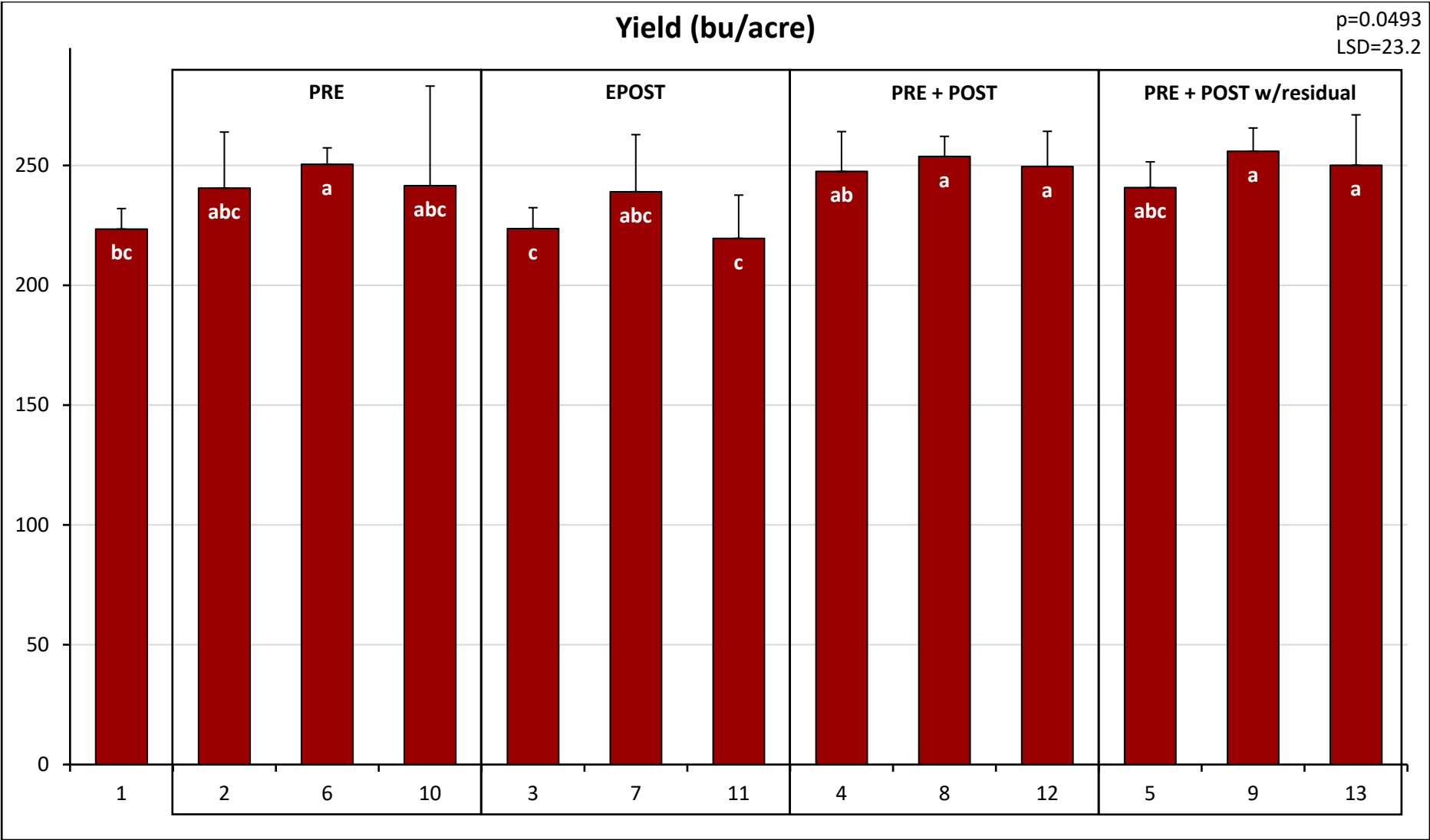


Figure 10. Grain yield for trial #19-ARL-CN09. Bars indicate the average yield in bushels per acre + the standard deviation of four replications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. Treatments are grouped according to application timing. Bars with the same letter are not significantly different (p=0.0493).

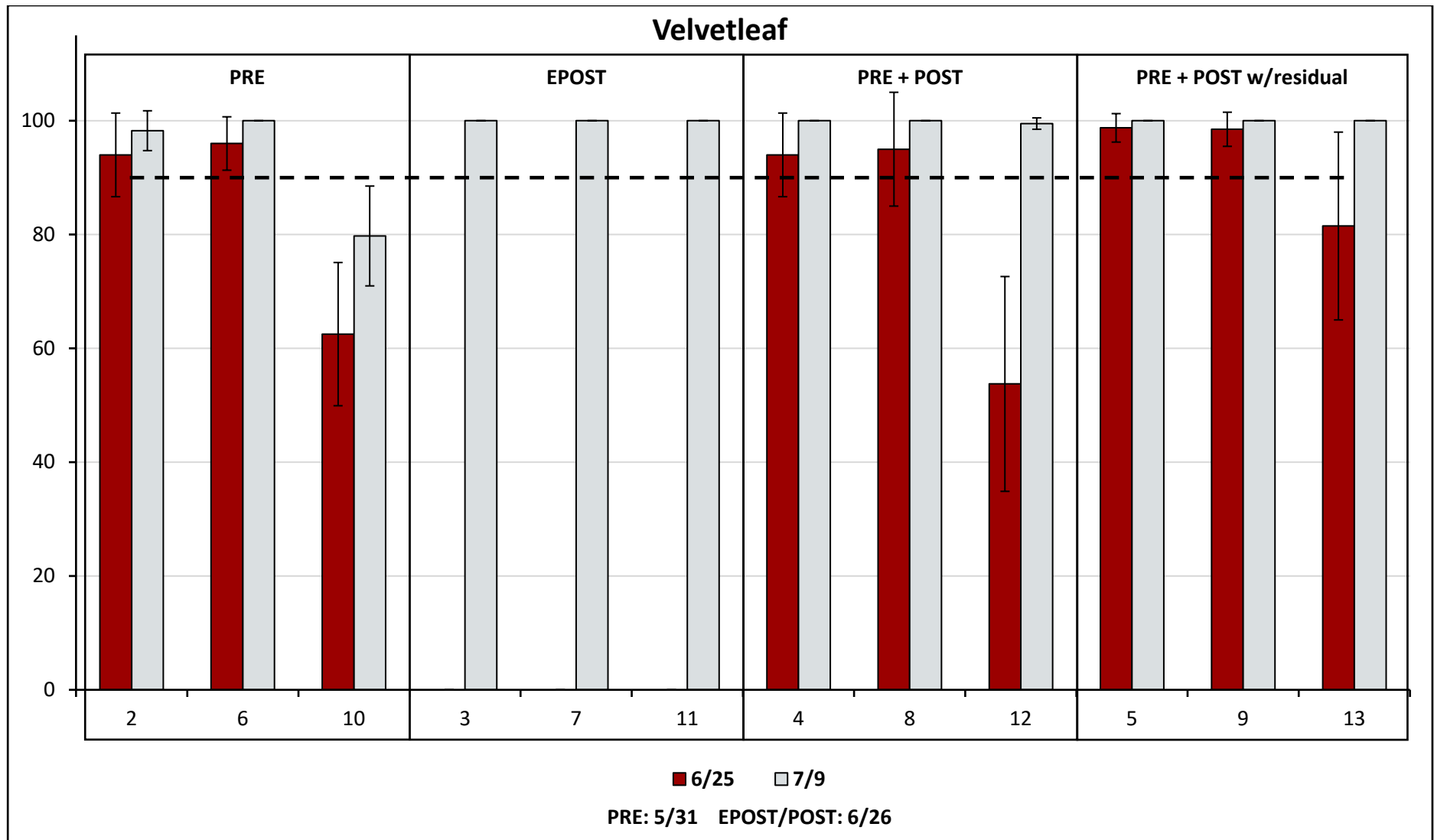


Figure 11. Velvetleaf efficacy ratings for trial #19-BRO-CN09. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. Treatments are grouped according to application timing. The dashed line indicates 90% control.

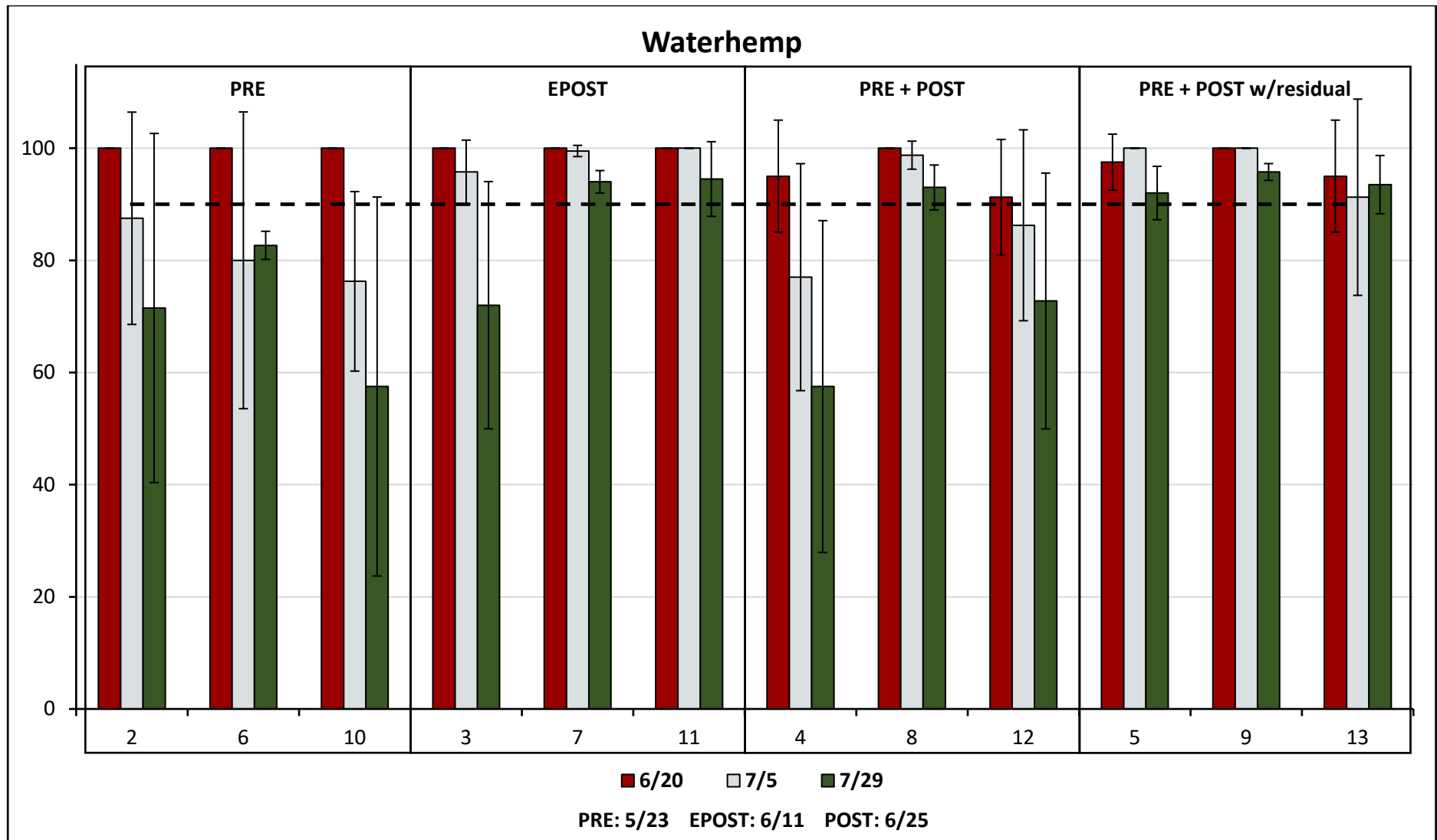


Figure 12. Waterhemp efficacy ratings for trial #19-LAN-CN09. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. Treatments are grouped according to application timing. The dashed line indicates 90% control.

Project Goal: Evaluate and demonstrate the effectiveness of multiple soil-applied corn herbicides.

Site Description:

Location:	Janesville, WI	Crop:	Corn
Field #:	3	Variety:	Wyfels W4358
Soil type:	Plano silt loam	Planting Date:	5/14
% OM:	3.3	Emergence Date:	5/23
pH:	6.9	Population:	34,000 seeds/acre
Fertilization:	200 lb N/acre 75 lb MAP/acre	Depth:	2 in
Previous crop:	Soybean	Row spacing:	30 in
Tillage:	conventional	Plot Size:	10 x 30 ft
Weed species:	giant ragweed (AMBTR), common lambsquarters (CHEAL), velvetleaf (ABUTH), giant foxtail (SETFA), barnyardgrass (ECHCG)		

Herbicide Application Information:

Date:	5/30
Treatment:	EPOST (A)
Air Temp (°F):	80
2" Soil Temp (°F):	80
Soil moisture [surface]:	wet
RH %:	45
Cloud cover %	50
Wind speed (mph)/direction	0-4/SW
Rainfall (in) 1 wk after APP:	2.0
GPA:	15
PSI:	20
Nozzle:	XR 11002
Nozzle spacing (in):	20
Boom Height (in):	22

Crop and weed information at application:

	Date:	5/30
Crop	Height (in):	2
	Stage:	V1
AMBTR	Height (in):	1-2
	Density:	0.5-65/m ²
ABUTH	Height (in):	0.5-1
	Density:	0-6/m ²
CHEAL	Height (in):	0.5
	Density:	0-3/m ²
Grass	Height (in):	0.5
	Density:	1-70/m ²

Project Goal: Evaluate and demonstrate the effectiveness of multiple soil-applied corn herbicides.

Site Description:

Location:	Brooklyn, WI	Crop:	Corn
Field #:	K-2	Variety:	DKC 54-38 RIB
Soil type:	Sebewa silt loam	Planting Date:	5/31
% OM:	5.2	Emergence Date:	6/6
pH:	6.2	Population:	35,000 seeds/acre
Fertilization:	178 lb N/acre	Depth:	2 in
Previous crop:	Soybean	Row spacing:	30 in
Tillage:	conventional	Plot Size:	10 x 30 ft
Weed species:	waterhemp (AMATA)		

Herbicide Application Information:

Date:	6/13
Treatment:	EPOST (A)
Air Temp (°F):	68
2" Soil Temp (°F):	59
Soil moisture [surface]:	wet
RH %:	51
Cloud cover %	51
Wind speed (mph)/direction	4-13/NNW
Rainfall (in) 1 wk after APP:	0.54
GPA:	15
PSI:	35
Nozzle:	TTI 110015
Nozzle spacing (in):	20
Boom Height (in):	23

Crop and weed information at application:

	Date:	6/13
Crop	Height (in):	2-4
	Stage:	V1
AMATA	Height (in):	<0.5
	Density:	0.5-15/ft ²

Liberty at 32 fl oz/a plus AMS at 8.5 lb/100 gal was applied to all treatments. Liberty was applied to control weeds that emerged after corn planting, as some of the products do not provide control of emerged weeds.

Trt #	Treatment	Formulation	SOA Group	Rate	App Timing	App Code
1	Check					
2	Python	80% w/w	2	1 oz/a	A	EPOST
3	Resolve SG	25% w/w	2	1.25 oz/a	A	EPOST
4	Stinger	3 lbae/gal	4	6 fl oz/a	A	EPOST
5	DiFlexx	4 lbae/gal	4	10 fl oz/a	A	EPOST
6	Aatrex	4 lb/gal	5	1.5 pt/a	A	EPOST
7	Aatrex	4 lb/gal	5	3 pt/a	A	EPOST
8	Harness	7 lb/gal	15	1.5 pt/a	A	EPOST
9	Dual II Magnum	7.64 lb/gal	15	1.67 pt/a	A	EPOST
10	Outlook	6 lb/gal	15	17.5 fl oz/a	A	EPOST
11	Zidua SC	4.17 lb/gal	15	3.25 fl oz/a	A	EPOST
12	Balance Flexx	2 lb/gal	27	4.5 fl oz/a	A	EPOST
13	Armezon	5.35 lb/gal	27	0.75 fl oz/a	A	EPOST
14	Callisto	4 lb/gal	27	3 fl oz/a	A	EPOST
15	Laudis	3.5 lb/gal	27	3 fl oz/a	A	EPOST
16	Armezon PRO	5.35 lb/gal	15, 27	20 fl oz/a	A	EPOST
17	Halex GT	4.4 lb/gal	9, 15, 27	4 pt/a	A	EPOST
18	Harness Max	3.85 lb/gal	15, 27	64 fl oz/a	A	EPOST
19	Acuron Flexi	3.26 lb/gal	15, 27	2 qt/a	A	EPOST
20	Capreno	3.45 lb/gal	2, 27	3 fl oz/a	A	EPOST
21	Corvus	2.63 lb/gal	2, 27	5.6 fl oz/a	A	EPOST
22	Realm Q	38.75% w/w	2, 27	4 oz/a	A	EPOST
23	DiFlexx DUO	2.13 lb/gal	4, 27	28 fl oz/a	A	EPOST
24	Bicep Lite II Magnum	6 lb/gal	5, 15	1.75 qt/a	A	EPOST
25	Harness XTRA	6 lb/gal	5, 15	2 qt/a	A	EPOST
26	Hornet WDG	78.5% w/w	2, 4	4 oz/a	A	EPOST
27	Resicore	3.29 lb/gal	4, 15, 27	2.5 qt/a	A	EPOST
28	Surestart II	4.25 lb/gal	2, 4, 15	2.5 pt/a	A	EPOST
29	Acuron	3.44 lb/gal	5, 15, 27	2.5 qt/a	A	EPOST
30*	Princep 4L	4 lb/gal	5	2 qt/a	A	EPOST
31*	Verdict	5.57 lb/gal	14, 15	15 fl oz/a	A	EPOST

*Princep 4L and Verdict are not labeled for applications to emerged corn. Do NOT apply these products postemergence. Treatments were included to evaluate the soil residual activity of these products that can only be applied preemergence.

Trial Summary:

In 2019 we conducted two field trials to evaluate and demonstrate the effectiveness of multiple soil-applied corn herbicides on waterhemp and giant ragweed, two of the most troublesome weeds in Wisconsin. Treatments consisted of corn herbicides containing one or multiple sites of action (SOA). Herbicides were sprayed when corn reached the V1-V2 growth stage. Since the objective was to evaluate soil residual activity, Liberty (32 fl oz per acre) was tank-mixed to all treatments to eliminate established weeds at the time of herbicide application (corn hybrid used in this study was LibertyLink). Two treatments were intentionally applied off-label in this study given their relevance in our state and thus the importance of collecting their soil residual efficacy data: Princep 4FL and Verdict (these products are labeled PRE-emergence only in corn). The herbicide rates used in the study are ones recommended by our industry colleagues and supported by us for a typical Wisconsin Silt Loam soil.

Giant ragweed results: None of the herbicides evaluated provided adequate control at 27 DAT (Figure 13). However, the levels of control may not be indicative of what a typical grower may experience. The field that the trial was located has been intentionally seeded with giant ragweed for research purposes. This allows us to test products under a worst-case scenario. It is more important to compare individual products against each other rather than look at overall levels of control. If a product performs better under a heavy infestation than it is likely to perform as good as or better in fields with lighter infestations.

Waterhemp results: Several of the herbicides we evaluated provided >90% control up to 48 days after treatment (Figure 14, Figure 15). For a full report on the waterhemp data see <http://www.wiscweeds.info/post/herbicide-comparison-for-residual-waterhemp-control-in-corn/>

While these results should be taken with a grain of salt (only one year of data), they clearly indicate the value of effective soil residual herbicides. This study will be replicated in 2020.

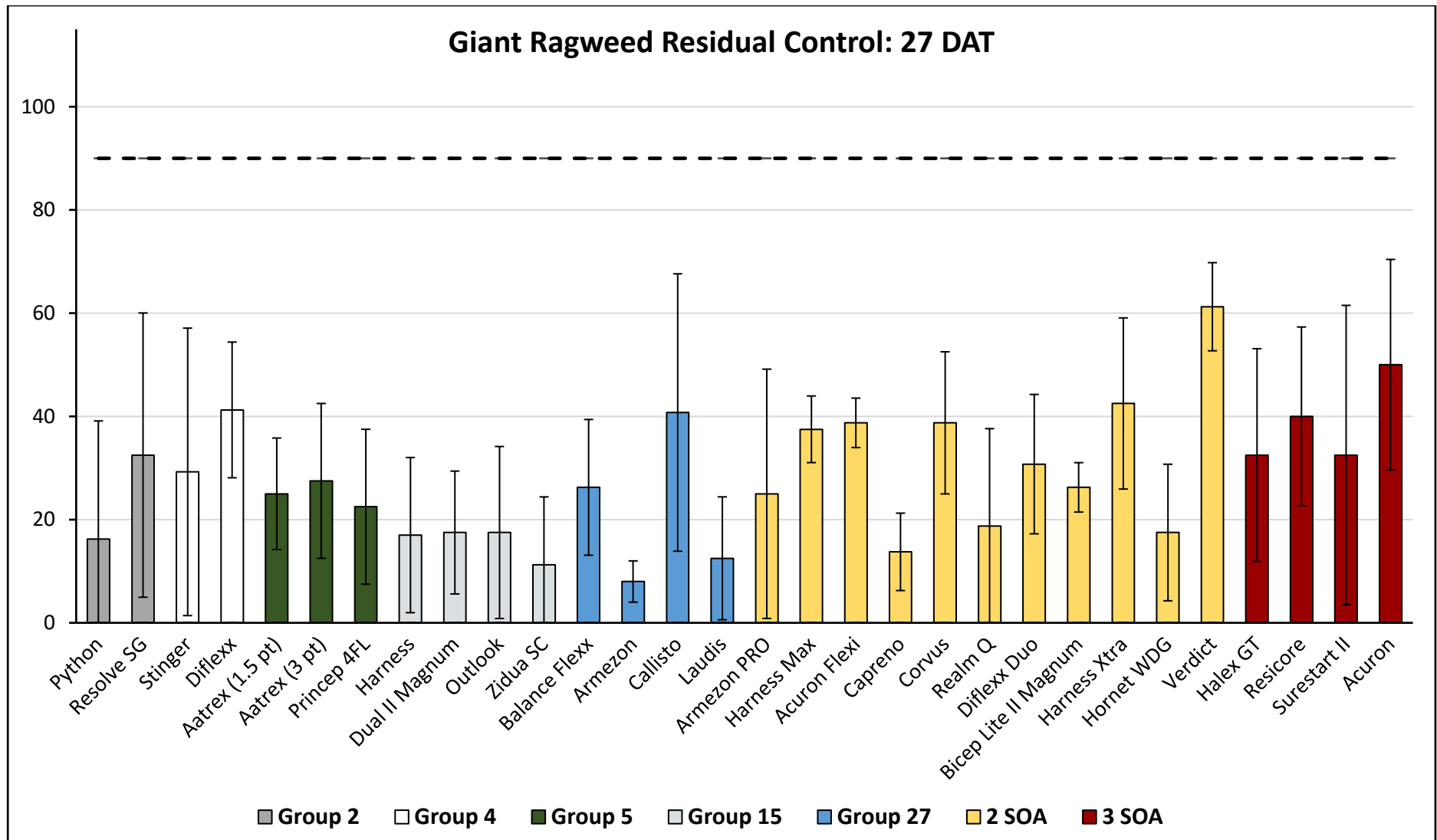


Figure 13. Giant ragweed soil efficacy ratings for trial #19-ROK-CN11 27 days after treatment (DAT). Bars indicate the average % control \pm the standard deviation of four replications following an EPOST herbicide application. Treatments are grouped and colored by herbicide sites of action (SOA). The dashed line indicates 90% control.

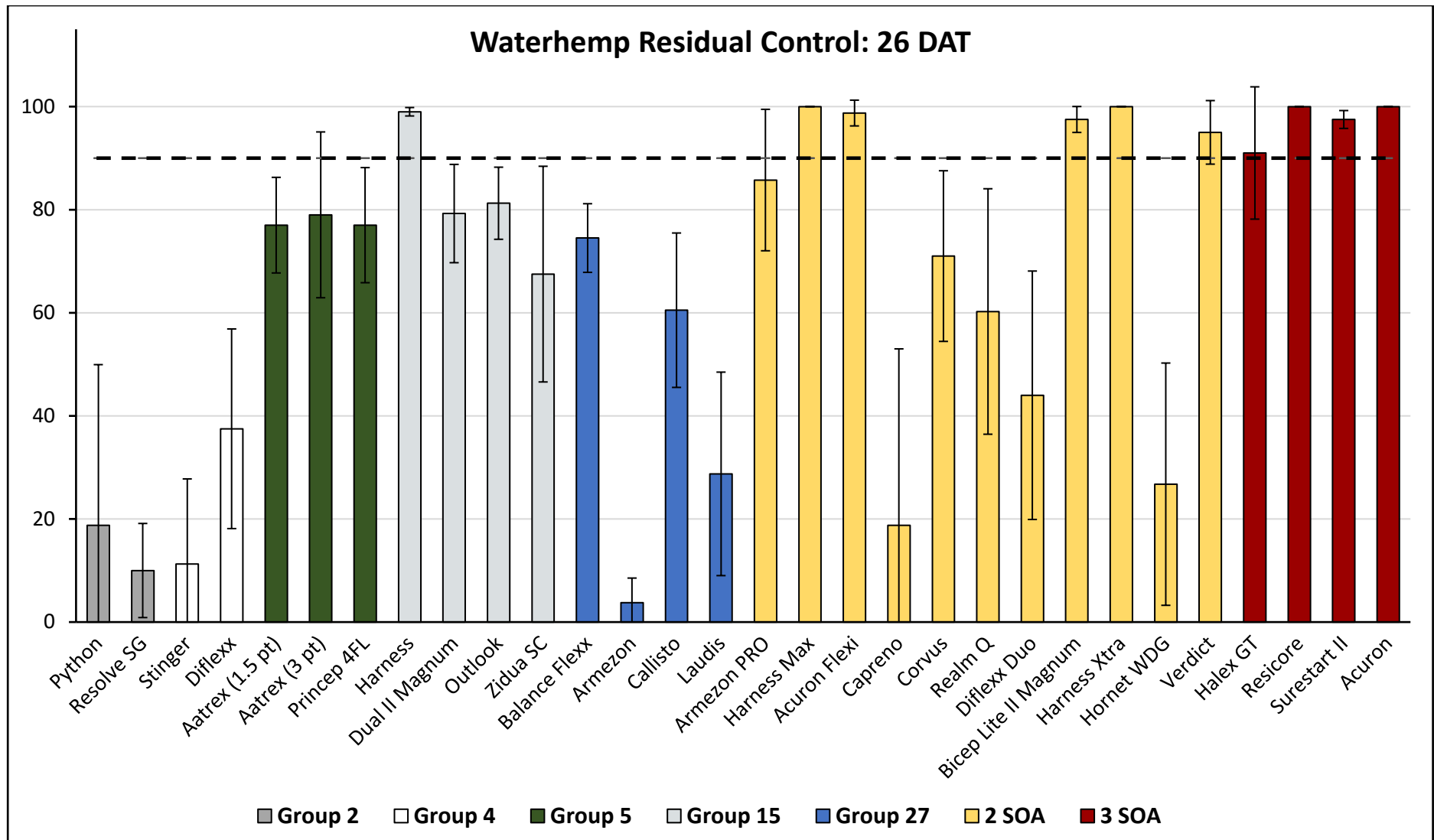


Figure 14. Waterhemp soil efficacy ratings for trial #19-BRO-CN11 26 days after treatment (DAT). Bars indicate the average % control \pm the standard deviation of four replications following an EPOST herbicide application. Treatments are grouped and colored by herbicide sites of action (SOA). The dashed line indicates 90% control.

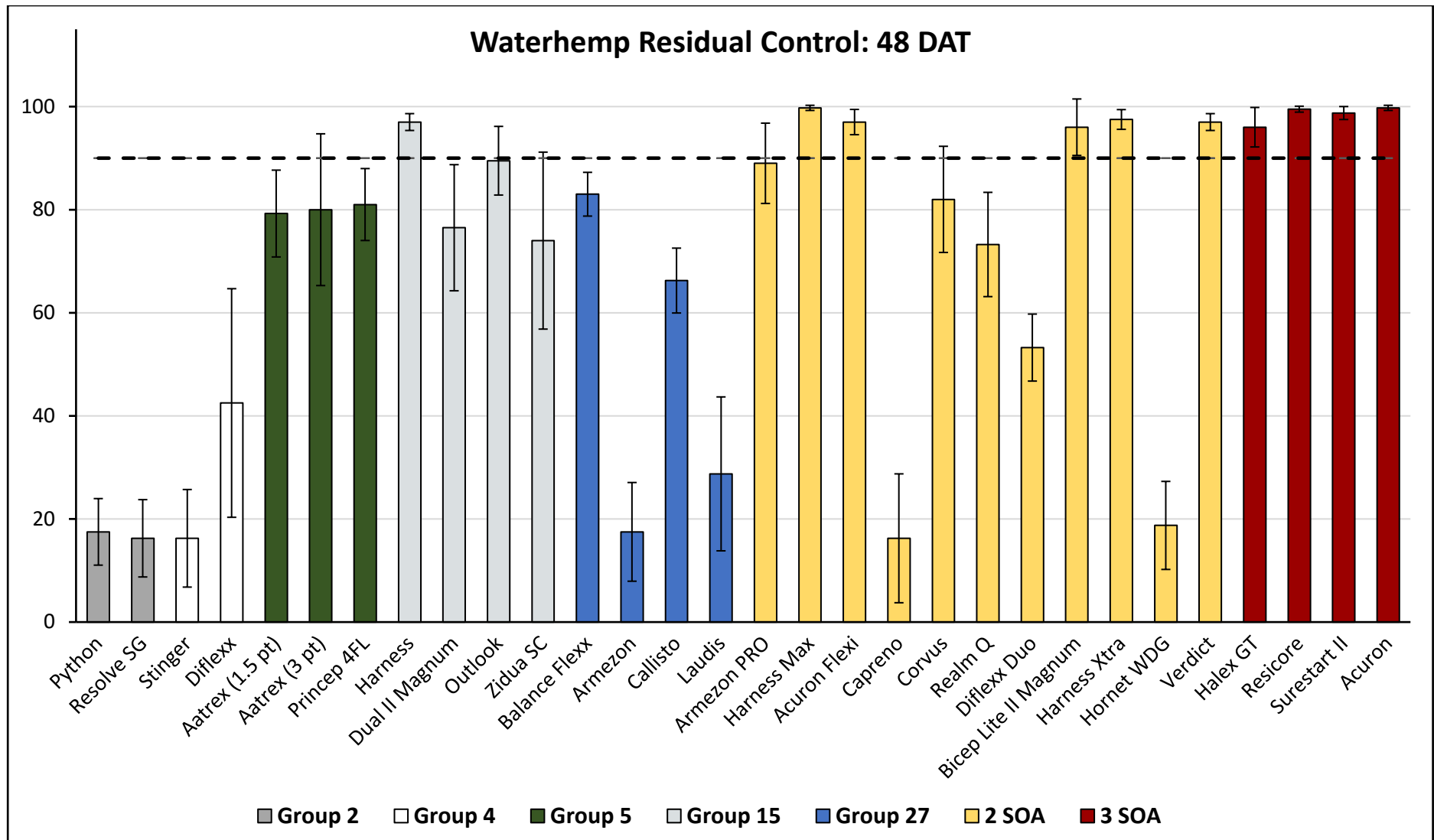


Figure 15. Waterhemp soil efficacy ratings for trial #19-BRO-CN11 48 days after treatment (DAT). Bars indicate the average % control \pm the standard deviation of four replications following an EPOST herbicide application. Treatments are grouped and colored by herbicide sites of action (SOA). The dashed line indicates 90% control.

Project Goal: Evaluate multiple herbicide programs to provide recommendations for the launch of XtendFlex soybeans.

Site Description:

Location:	Arlington, WI	Crop:	Soybean
Field #:	362	Variety:	AG23XF0
Soil type:	Plano silt loam	Planting Date:	5/14
% OM:	3.5	Emergence Date:	5/27
pH:	5.6	Population:	140,000 seeds/acre
Fertilization:	125 lb MAP/acre 3 tons lime/acre	Depth:	1.25 in
Previous crop:	Soybean	Row spacing:	30 in
Tillage:	conventional	Plot Size:	10 x 30 ft
Weed species:	common ragweed (AMBEL), common lambsquarters (CHEAL), velvetleaf (ABUTH), giant foxtail (SETFA)		

Herbicide Application Information:

Date:	5/14	6/17	7/3
Treatment:	PRE (A)	POST (B)	LPOST (C)
Air Temp (°F):	77	78	88
2" Soil Temp (°F):	70	75	80
Soil moisture [surface]:	moist	moist	moist
RH %:	32	66	63
Cloud cover %	40	60	65
Wind speed (mph)/direction	4-8/SW	0-3/NE	2-5/NE
Rainfall (in) 1 wk after APP:	1.56	1.07	1.34
GPA:	15	15	15
PSI:	38	38	38
Nozzle:	TTI 110015	TTI 110015	TTI 110015
Nozzle spacing (in):	20	20	20
Boom Height (in):	20	23	27

Crop and weed information at application:

	Date:	5/14	6/17	7/3
Soybean	Height (in):	-	3-4	8-10
	Stage:	-	V2	V5
AMBEL	Height (in):	-	1-2	1-2
	Density:	-	0-1/ft ²	sparse
CHEAL	Height (in):	-	0.25-1	2-6
	Density:	-	0-1/ft ²	sparse
ABUTH	Height (in):	-	0.25-0.5	1-3
	Density:	-	0-4/ft ²	sparse
SETFA	Height (in):	-	-	2-7
	Density:	-	-	sparse

Trt #	Treatment	Formulation	SOA Group	Rate	App Timing	App Code
1	Check					
2	XtendiMax	2.9 lbae/gal	4	22 fl oz/a	PRE	A
	Warrant	3 lb/gal	15	48 fl oz/a	PRE	A
	Mauler	4 lb/gal	5	8 fl oz/a	PRE	A
	XtendiMax	2.9 lbae/gal	4	22 fl oz/a	POST	B
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	POST	B
	Warrant	3 lb/gal	15	48 fl oz/a	POST	B
	Intact			0.5% v/v	POST	B
	Class Act Ridion			1% v/v	POST	B
3	XtendiMax	2.9 lbae/gal	4	22 fl oz/a	PRE	A
	Warrant	3 lb/gal	15	48 fl oz/a	PRE	A
	Mauler	4 lb/gal	5	8 fl oz/a	PRE	A
	XtendiMax	2.9 lbae/gal	4	22 fl oz/a	POST	B
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	POST	B
	Warrant	3 lb/gal	15	48 fl oz/a	POST	B
	Intact			0.5% v/v	POST	B
	Class Act Ridion			1% v/v	POST	B
	Liberty	2.34 lb/gal	10	32 fl oz/a	LPOST	C
	N-PAK (liquid AMS)			3% v/v	LPOST	C
4	XtendiMax	2.9 lbae/gal	4	22 fl oz/a	PRE	A
	Warrant	3 lb/gal	15	48 fl oz/a	PRE	A
	Mauler	4 lb/gal	5	8 fl oz/a	PRE	A
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	POST	B
	Liberty	2.34 lb/gal	10	32 fl oz/a	POST	B
	Warrant	3 lb/gal	15	48 fl oz/a	POST	B
	N-PAK (liquid AMS)			3% v/v	POST	B
5	XtendiMax	2.9 lbae/gal	4	22 fl oz/a	PRE	A
	Warrant	3 lb/gal	15	48 fl oz/a	PRE	A
	Mauler	4 lb/gal	5	8 fl oz/a	PRE	A
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	POST	B
	Warrant	3 lb/gal	15	48 fl oz/a	POST	B
	N-PAK (liquid AMS)			2% v/v	POST	B
	Liberty	2.34 lb/gal	10	32 fl oz/a	LPOST	C
6	N-PAK (liquid AMS)			3% v/v	LPOST	C
	XtendiMax	2.9 lbae/gal	4	22 fl oz/a	PRE	A
	Warrant Ultra	3 lb/gal	14, 15	50 fl oz/a	PRE	A
	XtendiMax	2.9 lbae/gal	4	22 fl oz/a	POST	B
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	POST	B
	Warrant	3 lb/gal	15	48 fl oz/a	POST	B
	Intact			0.5% v/v	POST	B
	Class Act Ridion			1% v/v	POST	B

Trt #	Treatment	Formulation	SOA Group	Rate	App Timing	App Code
7	XtendiMax	2.9 lbae/gal	4	22 fl oz/a	PRE	A
	Warrant Ultra	3.5 lb/gal	14, 15	50 fl oz/a	PRE	A
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	POST	B
	Liberty	2.34 lb/gal	10	32 fl oz/a	POST	B
	Warrant	3 lb/gal	15	48 fl oz/a	POST	B
	N-PAK (liquid AMS)			3% v/v	POST	B
8	XtendiMax	2.9 lbae/gal	4	22 fl oz/a	PRE	A
	Valor SX	51% w/w	14	2 oz/a	PRE	A
	XtendiMax	2.9 lbae/gal	4	22 fl oz/a	POST	B
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	POST	B
	Warrant	3 lb/gal	15	48 fl oz/a	POST	B
	Intact			0.5% v/v	POST	B
	Class Act Ridion			1% v/v	POST	B
9	XtendiMax	2.9 lbae/gal	4	22 fl oz/a	PRE	A
	Valor SX	51% w/w	14	2 oz/a	PRE	A
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	POST	B
	Liberty	2.34 lb/gal	10	32 fl oz/a	POST	B
	Warrant	3 lb/gal	15	48 fl oz/a	POST	B
	N-PAK (liquid AMS)			3% v/v	POST	B
10	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	POST	B
	Liberty	2.34 lb/gal	10	32 fl oz/a	POST	B
	Warrant	3 lb/gal	15	48 fl oz/a	POST	B
	N-PAK (liquid AMS)			3% v/v	POST	B
11	Liberty	2.34 lb/gal	10	32 fl oz/a	POST	B
	Warrant	3 lb/gal	15	48 fl oz/a	POST	B
	N-PAK (liquid AMS)			3% v/v	POST	B
12	XtendiMax	2.9 lbae/gal	4	22 fl oz/a	POST	B
	Warrant	3 lb/gal	15	48 fl oz/a	POST	B
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	LPOST	C
	Liberty	2.34 lb/gal	10	32 fl oz/a	LPOST	C
	N-PAK (liquid AMS)			3% v/v	LPOST	C

Trial Summary:

This trial evaluated multiple herbicide programs to provide recommendations for the launch of XtendFlex soybeans. There was soybean injury from the PRE herbicides observed in this trial (Figure 19). The most severe injury was observed in the XtendiMax + Valor SX treatments. All herbicide programs effectively controlled giant foxtail throughout the entire growing season (data not shown). All PRE herbicides were very effective at controlling all weeds in the trial area early in the season. Broadleaf weed control fell below 90% for some of the 1 pass POST treatments

(Figures 16, 17, 18). Soybean yield did not differ among herbicide treatments (data not shown). Yield across all treatments was 56 bu/acre, while the untreated check was 11 bu/acre, an 80% reduction.

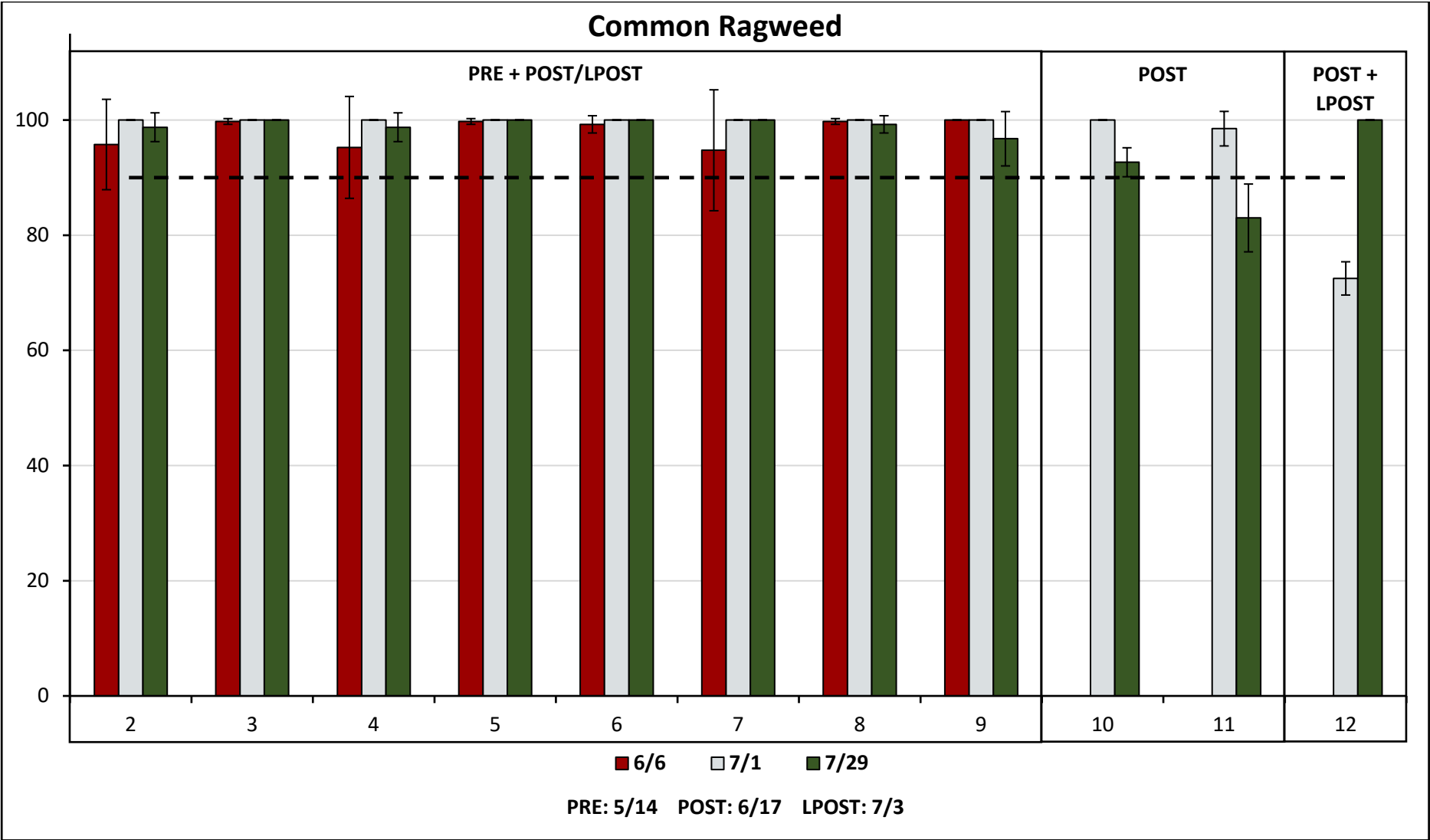


Figure 16. Common ragweed efficacy ratings for trial #19-ARL-SB04. Bars indicate the average % control ± the standard deviation of four replications following herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. The dashed line indicates 90% control.

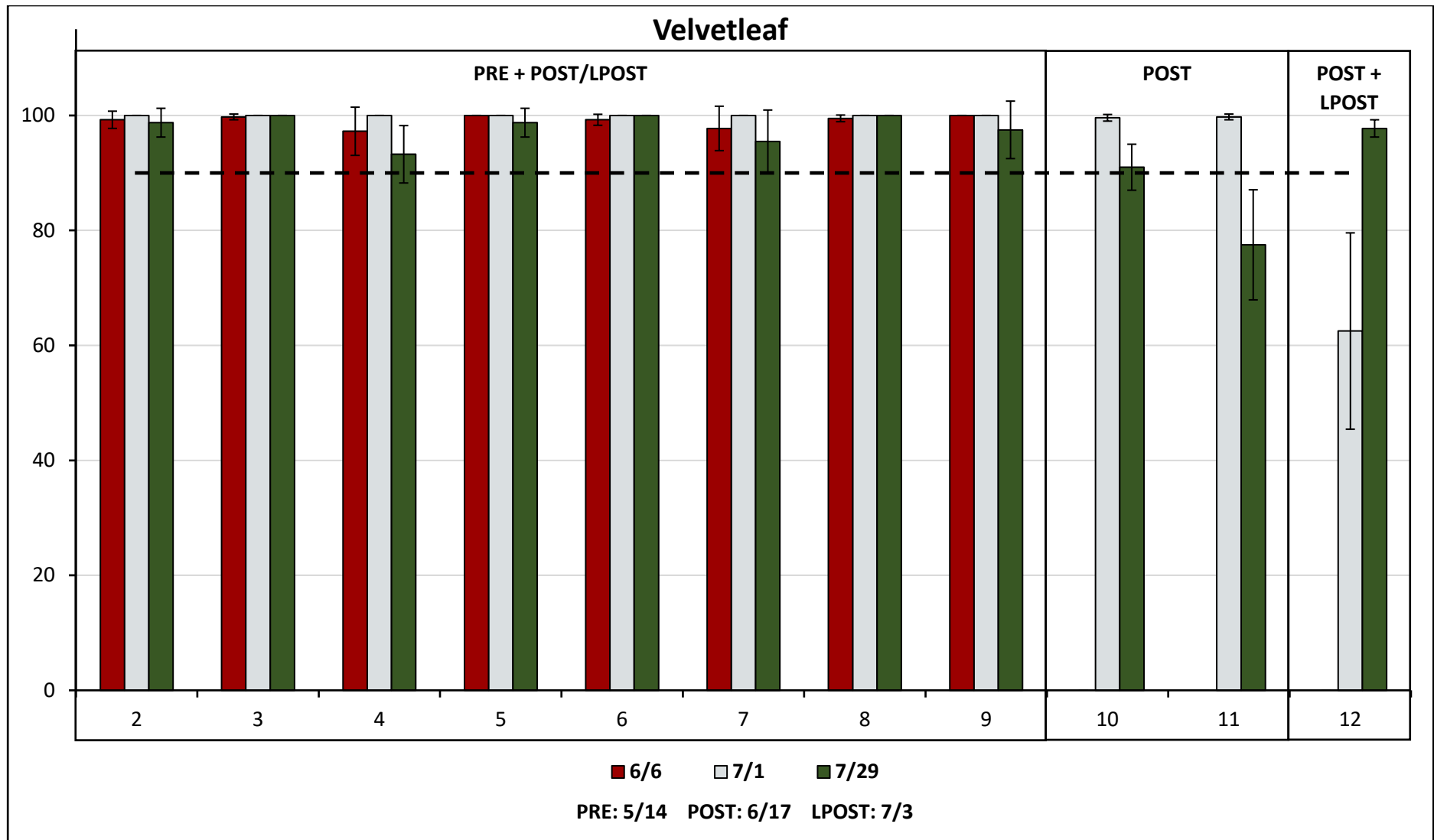


Figure 17. Velvetleaf efficacy ratings for trial #19-ARL-SB04. Bars indicate the average % control ± the standard deviation of four replications following herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. The dashed line indicates 90% control.

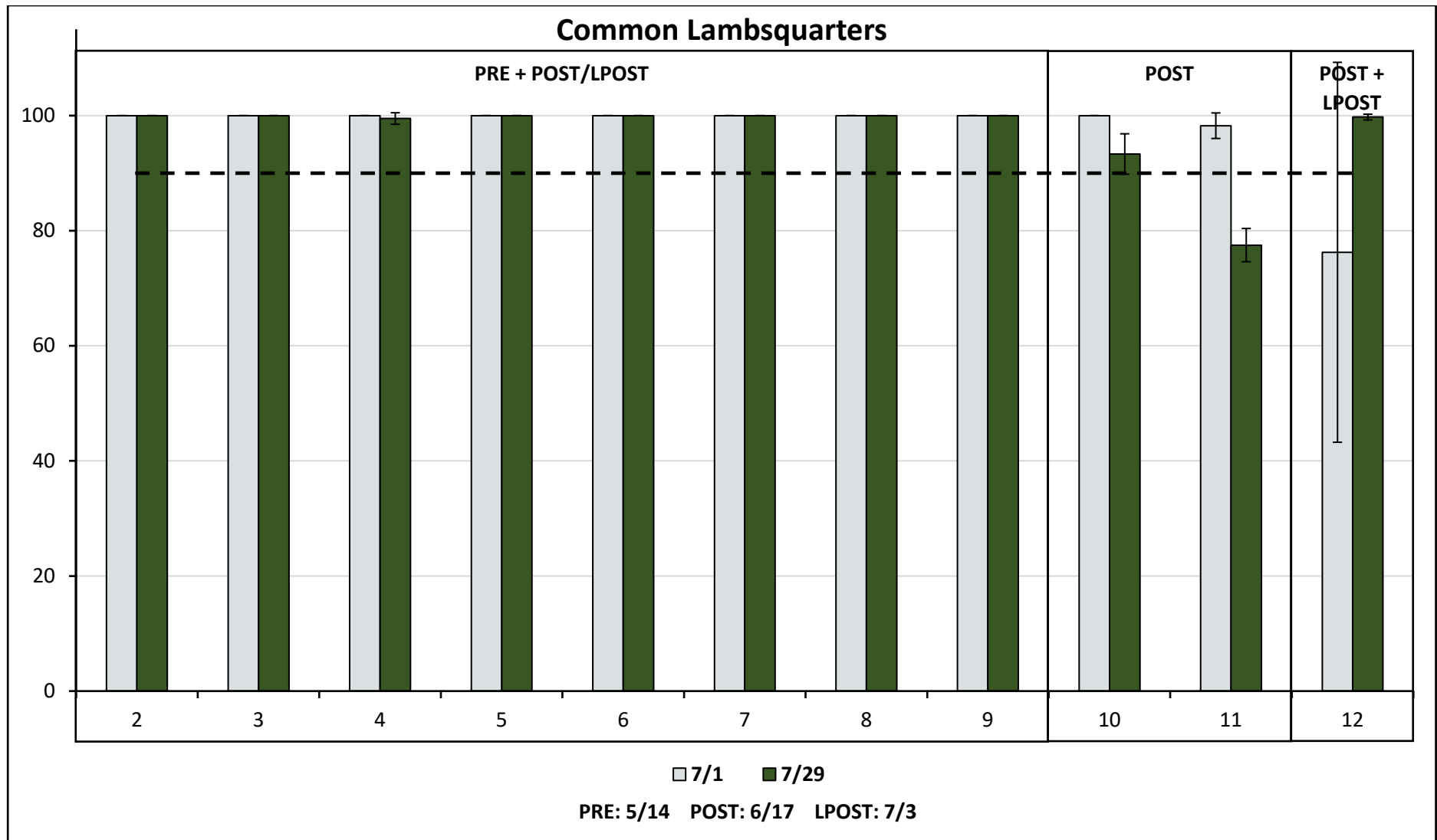


Figure 18. Common lambsquarters efficacy ratings for trial #19-ARL-SB04. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. The dashed line indicates 90% control.

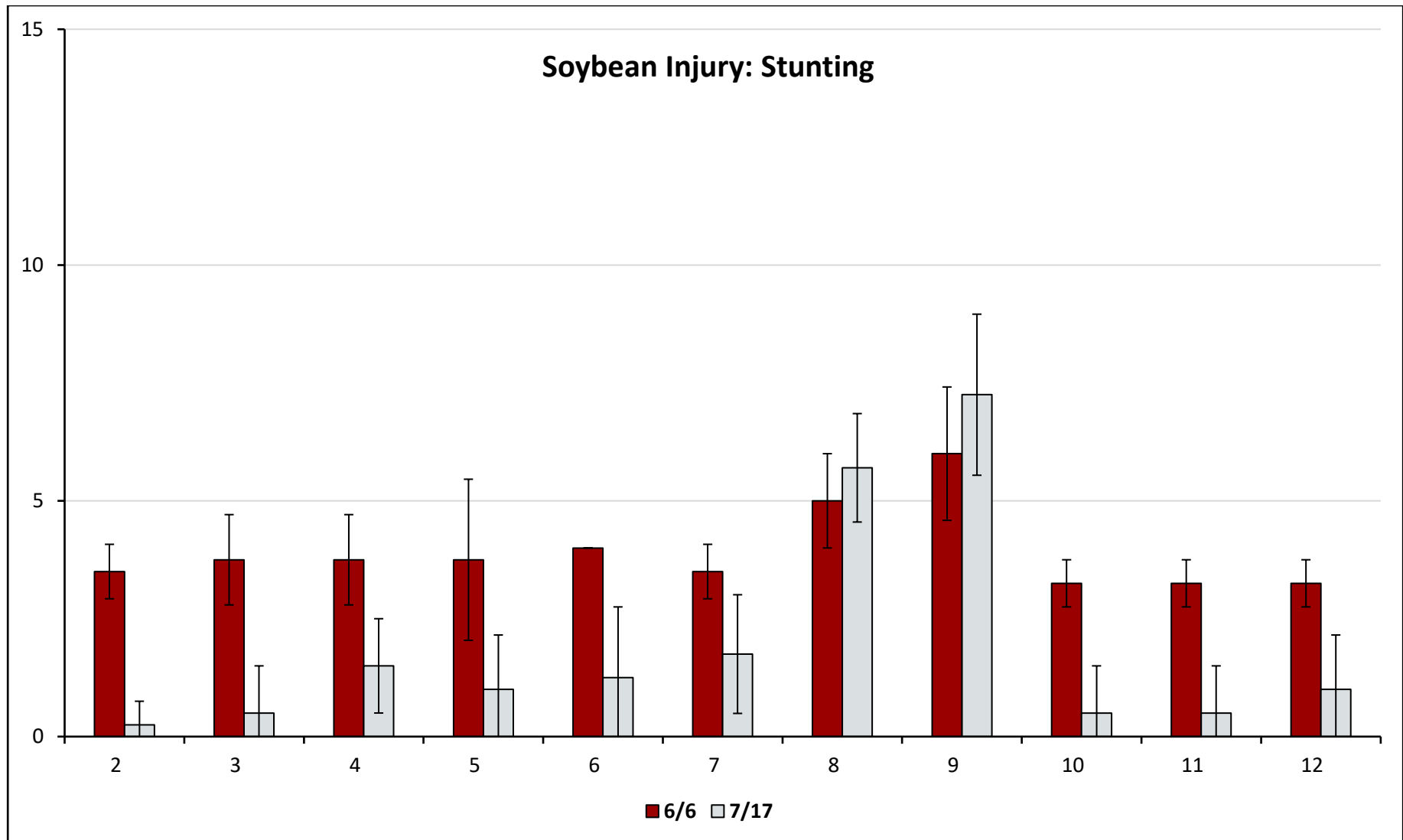


Figure 19. Soybean injury ratings at 23 and 64 days after the PRE application for trial #19-ARL-SB04. Bars indicate the average % stunting \pm the standard deviation of four replications following herbicide applications. Treatments 10, 11, and 12 did not receive a PRE application. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number.

Project Goal: Evaluate multiple soybean herbicide programs for season long-weed control.

Site Description:

Location:	Arlington, WI	Crop:	Soybean
Field #:	362	Variety:	NK S20-J5X
Soil type:	Plano silt loam	Planting Date:	5/13
% OM:	3.5	Emergence Date:	5/26
pH:	5.6	Population:	140,000 seeds/acre
Fertilization:	125 lb MAP/acre 3 tons lime/acre	Depth:	1.25 in
Previous crop:	Soybean	Row spacing:	30 in
Tillage:	conventional	Plot Size:	10 x 30 ft
Weed species:	common ragweed (AMBEL), common lambsquarters (CHEAL), velvetleaf (ABUTH), giant foxtail (SETFA)		

Herbicide Application Information:

Date:	5/14	6/4*	6/17
Treatment:	PRE (A)	EPOST (B)	POST (C)
Air Temp (°F):	69	75	78
2" Soil Temp (°F):	60	72	75
Soil moisture [surface]:	moist	moist	moist
RH %:	36	63	66
Cloud cover %	20	35	60
Wind speed (mph)/direction	1-7/SSW	3-10/SE	0-3/NE
Rainfall (in) 1 wk after APP:	1.56	0.14	1.07
GPA:	15	15	15
PSI:	40	38	38
Nozzle:	TTI 110015	TTI 110015	TTI 110015
Nozzle spacing (in):	20	20	20
Boom Height (in):	20	22	24

Crop and weed information at application:

	Date:	5/14	6/4*	6/17
Soybean	Height (in):	-	1-2	3-4
	Stage:	-	VC	V2
AMBEL	Height (in):	-	1	1-3
	Density:	-	1-50/m ²	1-60/m ²
CHEAL	Height (in):	-	0.5	2-6
	Density:	-	1-6/m ²	1-20/m ²
ABUTH	Height (in):	-	1	1-2
	Density:	-	0-2/m ²	0-2/m ²
SETFA	Height (in):	-	0.5	2-7
	Density:	-	0-4/m ²	0-5/m ²

*No data from the EPOST application is presented in this report as a herbicide used in that treatment is currently an experimental product.

Trt #	Treatment	Formulation	SOA Group	Rate	App Timing	App Code
1	Check					
2	Boundary	6.5 lb/gal	5, 15	1.8 pt/a	PRE	A
	Flexstar GT	3.5 lb/gal	9, 14	3.5 pt/a	POST	C
	Dual II Magnum	7.64 lb/gal	15	1.25 pt/a	POST	C
	MSO			1% v/v	POST	C
	AMS			8.5 lb/100 gal	POST	C
3	Boundary	6.5 lb/gal	5, 15	1.8 pt/a	PRE	A
	Tavium	3.38 lb/gal	4, 15	56.5 fl oz/a	POST	C
	Roundup PowerMAX	4.5 lbae/gal	9	26 fl oz/a	POST	C
	Intact			0.5% v/v	POST	C
	Class Act Ridion			1% v/v	POST	C
4	Prefix	5.3 lb/gal	14, 15	2 pt/a	PRE	A
	Tricor DF	75% w/w	5	6 oz/a	PRE	A
	Tavium	3.38 lb/gal	4, 15	56.5 fl oz/a	POST	C
	Roundup PowerMAX	4.5 lbae/gal	9	26 fl oz/a	POST	C
	Intact			0.5% v/v	POST	C
	Class Act Ridion			1% v/v	POST	C
5	Broadaxe XC	7 lb/gal	14, 15	25 fl oz/a	PRE	A
	Tricor DF	75% w/w	5	6 oz/a	PRE	A
	Tavium	3.38 lb/gal	4, 15	56.5 fl oz/a	POST	C
	Roundup PowerMAX	4.5 lbae/gal	9	26 fl oz/a	POST	C
	Intact			0.5% v/v	POST	C
	Class Act Ridion			1% v/v	POST	C
6	Tavium	3.38 lb/gal	4, 15	56.5 fl oz/a	POST	C
	Roundup PowerMAX	4.5 lbae/gal	9	26 fl oz/a	POST	C
	Intact			0.5% v/v	POST	C
	Class Act Ridion			1% v/v	POST	C
7	Boundary	6.5 lb/gal	5, 15	1.8 pt/a	PRE	A
	Spartan	4 lb/gal	14	5 fl oz/a	PRE	A
	Roundup PowerMAX	4.5 lbae/gal	9	26 fl oz/a	POST	C
	Dual II Magnum	7.64 lb/gal	15	1.25 pt/a	POST	C
	AMS			8.5 lb/100 gal	POST	C
8	Zidua PRO	4.09 lb/gal	2, 14, 15	6 fl oz/a	PRE	A
	Engenia PRO*	4.54 lb/gal	4, 15	16 fl oz/a	POST	C
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	POST	C
	NIS			0.25% v/v	POST	C
9	Engenia PRO*	4.54 lb/gal	4, 15	16 fl oz/a	PRE	A
	Tricor DF	75% w/w	5	5 oz/a	PRE	A
	Engenia PRO*	4.54 lb/gal	4, 15	16 fl oz/a	POST	C
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	POST	C
	NIS			0.25% v/v	POST	C

Trt #	Treatment	Formulation	SOA Group	Rate	App Timing	App Code
10	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	POST	C
	XtendiMax	2.9 lbae/gal	4	22 fl oz/a	POST	C
	Intact			0.5% v/v	POST	C
	NIS			0.25% v/v	POST	C
11	Fierce EZ	3.04 lb/gal	14, 15	6 fl oz/a	PRE	A
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	POST	C
	XtendiMax	2.9 lbae/gal	4	22 fl oz/a	POST	C
	Intact			0.5% v/v	POST	C
	NIS			0.25% v/v	POST	C
12	Fierce MTZ	3.64 lb/gal	5, 14, 15	1 pt/a	PRE	A
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	POST	C
	XtendiMax	2.9 lbae/gal	4	22 fl oz/a	POST	C
	Intact			0.5% v/v	POST	C
	NIS			0.25% v/v	POST	C
13	Valor SX	51% w/w	14	2 oz/a	PRE	A
	Tricor DF	75% w/w	5	4 oz/a	PRE	A
	Prowl H2O	3.8 lb/gal	3	1.5 pt/a	PRE	A
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	POST	C
	XtendiMax	2.9 lbae/gal	4	22 fl oz/a	POST	C
	Intact			0.5% v/v	POST	C
	NIS			0.25% v/v	POST	C

Adjuvants: MSO=Premium MSO; NIS=Induce

*Engenia PRO is a premix formulation of dicamba and pyroxasulfone. Registration is pending EPA approval.

Trial Summary:

This trial evaluated herbicide programs for use in RR2Y and/or RR2Xtend soybeans. Herbicide programs and rates were provided by industry representatives from Syngenta, BASF, and Valent. None of the PRE herbicide treatments caused significant soybean injury symptoms (data not shown). Control of common lambsquarters, velvetleaf, and giant foxtail was greater than 95% at all ratings (data not shown). Average common ragweed control was greater than 90% throughout the growing season (Figure 20). Soybean yield was not significantly different among the herbicide treatments (data not shown). Yield across all herbicide treatments was 62 bu/acre, while the untreated check was 10 bu/acre, an 84% reduction

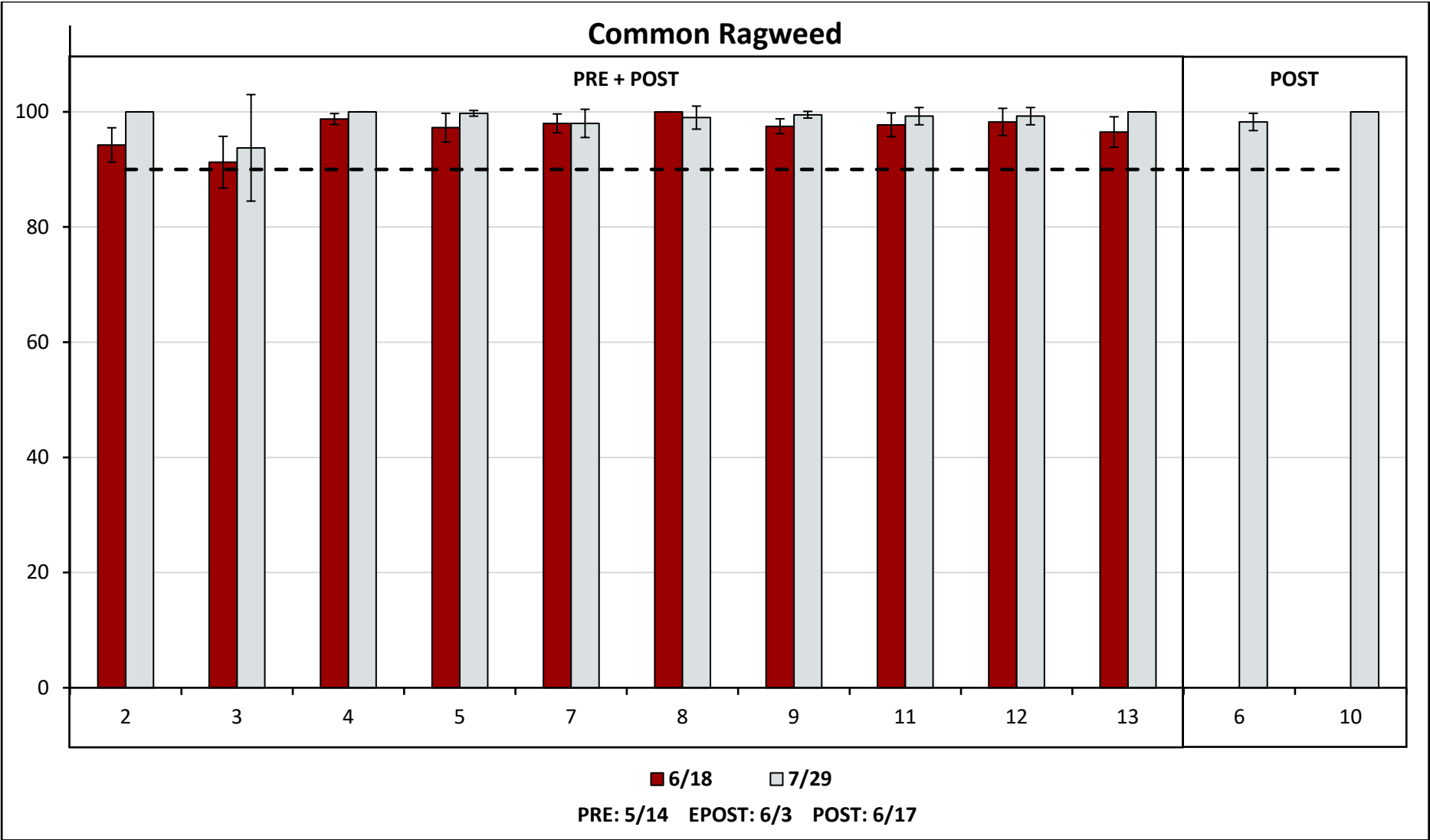


Figure 20. Common ragweed efficacy ratings for trial #19-ARL-SB07. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. The dashed line indicates 90% control.

Project Goal: Demonstrate the utility of UPL soybean herbicide pre-mixes alone and with additional active ingredients.

Site Description:

Location:	Arlington, WI	Crop:	Soybean
Field #:	360	Variety:	AG24X7
Soil type:	Plano silt loam	Planting Date:	5/13
% OM:	3.4	Emergence Date:	5/27
pH:	6.6	Population:	140,000 seeds/acre
Fertilization:	-	Depth:	1.25
Previous crop:	Corn	Row spacing:	30 in
Tillage:	conventional	Plot Size:	10 x 30 ft
Weed species:	common lambsquarters (CHEAL), velvetleaf (ABUTH), redroot pigweed (AMARE), common ragweed (AMBEL), eastern black nightshade (SOLPT), ladysthumb smartweed (POLPE), giant foxtail (SETFA), yellow foxtail (SETVI), barnyardgrass (ECHCG)		

Herbicide Application Information:

Date:	5/13
Treatment:	PRE (A)
Air Temp (°F):	68
2" Soil Temp (°F):	58
Soil moisture [surface]:	moist
RH %:	39
Cloud cover %	20
Wind speed (mph)/direction	2-8/NE
Rainfall (in) 1 wk after APP:	1.3
GPA:	15
PSI:	24
Nozzle:	XRFF11002
Nozzle spacing (in):	20
Boom Height (in):	20

Weed Density*:

<u>Species</u>	<u>Density (m²)</u>
common ragweed	5 - 20
common lambsquarters	15 - 60
velvetleaf	0.5 - 2
redroot pigweed	1 - 15
eastern black nightshade	2 - 25
ladysthumb smartweed	2 - 5
annual grasses	2 - 10

*Weed density recorded from check plots on 6/19.

Trt #	Treatment	Formulation	SOA Group	Rate	App Timing	App Code
1	Check					
2	Tripzin ZC	4 lb/gal	3, 5	44 fl oz/a		
3	Moccasin MTZ	4.47 lb/gal	5, 15	42 fl oz/a		
	Shutdown	4.16 lb/gal	14	7.7 fl oz/a		
4	Tripzin ZC	4 lb/gal	3, 5	44 fl oz/a		
	FirstRate	84% w/w	2	0.75 oz/a		
5	Moccasin MTZ	4.47 lb/gal	5, 15	42 fl oz/a		
	FirstRate	84% w/w	2	0.75 oz/a		
6	Tripzin ZC	4 lb/gal	3, 5	44 fl oz/a		
	Valor SX	51% w/w	14	2 oz/a		
7	Moccasin MTZ	4.47 lb/gal	5, 15	42 fl oz/a		
	Valor SX	51% w/w	14	2 oz/a		
8	Tripzin ZC	4 lb/gal	3, 5	44 fl oz/a		
	Outlook	6 lb/gal	15	18 fl oz/a		
9	Valor SX	51% w/w	4	2 oz/a		
10	Authority First*	70% w/w	2, 14	8 oz/a		
11	Authority MTZ	45% w/w	5, 14	11 oz/a		

* The rate of Authority First used is on the high end of the rate range.

Trial Summary:

This trial evaluated the weed control and crop safety of preemergence UPL soybean herbicide pre-mixes alone and with additional active ingredients. There was minor soybean injury (<5%) from all PRE herbicides except for the Tripzin ZC + Outlook tankmix 30 days after treatment. (data not shown). Injury from this treatment averaged 6.5%; however, by 37 days after treatment injury was <2% for all treatments. Observed symptoms were leaf “drawstringing” and plant stunting. Control of common ragweed, velvetleaf, eastern black nightshade, and annual grasses varied among treatments at 30 and 46 days after treatment (Figures 21, 22, 23, 24). Annual grass species consisted of giant foxtail, yellow foxtail, and barnyardgrass. Several herbicide treatments provided excellent control of all weed species evaluated.

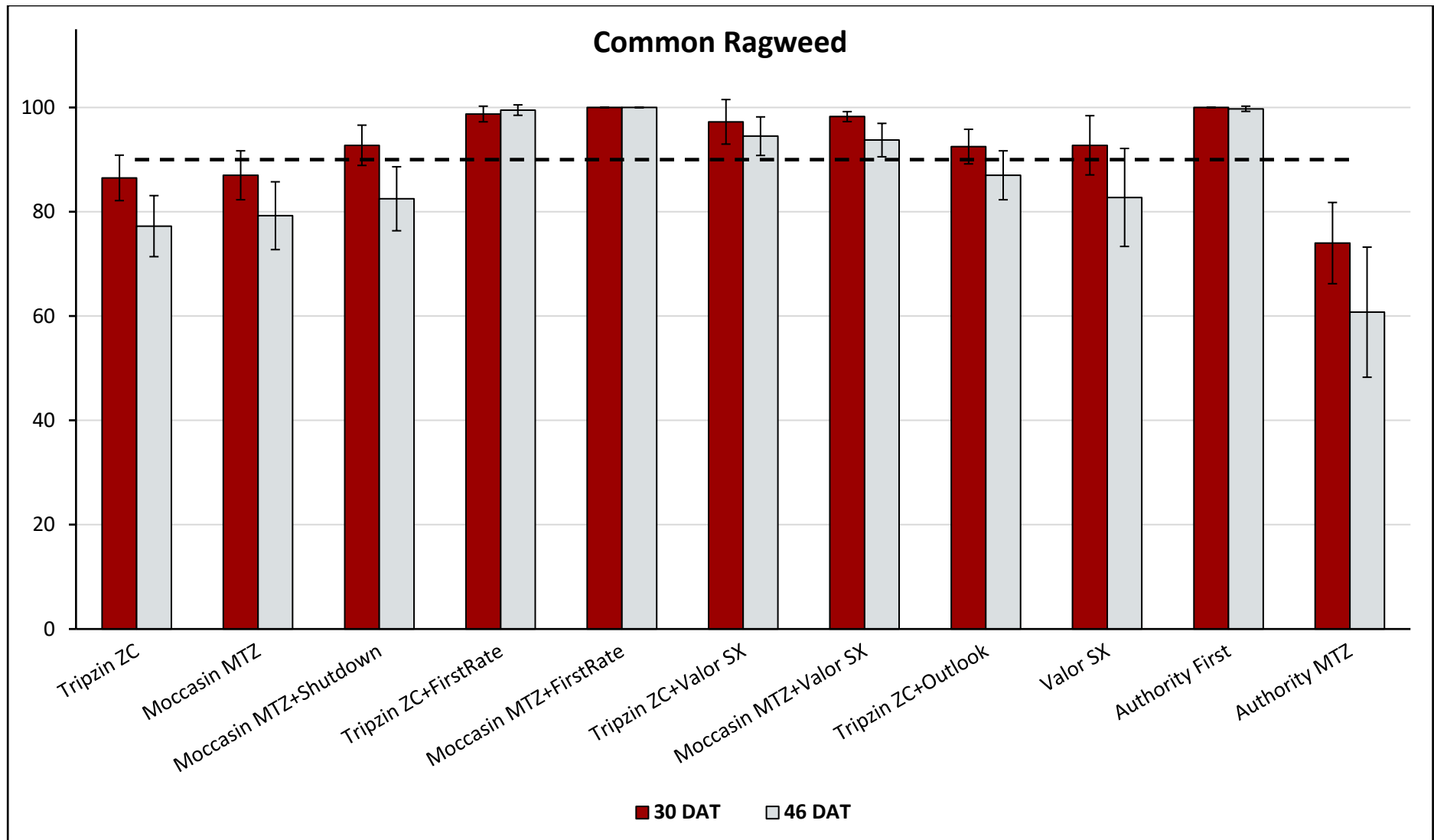


Figure 21. Common ragweed efficacy ratings for trial #19-ARL-SB10. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. Treatments are grouped according to application timing. The dashed line indicates 90% control.

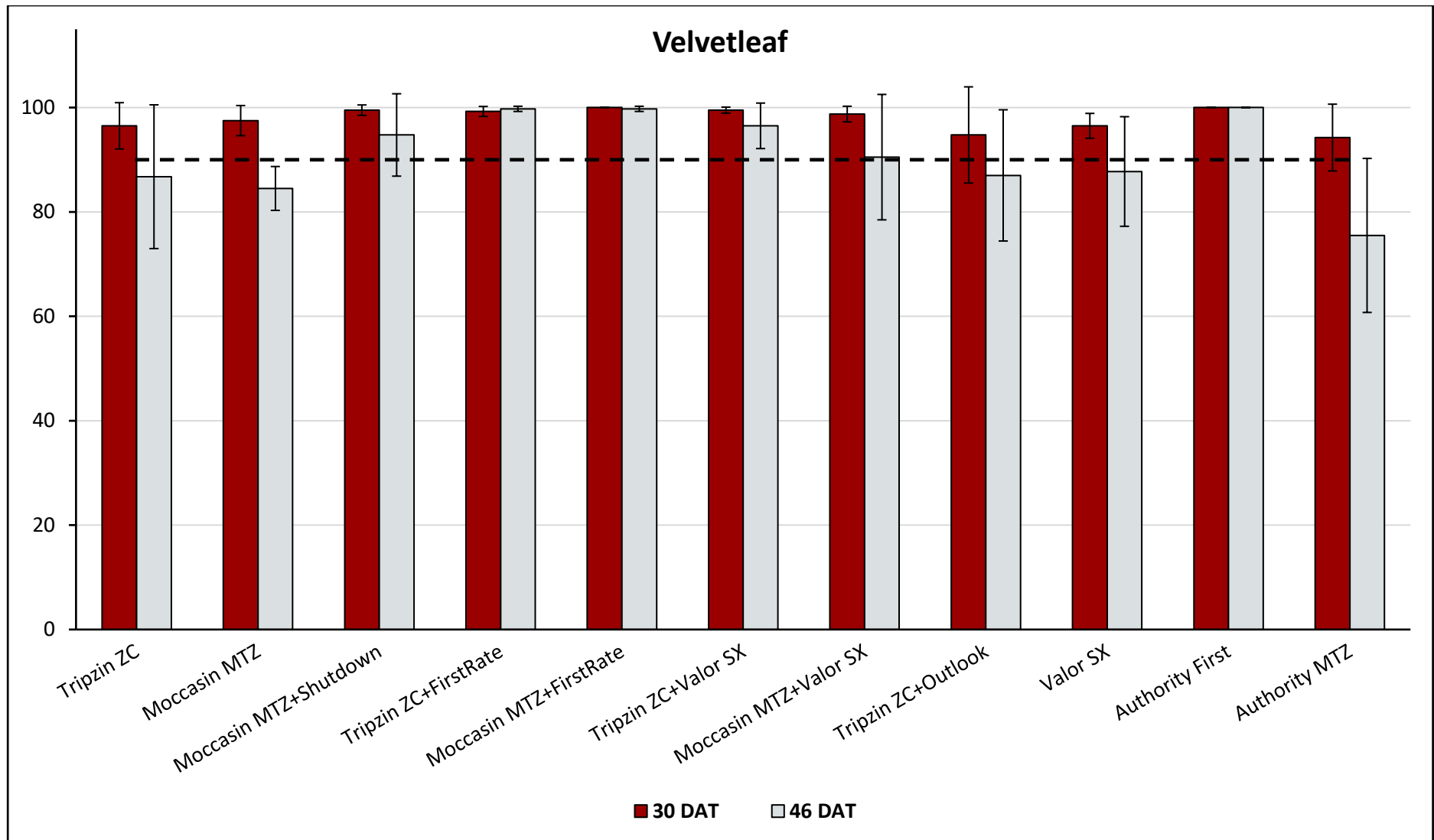


Figure 22. Velvetleaf efficacy ratings for trial #19-ARL-SB10. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. Treatments are grouped according to application timing. The dashed line indicates 90% control.

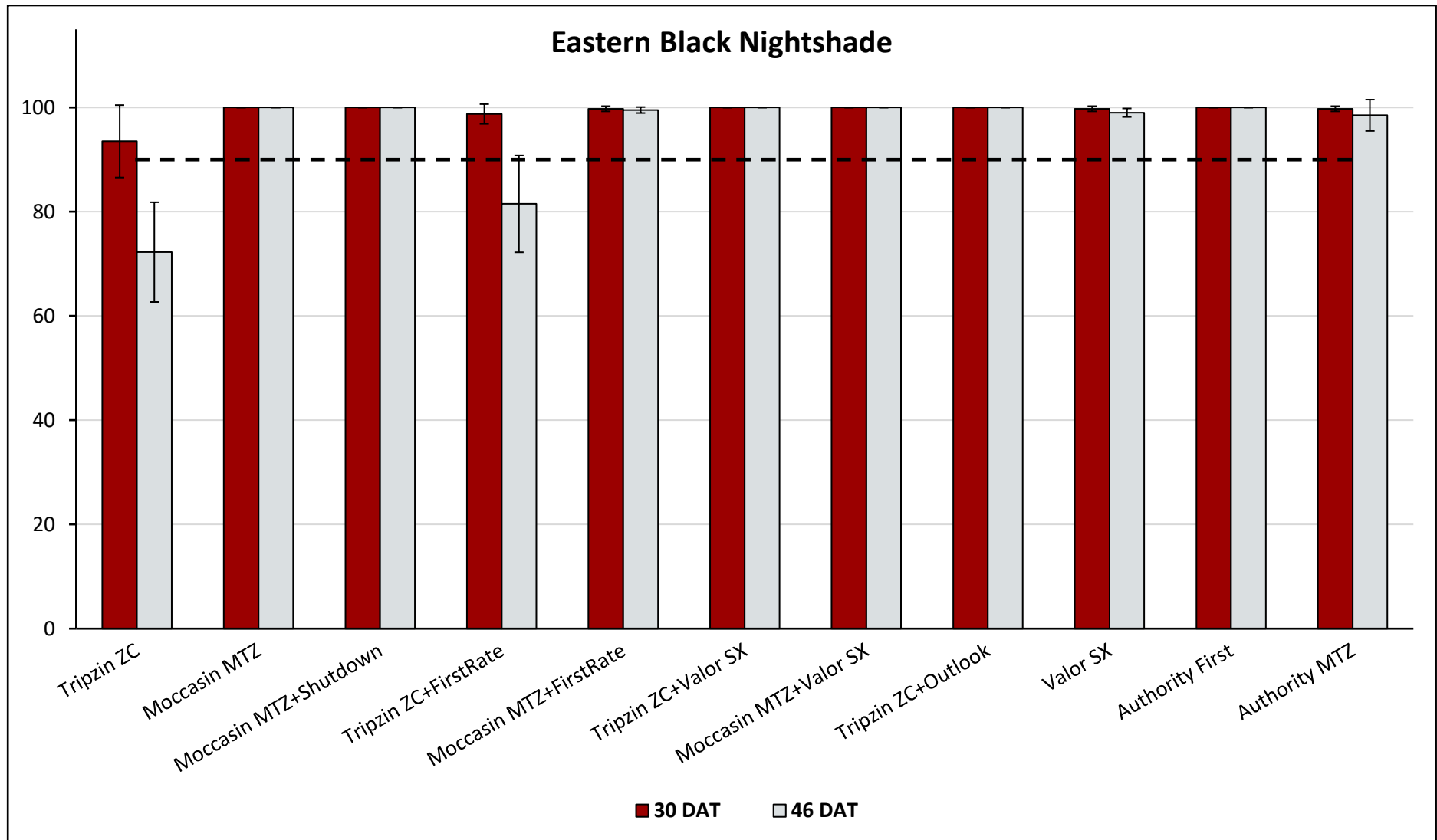


Figure 23. Eastern black nightshade efficacy ratings for trial #19-ARL-SB10. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. Treatments are grouped according to application timing. The dashed line indicates 90% control.

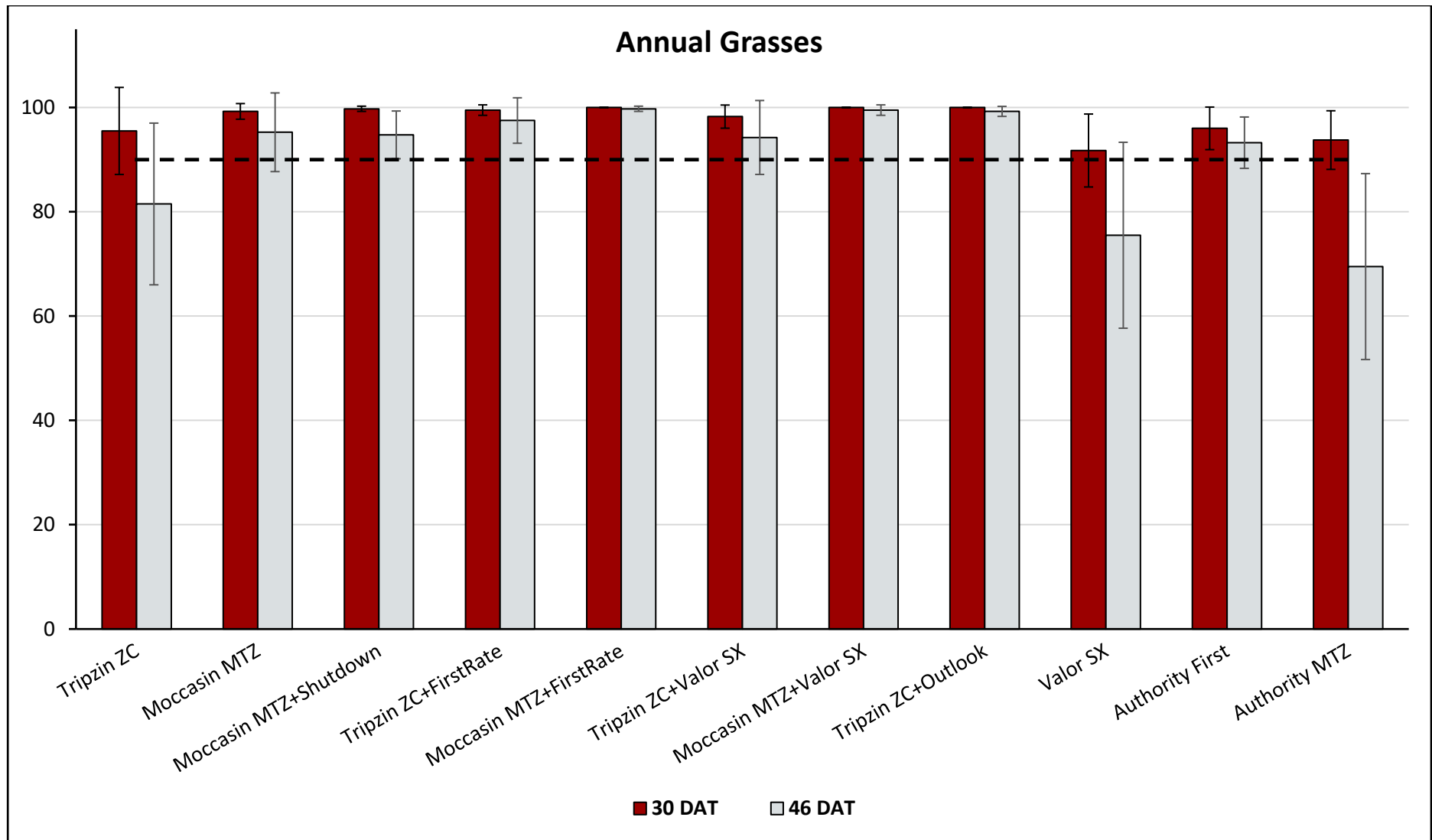


Figure 24. Annual grass efficacy ratings for trial #19-ARL-SB10. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. Treatments are grouped according to application timing. The dashed line indicates 90% control.

Project Goal: Evaluate multiple postemergence tank mixes for the Enlist weed control system.

Site Description:

Location:	Arlington, WI	Crop:	Enlist Soybean
Field #:	362	Variety:	-
Soil type:	Plano silt loam	Planting Date:	5/14
% OM:	3.5	Emergence Date:	5/27
pH:	5.6	Population:	140,000 seeds/acre
Fertilization:	125 lb MAP/acre 3 tons lime/acre	Depth:	1.25 in
Previous crop:	Soybean	Row spacing:	30 in
Tillage:	conventional	Plot Size:	10 x 30 ft
Weed species:	common ragweed (AMBEL), common lambsquarters (CHEAL), velvetleaf (ABUTH), giant foxtail (SETFA)		

Herbicide Application Information:

Date:	5/14	7/3
Treatment:	PRE (A)	POST (B)
Air Temp (°F):	77	88
2" Soil Temp (°F):	70	80
Soil moisture [surface]:	moist	moist
RH %:	32	63
Cloud cover %	40	65
Wind speed (mph)/direction	4-8/SW	2-5/NE
Rainfall (in) 1 wk after APP:	1.56	1.34
GPA:	15	15
PSI:	40	37
Nozzle:	TTI 110015	TTI 110015
Nozzle spacing (in):	20	20
Boom Height (in):	20	26

Crop and weed information at application:

	Date:	5/14	7/3*
Soybean	Height (in):	-	7-10
	Stage:	-	V5/R1
AMBEL	Height (in):	-	1-6
	Density:	-	0-1/m ²
CHEAL	Height (in):	-	-
	Density:	-	-
ABUTH	Height (in):	-	-
	Density:	-	-
SETFA	Height (in):	-	3-5
	Density:	-	0-1/m ²

*Weed density and height was recorded from plots that had a PRE herbicide applied.

Trt #	Treatment	Formulation	SOA Group	Rate	App Timing	App Code
1	Check					
2	Sonic	70% w/w	2, 14	4.5 oz/a	PRE	A
	Durango DMA	4 lbae/gal	10	32 fl oz/a	POST	B
	Bronc AMS			2.5% v/v	POST	B
3	Sonic	70% w/w	2, 14	4.5 oz/a	PRE	A
	Enlist Duo	3.3 lbae/gal	4, 9	56 fl oz/a	POST	B
	Bronc AMS			2.5% v/v	POST	B
4	Sonic	70% w/w	2, 14	4.5 oz/a	PRE	A
	Enlist Duo	3.3 lbae/gal	4, 9	75 fl oz/a	POST	B
	Bronc AMS			2.5% v/v	POST	B
5	Sonic	70% w/w	2, 14	4.5 oz/a	PRE	A
	Enlist One	3.8 lbae/gal	4	24 fl oz/a	POST	B
	Durango DMA	4 lbae/gal	9	24 fl oz/a	POST	B
	Bronc AMS			2.5% v/v	POST	B
6	Sonic	70% w/w	2, 14	4.5 oz/a	PRE	A
	Enlist One	3.8 lbae/gal	4	32 fl oz/a	POST	B
	Durango DMA	4 lbae/gal	9	32 fl oz/a	POST	B
	Bronc AMS			2.5% v/v	POST	B
7	Sonic	70% w/w	2, 14	4.5 oz/a	PRE	A
	Liberty	2.34 lb/gal	10	29 fl oz/a	POST	B
	Bronc AMS			2.5% v/v	POST	B
8	Sonic	70% w/w	2, 14	4.5 oz/a	PRE	A
	Enlist One	3.8 lbae/gal	4	24 fl oz/a	POST	B
	Liberty	2.34 lb/gal	10	29 fl oz/a	POST	B
	Bronc AMS			2.5% v/v	POST	B
9	Sonic	70% w/w	2, 14	4.5 oz/a	PRE	A
	Enlist One	3.8 lbae/gal	4	32 fl oz/a	POST	B
	Liberty	2.34 lb/gal	10	29 fl oz/a	POST	B
	Bronc AMS			2.5% v/v	POST	B

Trial Summary:

This trial evaluated potential POST tank mixes for the Enlist weed control system. The Enlist soybean trait confers tolerance to glyphosate, glufosinate, and 2,4-D choline (Enlist One). The PRE application of Sonic was very effective at controlling the spectrum of weeds in the trial. Very few weeds were emerged when the POST application occurred at the soybean V5 growth stage. Control of all weed species was greater than 95% 34 days after the POST application (data not shown). Averaged across all herbicide treatments soybean yield was 50 bu/acre. Yield of the untreated check was 9 bu/acre.

Project Goal: Evaluate the efficacy of glyphosate + dicamba applied POST at different timings in RR2Xtend soybeans and the value of adding a layered group 15 soil-residual herbicide POST.

Site Description:

Location:	Brooklyn	Crop:	Soybean
Field #:	OB-1	Variety:	AG21X7
Soil type:	Kegonsa loam	Planting Date:	6/3
% OM:	7.1	Emergence Date:	-
pH:	2	Population:	140,000 seeds/acre
Fertilization:	none	Depth:	1 in
Previous crop:	soybean	Row spacing:	30 in
Tillage:	conventional	Plot Size:	10 x 30 ft
Weed species:	glyphosate resistant waterhemp (AMATA)		

Herbicide Application Information:

Date:	6/4	6/27	7/9	7/11
Treatment:	PRE (A)	EPOST (B)	MPOST (C)	LPOST (D)
Air Temp (°F):	73	81.5	86	77
2" Soil Temp (°F):	61	72	92	79
Soil moisture [surface]:	wet	dry	dry	dry
RH %:	78	58	48	67
Cloud cover %	100	2	10	10
Wind speed (mph)/direction	3/SE	2.2/NE	3/S	4/N
Rainfall (in) 1 wk after APP:	0.48	1.68	1.90	1.33
GPA:	15	15	15	15
PSI:	26	40	37	40
Nozzle:	XRFF 11002	TTI 110015	TTI 110015	TTI 110015
Nozzle spacing (in):	20"	20"	20"	20"
Boom Height (in):	20"	21-22"	26"	28"

Crop and Weed Information at Application:

	Date:	6/4	6/27	7/9	7/11
Soybean	Height (in):	-	2.5"	7.5"	8"
	Stage:	PRE	V1	V4-V5	V5-V6
AMATA	Height (in):	-	0.75"	3"	3"
	Density:	-	3.1/ft ²	3.4/ft ²	5.6/ft ²

Project Goal: Evaluate the efficacy of glyphosate + dicamba applied POST at different timings in RR2Xtend soybeans and the value of adding a layered group 15 soil-residual herbicide POST.

Site Description:

Location:	Janesville	Crop:	Soybean
Field #:	5	Variety:	AG21X7
Soil type:	Plano silt loam	Planting Date:	5/15
% OM:	3.3	Emergence Date:	-
pH:	7.0	Population:	140,000 seeds/acre
Fertilization:	none	Depth:	1 in
Previous crop:	soybean	Row spacing:	30 in
Tillage:	conventional	Plot Size:	10 x 30 ft
Weed species:	giant ragweed (AMBTR)		

Herbicide Application Information:

Date:	5/15	6/11	6/25	7/2
Treatment:	PRE (A)	EPOST (B)	MPOST (C)	LPOST (D)
Air Temp (°F):	79.7	76.2	76	91
2" Soil Temp (°F):	69	76	69	80
Soil moisture [surface]:	moist	dry	moist	dry
RH %:	34.3	38.1	63.4	50
Cloud cover %	35	5	10	60
Wind speed (mph)/direction	1.9/NW	2.4/SW	2.3/SE	2.2/SW
Rainfall (in) 1 wk after APP:	1.26	0.22	1.52	1.26
GPA:	15	15	15	15
PSI:	25	38	38-39	36
Nozzle:	XRFF 11002	TTI 110015	TTI 110015	TTI 110015
Nozzle spacing (in):	20	20	20	20
Boom Height (in):	20	22	26	36

Crop and Weed Information at Application:

	Date:	5/15	6/11	6/25	7/2
Soybean	Height (in):	-	3"	6"	11"
	Stage:	PRE	V1	V3-V4	V5
AMBTR	Height (in):	-	2"	5.5"	17.5"
	Density:	-	3.5/ft ²	6/ft ²	7/ft ²

Trt #	Treatment	Formulation	SOA Group	Rate	App Timing	App Code
1	Valor SX	51% w/w	14	3 oz/A	PRE	A
	Roundup PowerMax	4.5 lbae/gal	9	28 fl oz/A	EPOST	B
	Xtendimax	2.89 lbae/gal	4	22 fl oz/A	EPOST	B
	Intact			0.5% v/v	EPOST	B
	Class Act Ridion			1.0% v/v	EPOST	B
2	Valor SX	51% w/w	14	3 oz/A	PRE	A
	Roundup PowerMax	4.5 lbae/gal	9	28 fl oz/A	MPOST	C
	Xtendimax	2.89 lbae/gal	4	22 fl oz/A	MPOST	C
	Intact			0.5% v/v	MPOST	C
	Class Act Ridion			1.0% v/v	MPOST	C
3	Valor SX	51% w/w	14	3 oz/A	PRE	A
	Roundup PowerMax	4.5 lbae/gal	9	28 fl oz/A	LPOST	D
	Xtendimax	2.89 lbae/gal	4	22 fl oz/A	LPOST	D
	Intact			0.5% v/v	LPOST	D
	Class Act Ridion			1.0% v/v	LPOST	D
4	Valor SX	51% w/w	14	3 oz/A	PRE	A
	Roundup PowerMax	4.5 lbae/gal	9	28 fl oz/A	EPOST	B
	Xtendimax	2.89 lbae/gal	4	22 fl oz/A	EPOST	B
	Warrant	3 lba/gal	15	1.5 qt/A	EPOST	B
	Intact			0.5% v/v	EPOST	B
	Class Act Ridion			1.0% v/v	EPOST	B
5	Valor SX	51% w/w	14	3 oz/A	PRE	A
	Roundup PowerMax	4.5 lbae/gal	9	28 fl oz/A	MPOST	C
	Xtendimax	2.89 lbae/gal	4	22 fl oz/A	MPOST	C
	Warrant	3 lba/gal	15	1.5 qt/A	MPOST	C
	Intact			0.5% v/v	MPOST	C
	Class Act Ridion			1.0% v/v	MPOST	C
6	Valor SX	51% w/w	14	3 oz/A	PRE	A
	Roundup PowerMax	4.5 lbae/gal	9	28 fl oz/A	LPOST	D
	Xtendimax	2.89 lbae/gal	4	22 fl oz/A	LPOST	D
	Warrant	3 lba/gal	15	1.5 qt/A	LPOST	D
	Intact			0.5% v/v	LPOST	D
	Class Act Ridion			1.0% v/v	LPOST	D
7	Valor SX	51% WG	14	3 oz/A	PRE	A
8	Untreated Check					

Adjuvants: DRA=Intact; non-AMS water conditioner= Class Act Ridion

Trial Summary:

This study is a component of Sarah Striegel's MS research. It was conducted to evaluate the efficacy of a pre-emergence (PRE) followed-by (*fb*) Roundup PowerMAX + Xtendimax® with Vaporgrip® technology applied post-emergence (POST) at different timings in RR2X soybeans and the value of adding a layered residual herbicide POST. This study was conducted at four locations in 2019: Arlington (ARL), Janesville (ROK), Lancaster (LAN) and Brooklyn (BRO). Yield and efficacy data is only presented from the two sites with the highest weed pressure (Janesville and Brooklyn). Treatments consisted of three POST application timings, with and without a layered residual POST (Warrant): EPOST (V1-V2), MPOST (V3-V4), and LPOST (V5-V6). Controls (PRE-only and untreated check) were excluded from analysis for weed biomass and grain yield but means have been included for reference.

The PRE *fb* M POST (V2-V3 soybean) treatment timing seemed to optimize weed control and grain yield while sufficiently reducing weed seed production across varying weed species compositions and densities (Table 1). The inclusion of a residual herbicide (Warrant) at the POST application did not enhance weed control or yield at Janesville. At Brooklyn, the addition of Warrant did improve weed control when used at the EPOST (V1-V2 soybean) application, although it did not impact soybean yield. Difference between locations is likely due to the predominant weed species at each site. Acetochlor, the active ingredient in Warrant, has much greater efficacy on small seeded broadleaves (waterhemp) than large seeded species (giant ragweed). Inclusion of residual POST could potentially bring value depending on the weed species spectrum and density, and reasonably would vary based on herbicide selection.

Table 1: 2019 weed control (%) and grain yield (bu/A) at Janesville and Brooklyn, WI. Systems approach to weed control in Xtend soybeans.^a

Trt #	Herbicide Program	Janesville, WI ^b		Brooklyn, WI ^c	
		Weed control (%)	Grain yield (bu/A)	Weed control (%)	Grain yield (bu/A)
1	PRE <i>fb</i> EPOST (<i>gly + dicamba</i>)	82.3 c	51.2 ab	59.9 d	40.0 b
2	PRE <i>fb</i> MPOST (<i>gly + dicamba</i>)	97.3 ab	54.8 a	86.9 ab	50.5 a
3	PRE <i>fb</i> LPOST (<i>gly + dicamba</i>)	98.2 a	50.6 ab	88.3 a	51.0 a
4	PRE <i>fb</i> EPOST (<i>gly + dicamba + residual</i>)	83.5 c	50.2 ab	74.8 c	43.4 b
5	PRE <i>fb</i> MPOST (<i>gly + dicamba + residual</i>)	97.4 a	54.5 a	83.4 b	45.0 ab
6	PRE <i>fb</i> LPOST (<i>gly + dicamba + residual</i>)	95.1 b	45.9 b	84.6 ab	45.9 ab
7	PRE-only	10.8	6.7	15	22.3
8	CHECK	0	0.4	0	13.9

^ameans within a column followed by the same letter are not significantly different at $p \leq 0.05$

^bPredominant species at Janesville was giant ragweed. Control data collected on 7/31/19

^cPredominant species at Brooklyn was waterhemp. Control data collected on 8/7/19

Project Goal: Evaluate weed control of different PRE herbicides followed by EPOST applications of XtendiMAX, Warrant, and/or Roundup PowerMAX.

Site Description:

Location:	Brooklyn, WI	Crop:	Soybean
Field #:	OB-1	Variety:	AG24X7
Soil type:	Kegonsa loam	Planting Date:	6/3
% OM:	2	Emergence Date:	-
pH:	7.1	Population:	140,000 seeds/acre
Fertilization:	-	Depth:	1.25 in
Previous crop:	Soybean	Row spacing:	30 in
Tillage:	conventional	Plot Size:	10 x 30 ft
Weed species:	glyphosate resistant waterhemp (AMATA), common lambsquarters (CHEAL), velvetleaf (ABUTH)		

Herbicide Application Information:

Date:	6/4	6/27	7/9
Treatment:	PRE (A)	EPOST (B)	POST (C)
Air Temp (°F):	73	82	86
2" Soil Temp (°F):	61	72	92
Soil moisture [surface]:	very wet	dry	dry
RH %:	78	58	48
Cloud cover %	100	2	10
Wind speed (mph)/direction	1-5/SE	2-4/NE	2-6/S
Rainfall (in) 1 wk after APP:	0.48	1.68	1.43
GPA:	15	15	15
PSI:	38	38	38
Nozzle:	TTI 110015	TTI 110015	TTI 110015
Nozzle spacing (in):	20	20	20
Boom Height (in):	20	22	26

Crop and weed information at application:

	Date:	6/4	6/27	7/9
Soybean	Height (in):	-	3	4-6
	Stage:	-	V1	V4/V5
AMATA	Height (in):	-	0.5-2.5	1-11
	Density:	-	5-70/ft ²	10-100/ft ²
CHEAL	Height (in):	-	1-2	4-11
	Density:	-	0.25-3/ft ²	0-2/ft ²
ABUTH	Height (in):	-	1-2	-
	Density:	-	0-0.2/ft ²	-

Trt #	Treatment	Formulation	SOA Group	Rate	App Timing	App Code
1	Warrant	3 lb/gal	15	48 fl oz/a	PRE	A
	Mauler	4 lb/gal	5	8 fl oz/a	PRE	A
	XtendiMAX	2.9 lbae/gal	4	22 fl oz/a	EPOST	B
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	EPOST	B
	Warrant Ultra	3.5 lb/gal	14, 15	50 fl oz/a	EPOST	B
	Intact			0.5% v/v	EPOST	B
	Class Act Ridion			1% v/v	EPOST	B
2	Warrant	3 lb/gal	15	48 fl oz/a	PRE	A
	Mauler	4 lb/gal	5	8 fl oz/a	PRE	A
	XtendiMAX	2.9 lbae/gal	4	22 fl oz/a	EPOST	B
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	EPOST	B
	Warrant	3 lb/gal	15	48 fl oz/a	EPOST	B
	Intact			0.5% v/v	EPOST	B
	Class Act Ridion			1% v/v	EPOST	B
3	Fierce	76% w/w	14, 15	3 oz/a	PRE	A
	Mauler	4 lb/gal	5	8 fl oz/a	PRE	A
	XtendiMAX	2.9 lbae/gal	4	22 fl oz/a	EPOST	B
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	EPOST	B
	Warrant	3 lb/gal	15	48 fl oz/a	EPOST	B
	Intact			0.5% v/v	EPOST	B
	Class Act Ridion			1% v/v	EPOST	B
4	Valor SX	51% w/w	14	2 oz/a	PRE	A
	XtendiMAX	2.9 lbae/gal	4	22 fl oz/a	EPOST	B
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	EPOST	B
	Warrant	3 lb/gal	15	48 fl oz/a	EPOST	B
	Intact			0.5% v/v	EPOST	B
	Class Act Ridion			1% v/v	EPOST	B
5	XtendiMAX	2.9 lbae/gal	4	22 fl oz/a	PRE	A
	Valor SX	51% w/w	14	2 oz/a	PRE	A
	XtendiMAX	2.9 lbae/gal	4	22 fl oz/a	EPOST	B
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	EPOST	B
	Warrant	3 lb/gal	15	48 fl oz/a	EPOST	B
	Intact			0.5% v/v	EPOST	B
	Class Act Ridion			1% v/v	EPOST	B
6	Warrant Ultra	3.5 lb/gal	14, 15	50 fl oz/a	PRE	A
	XtendiMAX	2.9 lbae/gal	4	22 fl oz/a	EPOST	B
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	EPOST	B
	Warrant	3 lb/gal	15	48 fl oz/a	EPOST	B
	Intact			0.5% v/v	EPOST	B
	Class Act Ridion			1% v/v	EPOST	B
7	Warrant	3 lb/gal	15	48 fl oz/a	PRE	A
	XtendiMAX	2.9 lbae/gal	4	22 fl oz/a	EPOST	B
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	EPOST	B
	Warrant	3 lb/gal	15	48 fl oz/a	EPOST	B
	Intact			0.5% v/v	EPOST	B
	Class Act Ridion			1% v/v	EPOST	B

Trt #	Treatment	Formulation	SOA Group	Rate	App Timing	App Code
8	XtendiMAX	2.9 lbae/gal	9	22 fl oz/a	PRE	A
	Warrant	3 lb/gal	15	48 fl oz/a	PRE	A
	XtendiMAX	2.9 lbae/gal	4	22 fl oz/a	EPOST	B
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	EPOST	B
	Warrant	3 lb/gal	15	48 fl oz/a	EPOST	B
	Intact			0.5% v/v	EPOST	B
	Class Act Ridion			1% v/v	EPOST	B
9	Warrant	3 lb/gal	15	48 fl oz/a	PRE	A
	Mauler	4 lb/gal	5	8 fl oz/a	PRE	A
	XtendiMAX	2.9 lbae/gal	4	22 fl oz/a	EPOST	B
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	EPOST	B
	Warrant	3 lb/gal	15	48 fl oz/a	EPOST	B
	Select Max	0.97 lb/gal	1	8 fl oz/a	EPOST	B
	Intact			0.5% v/v	EPOST	B
	Class Act Ridion			1% v/v	EPOST	B
10	Warrant	3 lb/gal	15	48 fl oz/a	PRE	A
	Mauler	4 lb/gal	5	8 fl oz/a	PRE	A
	XtendiMAX	2.9 lbae/gal	4	22 fl oz/a	EPOST	B
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	EPOST	B
	Warrant	3 lb/gal	15	48 fl oz/a	EPOST	B
	Cobra	2 lb/gal	14	10 fl oz/a	EPOST	B
	Intact			0.5% v/v	EPOST	B
	Class Act Ridion			1% v/v	EPOST	B
11	Verdict	2 lb/gal	14, 15	5 fl oz/a	PRE	A
	Engenia	5 lbae/gal	4	12.8 fl oz/a	EPOST	B
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	EPOST	B
	Outlook	6 lb/gal	15	16 fl oz/a	EPOST	B
	Class Act Ridion			1% v/v	EPOST	B
12	Zidua PRO	4.1 lb/gal	2, 14, 15	6 fl oz/a	PRE	A
	Engenia	5 lbae/gal	4	12.8 fl oz/a	EPOST	B
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	EPOST	B
	Outlook	6 lb/gal	15	16 fl oz/a	EPOST	B
	Class Act Ridion			1% v/v	EPOST	B
13	XtendiMAX	2.9 lbae/gal	4	22 fl oz/a	EPOST	B
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	EPOST	B
	Intact			0.5% v/v	EPOST	B
	Class Act Ridion			1% v/v	EPOST	B
	XtendiMAX	2.9 lbae/gal	4	22 fl oz/a	POST	C
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	POST	C
	Warrant	3 lb/gal	15	48 fl oz/a	POST	C
	Intact			0.5% v/v	POST	C
	Class Act Ridion			1% v/v	POST	C
14	Check					

Trial Summary:

The purpose of this trial was to evaluate a systems approach of controlling weeds within the 45-day application window of the newer dicamba formulations over the top of Xtend traited soybeans. The trial was conducted in a field with a heavy population of glyphosate-resistant waterhemp. Heavy rains within a week of planting greatly reduced soybean emergence and final stand. This resulted in slow canopy closure and created an ideal environment for waterhemp emergence and growth. This can partially explain why very few of the herbicide programs evaluated provided adequate season long waterhemp control. Another possible reason would be the extremely high waterhemp density which ranged from 50-150 plants/ft². For these reasons, it would be reasonable to expect higher levels of waterhemp control with these herbicide programs under more typical field conditions.

There was no observable soybean injury from the PRE herbicides (data not shown). There was visible soybean leaf necrosis (burn) from the EPOST herbicide application 6 days after treatment (Figure 28). The treatments containing Warrant Ultra and Cobra resulted in more severe injury. All treatments provided excellent late season common lambsquarters control (Figure 26). Waterhemp and velvetleaf control differed amongst herbicide treatments (Figures 25, 27). Several PRE herbicides provided excellent early season waterhemp control. However, slow soybean canopy closure and poor POST emergence control resulted in late season escapes which survived and produced seed. Under these field conditions, a 3-pass program would have been necessary to achieve acceptable levels of control at the end of the season. Due to the very poor and uneven soybean stand, grain yield was not collected.

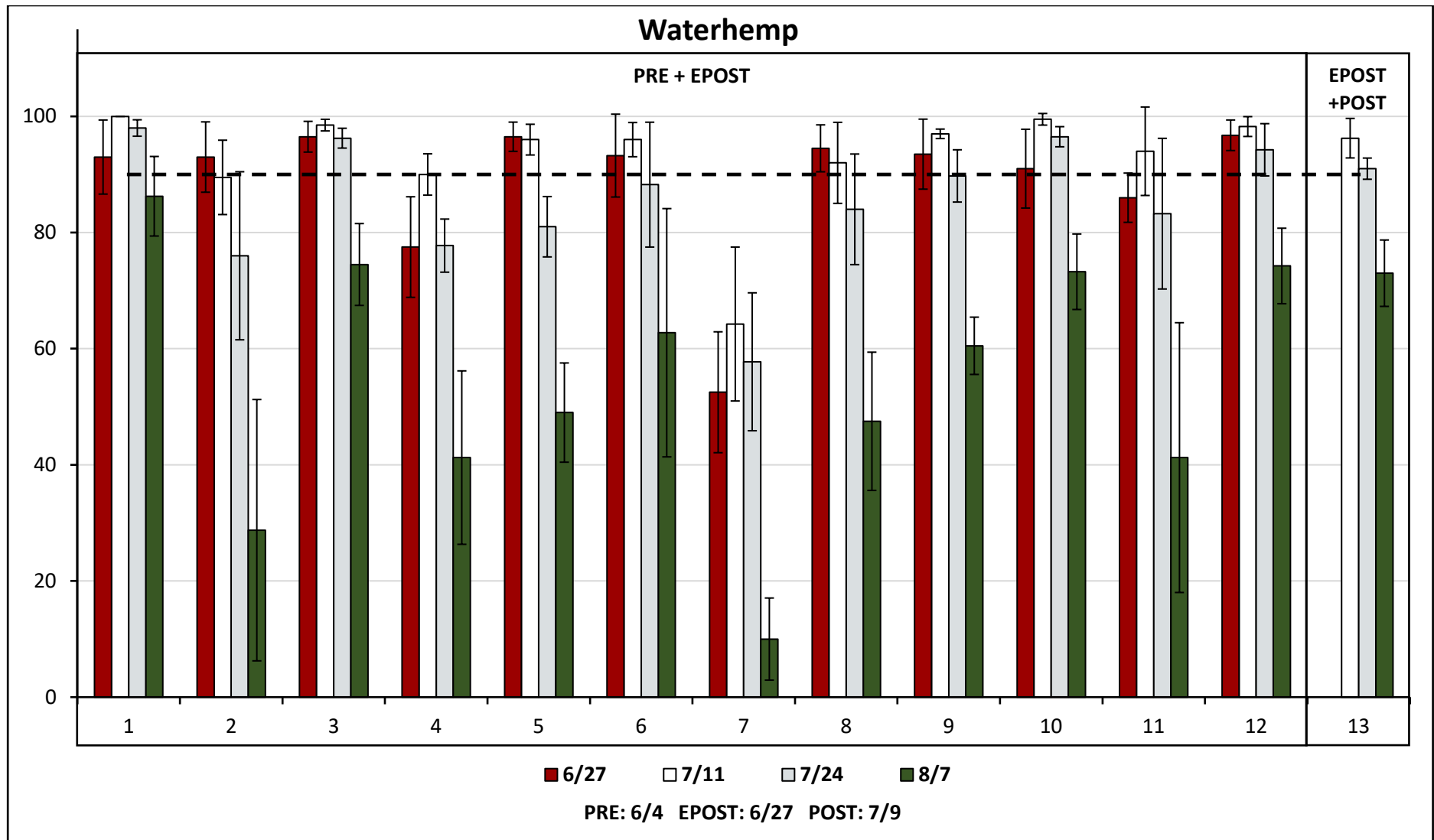


Figure 25. Waterhemp efficacy ratings for trial #19-BRO-SB02. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. The dashed line indicates 90% control.

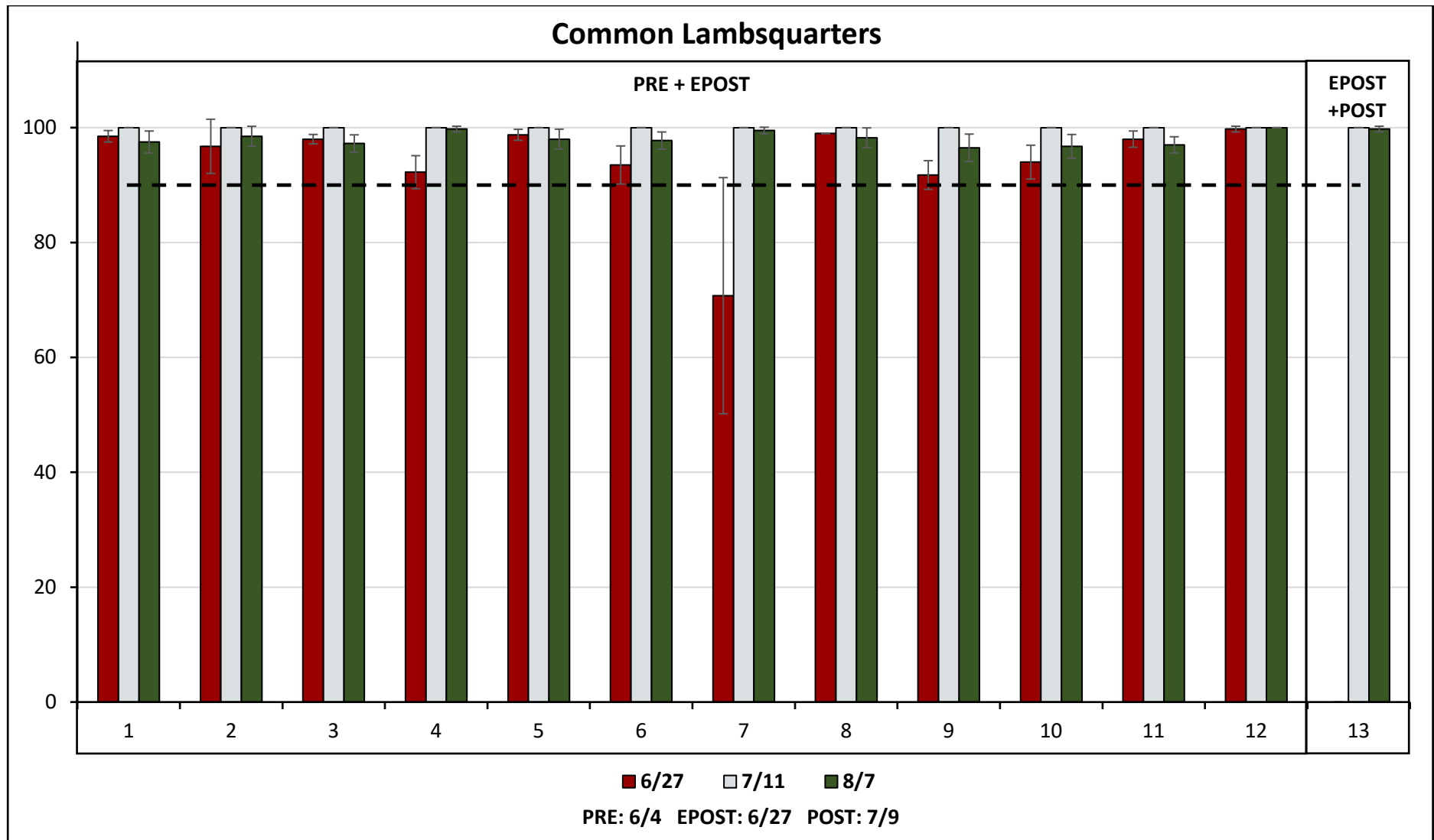


Figure 26. Common lambsquarters efficacy ratings for trial #19-BRO-SB02. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. The dashed line indicates 90% control.

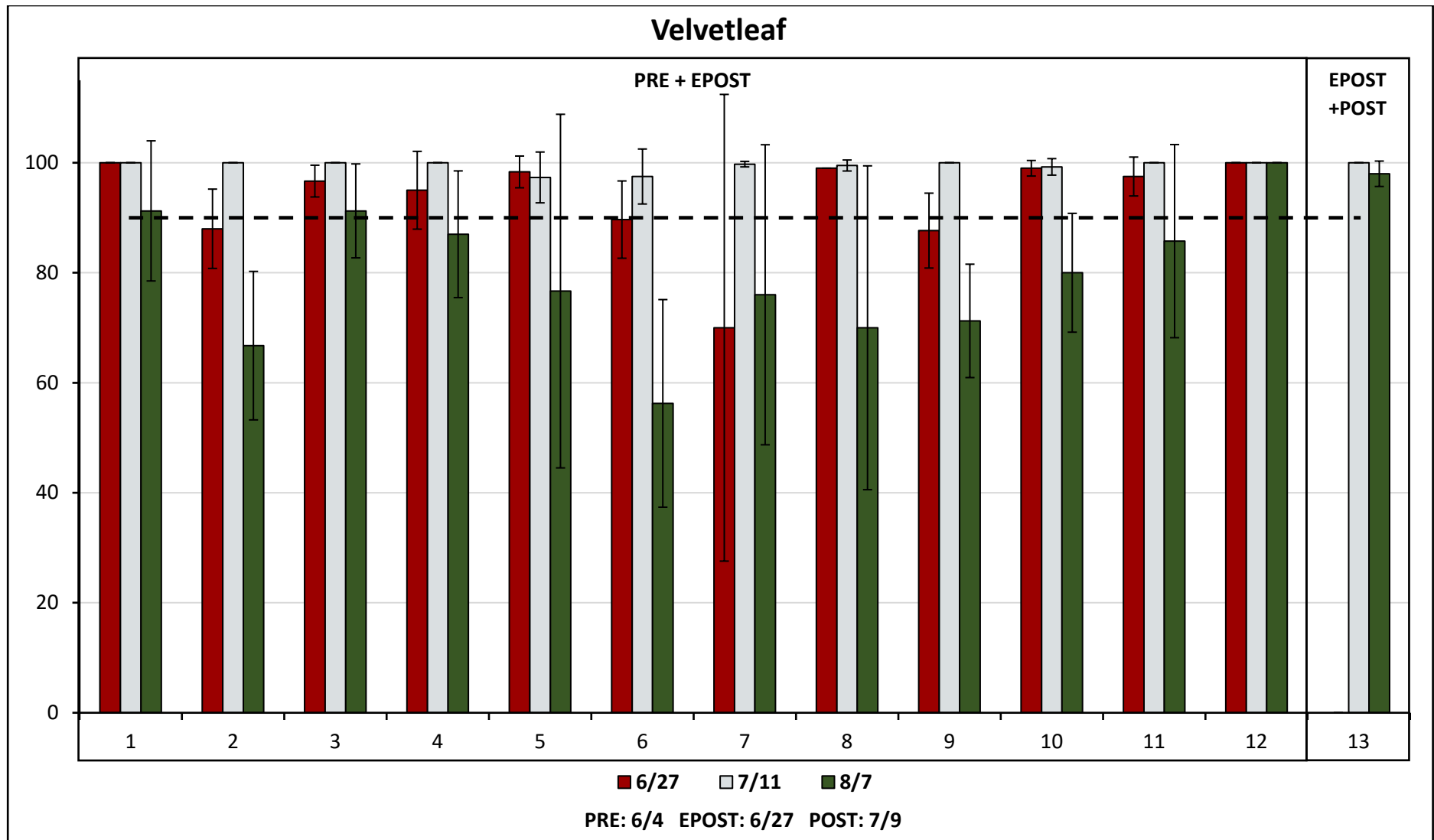


Figure 27. Velvetleaf efficacy ratings for trial #19-BRO-SB02. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. The dashed line indicates 90% control.

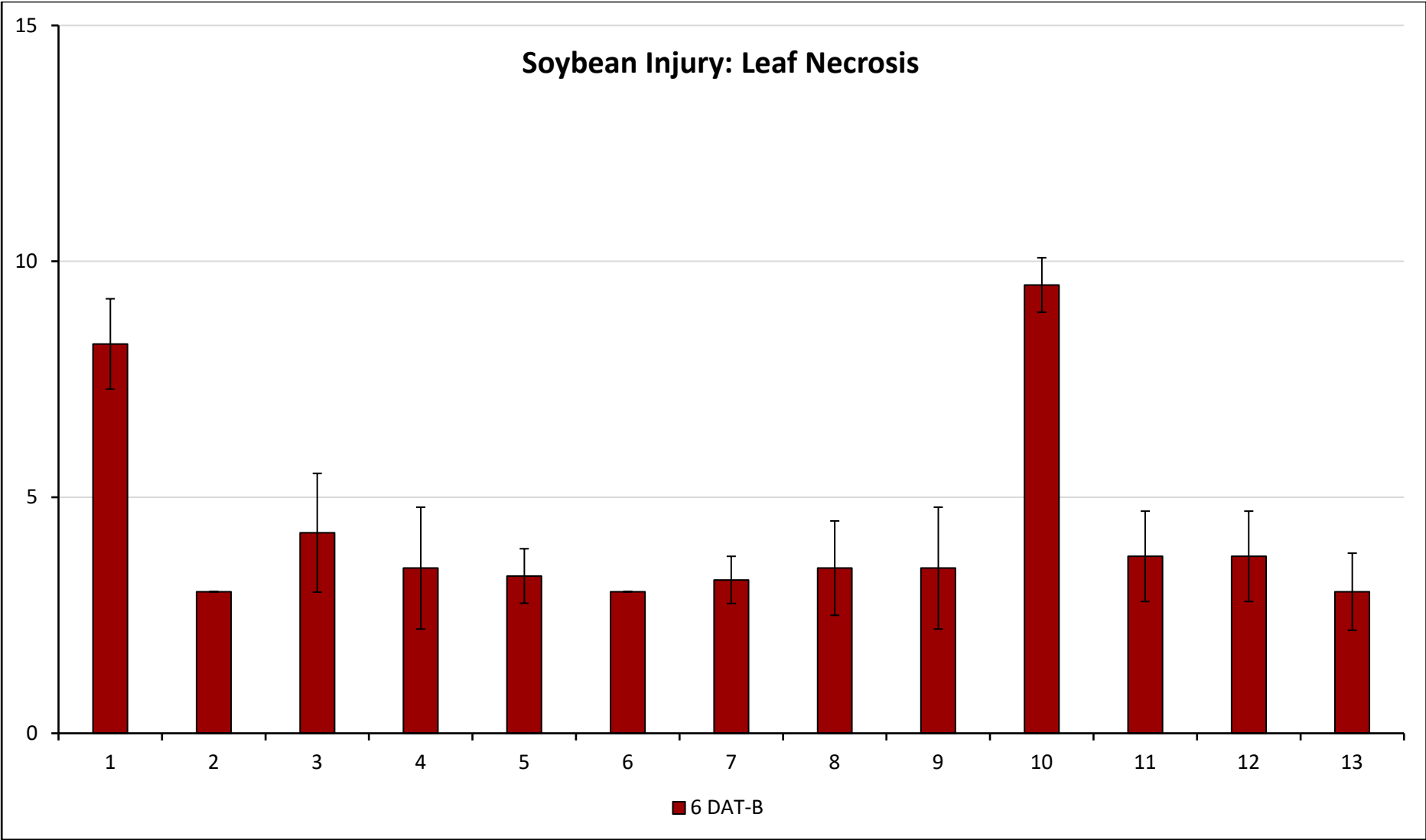


Figure 28. Soybean injury ratings at 6 days after the EPOST application for trial #19-BRO-SB02. Bars indicate the average % leaf necrosis (burn) \pm the standard deviation of four replications following the EPOST herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number.

Project Goal: Compare Syngenta PRE herbicide programs followed by Tavium plus VaporGrip Technology to similar competitor programs.

Site Description:

Location:	Brooklyn, WI	Crop:	Soybean
Field #:	OB-1	Variety:	S20-J5X
Soil type:	Kegonsa loam	Planting Date:	6/3
% OM:	2	Emergence Date:	-
pH:	7.1	Population:	140,000 seeds/acre
Fertilization:	-	Depth:	1 in
Previous crop:	Soybean	Row spacing:	30 in
Tillage:	conventional	Plot Size:	10 x 30 ft
Weed species:	glyphosate resistant waterhemp (AMATA), common lambsquarters (CHEAL), velvetleaf (ABUTH), fall panicum (PANDI), wild proso millet (PANMI)		

Herbicide Application Information:

Date:	6/4	7/1
Treatment:	PRE (A)	POST (B)
Air Temp (°F):	73	88
2" Soil Temp (°F):	61	80
Soil moisture [surface]:	very wet	wet
RH %:	78	50
Cloud cover %	50	50
Wind speed (mph)/direction	1-5/SE	2-4/SW
Rainfall (in) 1 wk after APP:	0.48	5.8
GPA:	15	15
PSI:	26	38
Nozzle:	XR 11002	TTI 110015
Nozzle spacing (in):	20	20
Boom Height (in):	20	24

Crop and weed information at application:

	Date:	6/4	7/1*
Soybean	Height (in):	-	3-4
	Stage:	-	V2
AMATA	Height (in):	-	1-4
	Density:	-	1-12/ft ²
ABUTH	Height (in):	-	0.5-2
	Density:	-	0-0.1/ft ²
CHEAL	Height (in):	-	1-3
	Density:	-	0-0.25/ft ²
Grass	Height (in):	-	-
	Density:	-	sparse

*Density and heights were recorded from plots with a PRE herbicide. Density varied depending on the effectiveness of the PRE treatment.

Trt #	Treatment	Formulation	SOA Group	Rate	App Timing	App Code
1	Check					
2	Boundary	6.5 lb/gal	5, 15	1.8 pt/a	PRE	A
	Tavium	3.38 lb/gal	4, 15	56.5 fl oz/a	POST	B
	Roundup PowerMAX	4.5 lbae/gal	9	28 fl oz/a	POST	B
	Intact			0.5% v/v	POST	B
	Class Act Ridion			1% v/v	POST	B
3	BroadAxe XC	7 lb/gal	14, 15	25 fl oz/a	PRE	A
	Tavium	3.38 lb/gal	4, 15	56.5 fl oz/a	POST	B
	Roundup PowerMAX	4.5 lbae/gal	9	28 fl oz/a	POST	B
	Intact			0.5% v/v	POST	B
	Class Act Ridion			1% v/v	POST	B
4	Prefix	5.29 lb/gal	14, 15	2 pt/a	PRE	A
	Tavium	3.38 lb/gal	4, 15	56.5 fl oz/a	POST	B
	Roundup PowerMAX	4.5 lbae/gal	9	28 fl oz/a	POST	B
	Intact			0.5% v/v	POST	B
	Class Act Ridion			1% v/v	POST	B
5	Valor SX	51% w/w	14	2 oz/a	PRE	A
	XtendiMax	2.9 lbae/gal	4	22 fl oz/a	POST	B
	Roundup PowerMAX	4.5 lbae/gal	9	28 fl oz/a	POST	B
	Intact			0.5% v/v	POST	B
	Class Act Ridion			1% v/v	POST	B
6	Zidua PRO	4.1 lb/gal	2, 14, 15	4.5 fl oz/a	PRE	A
	Engenia	5 lbae/gal	4	12.8 fl oz/a	POST	B
	Roundup PowerMAX	4.5 lbae/gal	9	28 fl oz/a	POST	B
	Intact			0.5% v/v	POST	B
	Class Act Ridion			1% v/v	POST	B

Trial Summary:

Tavium plus VaporGrip Technology is a new herbicide from Syngenta that received EPA approval during the 2019 growing season. Tavium is a premix formulation of dicamba and S-metolachlor. There was some leaf necrosis (burn) from the POST application (Figure 32). There were varying levels of common lambsquarters and grass control from the PRE herbicides evaluated; however, all POST applications provided excellent control of any escapes (Figures 30, 31). The PRE herbicides provided fair to good waterhemp control (70-89%). The added residual component of Tavium, S-metolachlor, in the POST application enhanced late season waterhemp control (Figure 29). Soybean yield did not significantly differ among the herbicide treatments, $p=0.9388$ (data not shown). Yield across all treatments was 56 bu/acre, while the untreated check was 28 bu/acre, a 50% reduction.

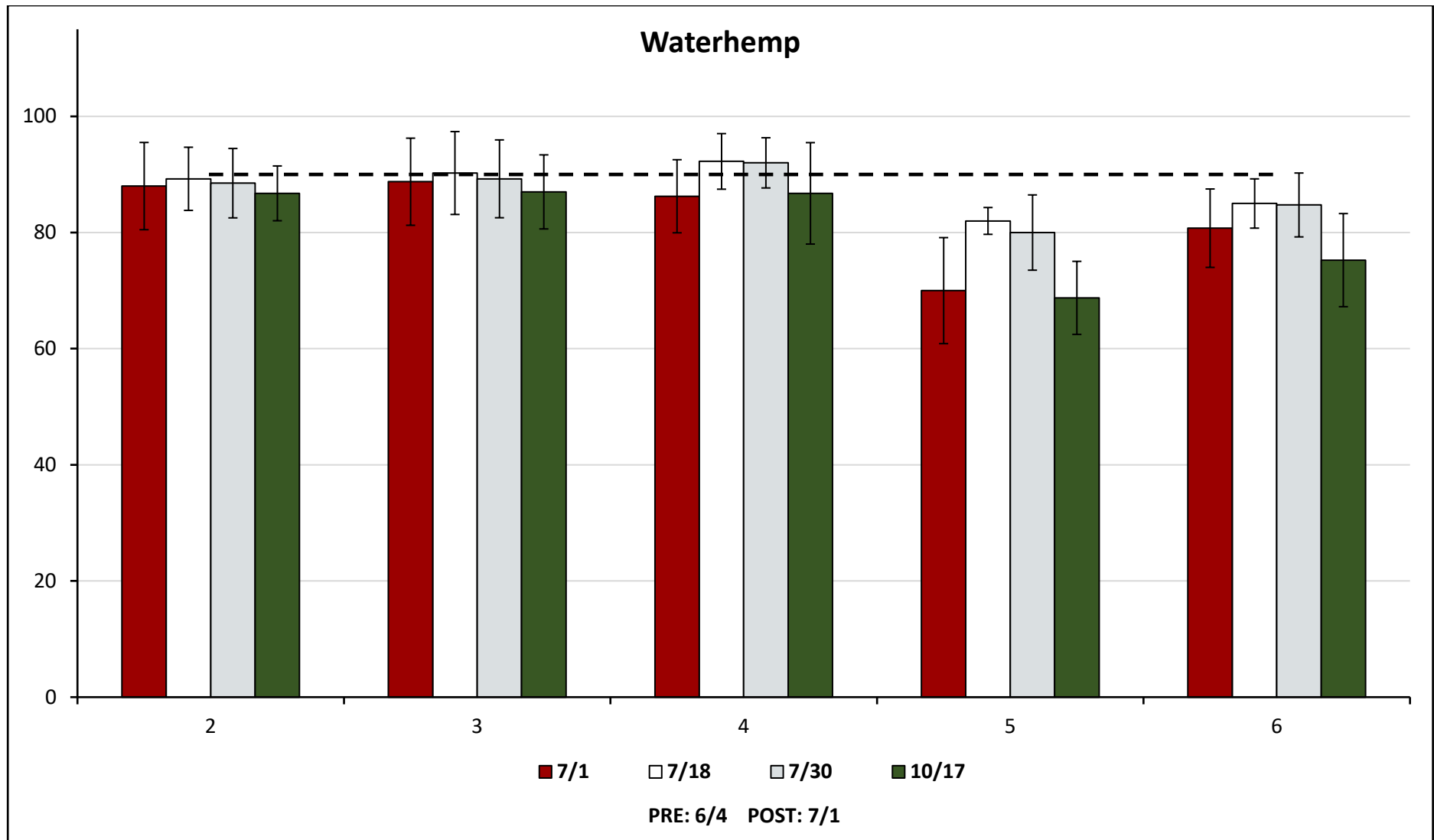


Figure 29. Waterhemp efficacy ratings for trial #19-BRO-SB06. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. The dashed line indicates 90% control.

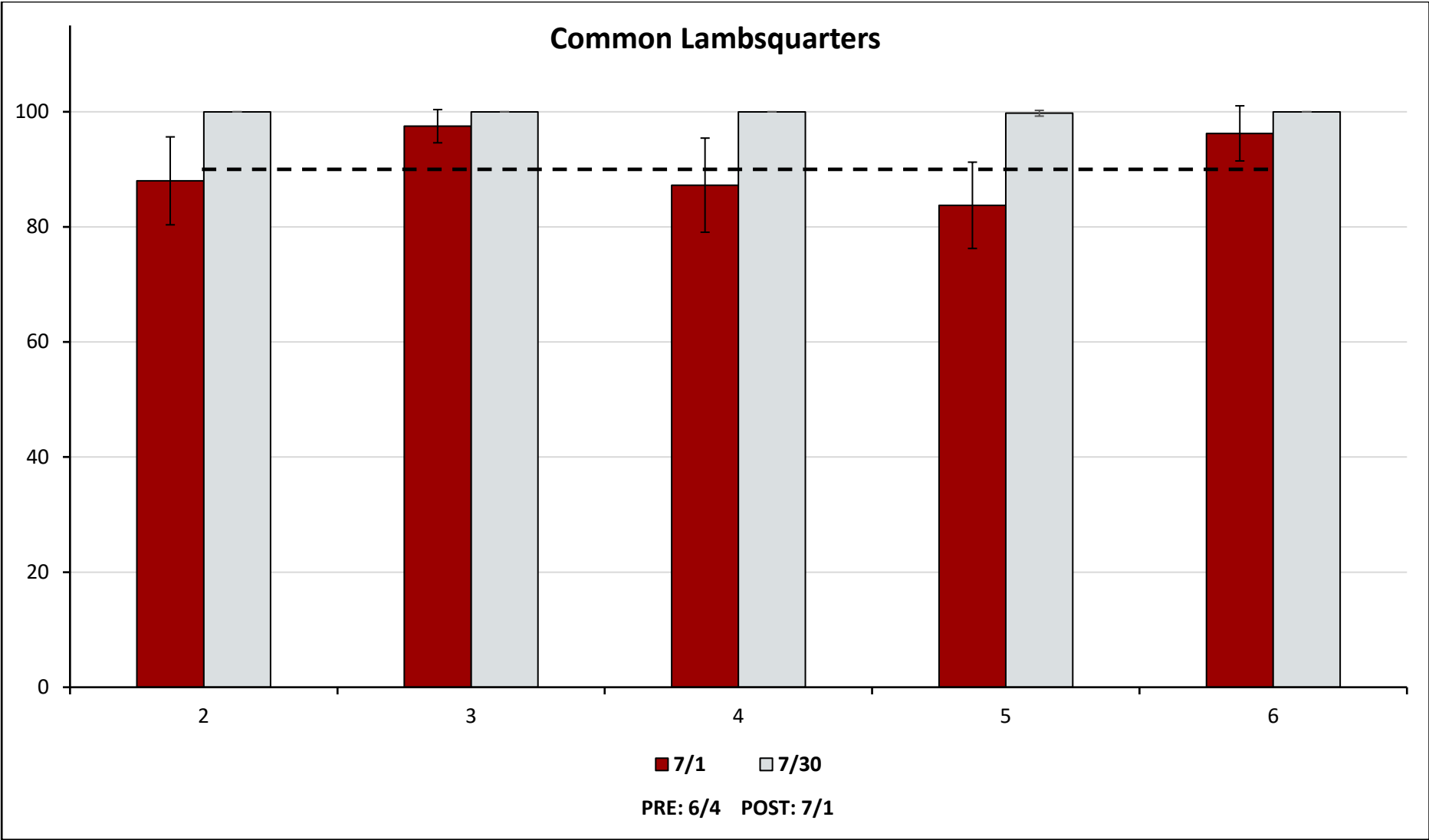


Figure 30. Common lambsquarters efficacy ratings for trial #19-BRO-SB06. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. The dashed line indicates 90% control.

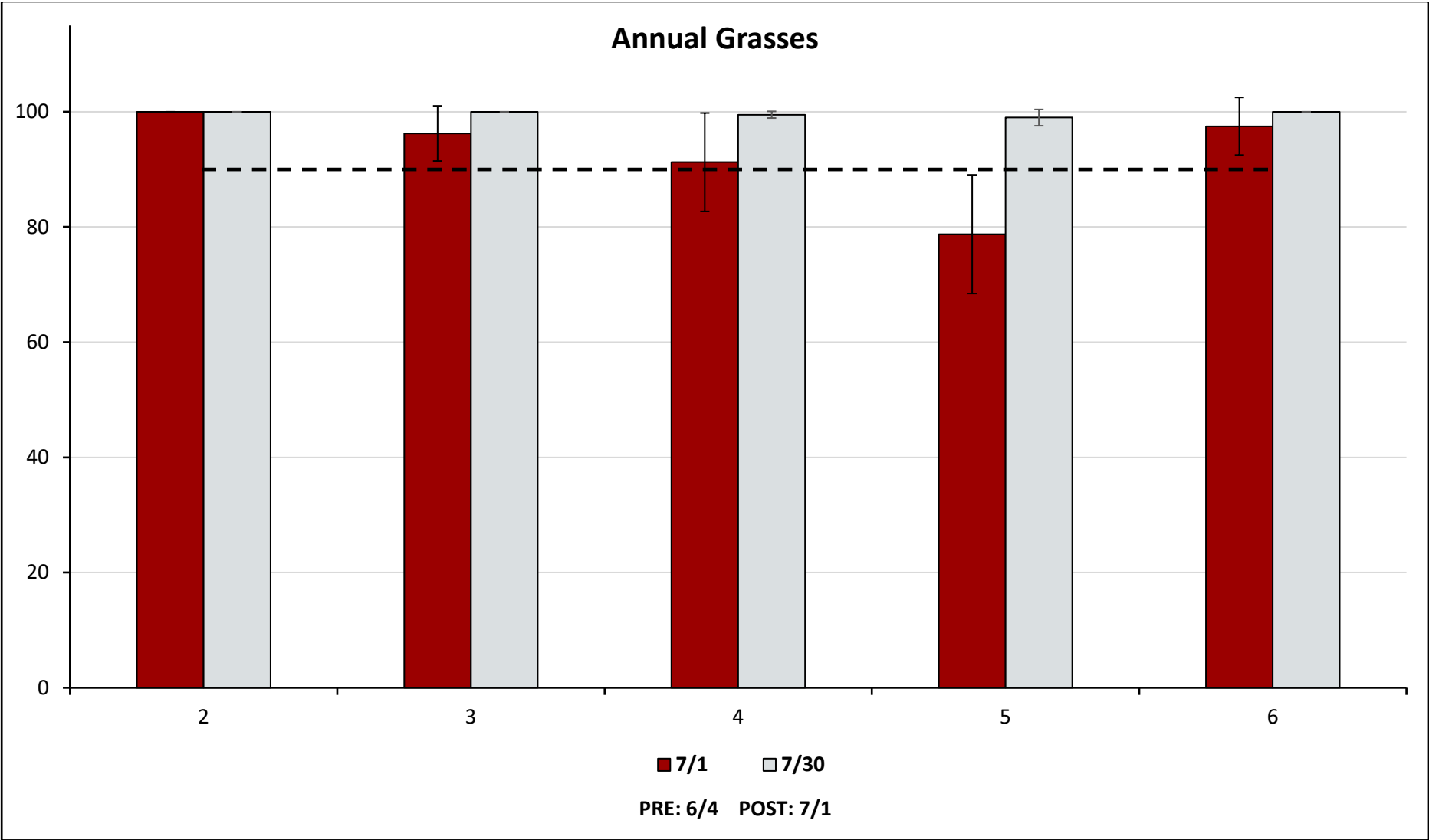


Figure 31. Summer annual grass (fall panicum, wild proso millet) efficacy ratings for trial #19-BRO-SB06. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. The dashed line indicates 90% control.

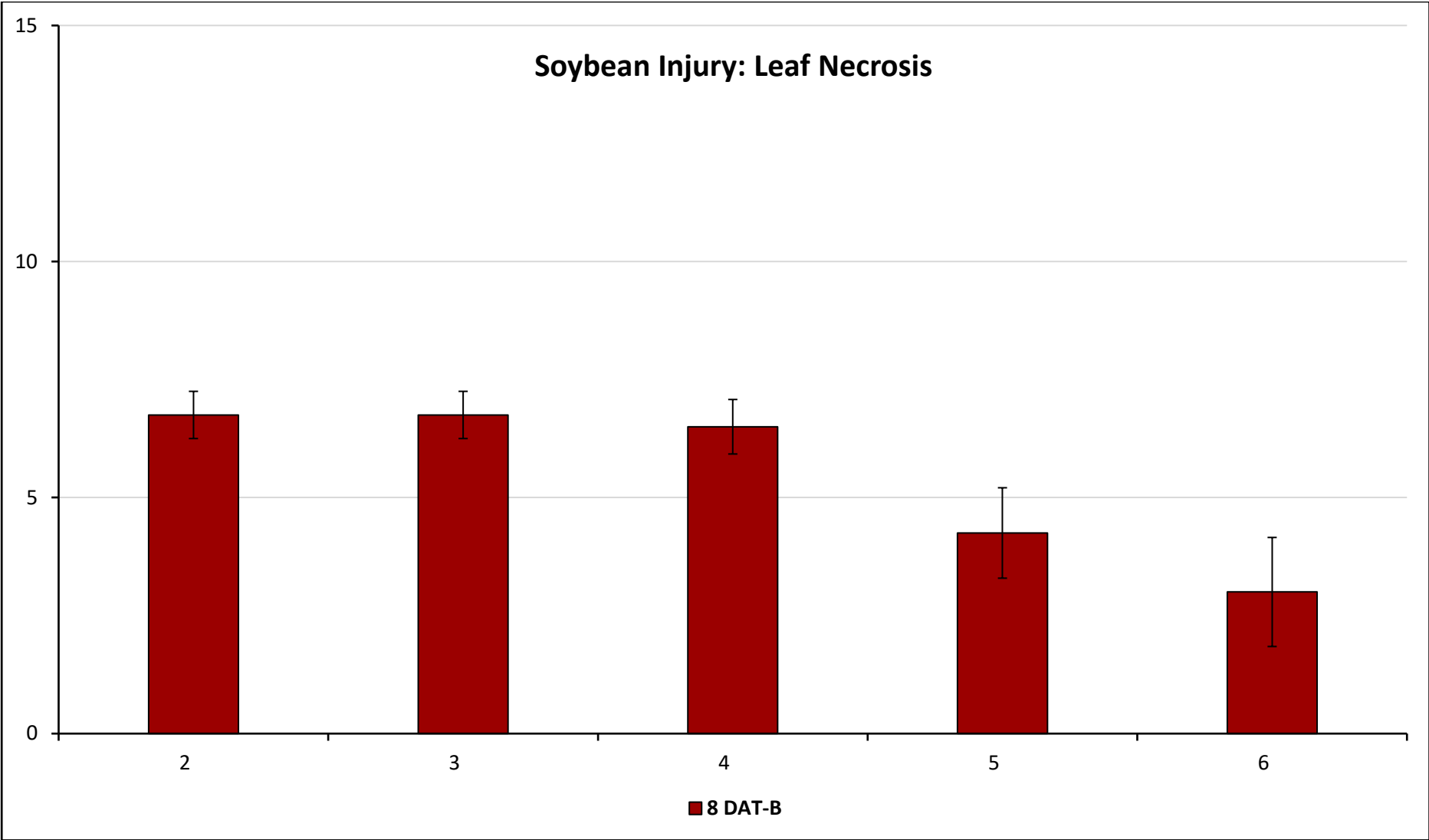


Figure 32. Soybean injury ratings at 8 days after the POST application for trial #19-BRO-SB06. Bars indicate the average % leaf necrosis (burn) \pm the standard deviation of four replications following the POST herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number.

Project Goal: Evaluate the weed control and crop safety of PRE herbicide programs in soybean.

Site Description:

Location:	Brooklyn, WI	Crop:	LLGT27 Soybean
Field #:	OB-1	Variety:	O'Briens OS-2519LLGT27
Soil type:	Kegonsa loam	Planting Date:	5/31
% OM:	2	Emergence Date:	
pH:	7.1	Population:	140,000 seeds/acre
Fertilization:	-	Depth:	1
Previous crop:	Soybean	Row spacing:	30 in
Tillage:	Conventional	Plot Size:	10 x 30 ft
Weed species:	glyphosate resistant waterhemp (AMATA), common lambsquarters (CHEAL), velvetleaf (ABUTH), fall panicum (PANDI), wild proso millet (PANMI)		

Herbicide Application Information:

Date:	6/3	7/3
Treatment:	PRE (A)	POST (B)
Air Temp (°F):	71	86
2" Soil Temp (°F):	69	86
Soil moisture [surface]:	moist	wet
RH %:	46	67
Cloud cover %	100	90
Wind speed (mph)/direction	2-8/E	1-6/E
Rainfall (in) 1 wk after APP:	0.41	6.25
GPA:	15	15
PSI:	26	36
Nozzle:	XRFF11002	AIXR110015
Nozzle spacing (in):	20	
Boom Height (in):	20	

Crop and weed information at application:

	Date:	6/3	7/3*
Soybean	Height (in):	-	5-6
	Stage:	-	V4
AMATA	Height (in):	-	1-6
	Density:	-	0-20/ft ²
CHEAL	Height (in):	-	1-4
	Density:	-	0-1/ft ²
ABUTH	Height (in):	-	1-5
	Density:	-	0-1/ft ²
Grass	Height (in):	-	2-7
	Density:	-	0-2/ft ²

*All weed densities and heights were recorded from plots with a PRE herbicide.

Trt #	Treatment	Formulation	SOA Group	Rate	App Timing	App Code
1	Check					
2	Authority First DF	70% w/w	2, 14	6.4 oz/a	PRE	A
	Liberty	2.34 lb/gal	10	22 fl oz/a	POST	B
	AMS			8.5 lb/100 gal	POST	B
3	Authority Assist	4 lb/gal	2, 14	10 fl oz/a	PRE	A
	Liberty	2.34 lb/gal	10	22 fl oz/a	POST	B
	AMS			8.5 lb/100 gal	POST	B
4	Authority Supreme	4.16 lb/gal	14, 15	7 fl oz/a	PRE	A
	Liberty	2.34 lb/gal	10	22 fl oz/a	POST	B
	AMS			8.5 lb/100 gal	POST	B
5	Authority Edge*	4.25 lb/gal	14, 15	8 fl oz/a	PRE	A
	Liberty	2.34 lb/gal	10	22 fl oz/a	POST	B
	AMS			8.5 lb/100 gal	POST	B
6	Authority Edge*	4.25 lb/gal	14, 15	11 fl oz/a	PRE	A
	Liberty	2.34 lb/gal	10	22 fl oz/a	POST	B
	AMS			8.5 lb/100 gal	POST	B
7	Authority Edge*	4.25 lb/gal	14, 15	8 fl oz/a	PRE	A
	Anthem Maxx	4.3 lb/gal	14, 15	2.5 fl oz/a	POST	B
	Liberty	2.34 lb/gal	10	22 fl oz/a	POST	B
	AMS			8.5 lb/100 gal	POST	B
8	Zidua PRO	4.09 lb/gal	2, 14, 15	6 fl oz/a	PRE	A
	Liberty	2.34 lb/gal	10	22 fl oz/a	POST	B
	AMS			8.5 lb/100 gal	POST	B
9	Fierce XLT	62% w/w	2, 14, 15	4 oz/a	PRE	A
	Liberty	2.34 lb/gal	10	22 fl oz/a	POST	B
	AMS			8.5 lb/100 gal	POST	B
10	Boundary	6.5 lb/gal	5, 15	1.8 pt/a	PRE	A
	Liberty	2.34 lb/gal	10	22 fl oz/a	POST	B
	AMS			8.5 lb/100 gal	POST	B
11	Valor XLT	40% w/w	2, 14	4 oz/a	PRE	A
	Liberty	2.34 lb/gal	10	22 fl oz/a	POST	B
	AMS			8.5 lb/100 gal	POST	B
12	Tricor DF	75% w/w	5	6 oz/a	PRE	A
	Liberty	2.34 lb/gal	10	22 fl oz/a	POST	B
	AMS			8.5 lb/100 gal	POST	B

*Authority Edge is a new premix of sulfentrazone and pyroxasulfone

Trial Summary:

This trial evaluated the weed control and crop safety of FMC's Authority herbicide brands. The trial was located in a growers's field with a heavy population of glyphosate resistant waterhemp. There was no significant herbicide injury from the PRE herbicides evaluated as average percent injury was <5% for all treatments (data not shown). The POST treatment of Anthem Maxx (treatment 7) resulted in minor leaf necrosis 14 days after application (data not shown). All the PRE herbicides provided excellent common lambsquarters control (>90%) throughout the entire season (data not shown). Only Tricor DF (treatment 12) failed to control the annual grasses, as average control was 78 and 65% at 22 and 30 DAT, respectively. Velvetleaf control was >98% for all treatments at 30 DAT except for Tricor = 69% and Boundary = 86%. Waterhemp control varied at all rating timings (Figure 33). Waterhemp density at the time of POST application (7/3) was also impacted by PRE herbicide treatment (Table 2). The POST application of Liberty was not very effective at controlling the emerged waterhemp as indicated by control data collected 14 days after application (data not shown). The 22 fl oz rate was too low given the density and height of the waterhemp. A higher rate of 32 fl oz would have been more appropriate. It was also very cloudy with showers in the area the day of POST application. Liberty efficacy is generally improved under sunny, warm conditions. Soybean yield did not differ among herbicide treatments (data not shown). Yield averaged across all herbicide treatments was 68 bu/acre, while the untreated check was 30 bu/acre, a 56% reduction.

Table 2: Waterhemp density at the time of POST herbicide application at Brooklyn, WI

Trt #	PRE Herbicide	Rate	Density (ft ²)*	Standard Deviation	% Reduction**
1	Check		78.5	29.42	-
2	Authority First DF	6.4 oz	2.3	2.60	97.1
3	Authority Assist	10 fl oz	1.4	0.25	98.2
4	Authority Supreme	7 fl oz	0.6	0.63	99.2
5, 7	Authority Edge	8 fl oz	0.7	0.42	98.9
6	Authority Edge	11 fl oz	0.4	0.48	99.5
8	Zidua PRO	6 fl oz	2.0	0.91	99.4
9	Fierce XLT	4 oz	1.4	1.18	97.5
10	Boundary	1.8 pt	3.9	3.01	98.2
11	Valor XLT	4 oz	6.3	3.84	95.1
12	Tricor DF	6 oz	14.1	3.68	92.0

*density was collected from two 1 ft² areas in each plot

**percent reduction in density from untreated check

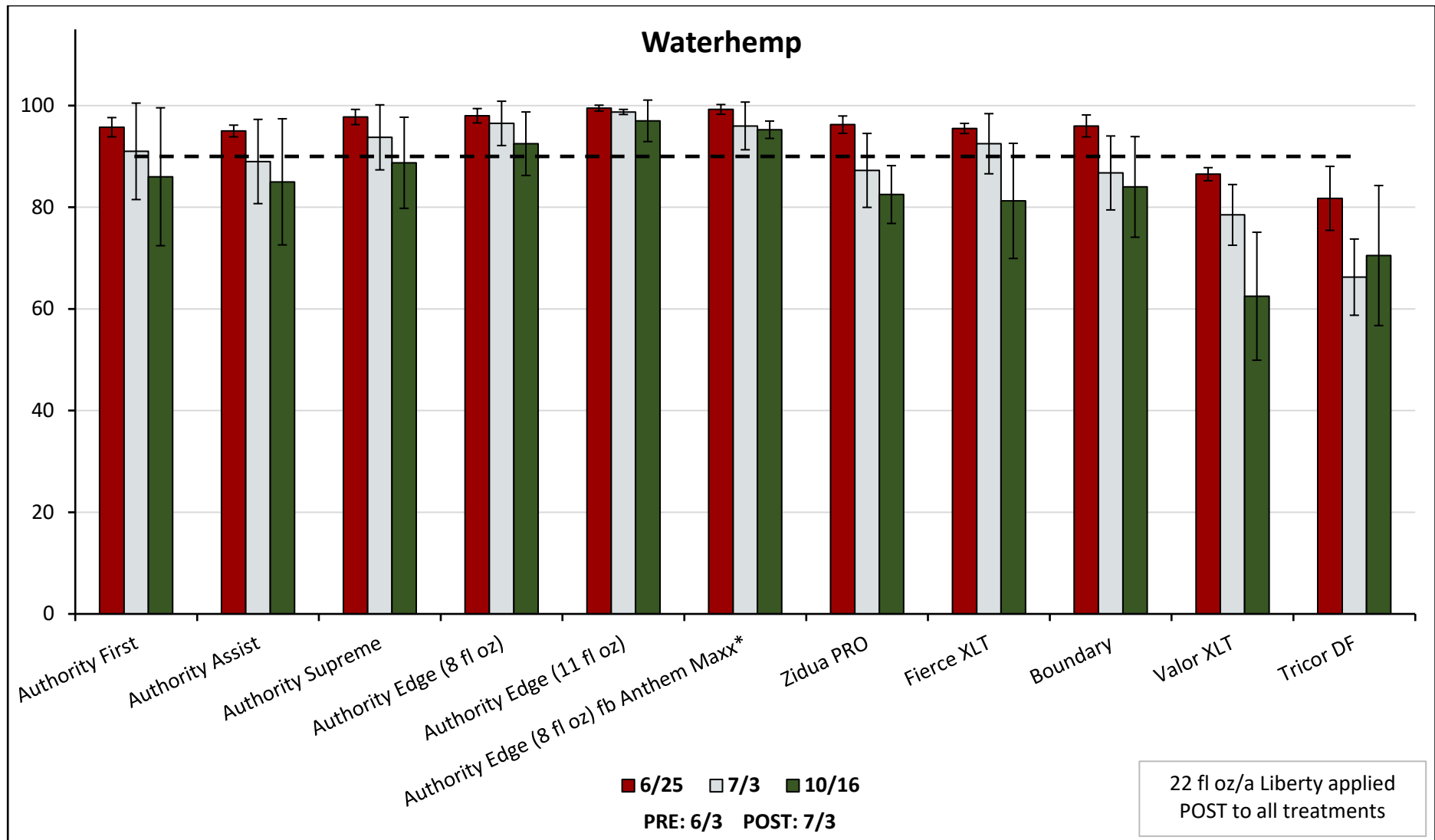


Figure 33. Waterhemp efficacy ratings for trial #19-BRO-SB09. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Products along the x axis were applied PRE, see treatment list for rates. *Anthem Maxx was tank mixed with Liberty at the POST application. The dashed line indicates 90% control.

Project Goal: Evaluate and demonstrate the effectiveness of multiple PRE-emergence soybean herbicides.

Site Description:

Location:	Brooklyn, WI	Crop:	LLGT27 Soybean
Field #:	OB-1	Variety:	O'Briens OS-2519LLGT27
Soil type:	Kegonsa loam	Planting Date:	5/31
% OM:	2	Emergence Date:	-
pH:	7.1	Population:	140,000 seeds/acre
Fertilization:	none	Depth:	1
Previous crop:	Soybean	Row spacing:	30 in
Tillage:	conventional	Plot Size:	10 x 30 ft
Weed species:	glyphosate resistant common waterhemp (AMATA)		

Herbicide Application Information:

Date:	6/3
Treatment:	PRE (A)
Air Temp (°F):	71
2" Soil Temp (°F):	69
Soil moisture [surface]:	moist
RH %:	46
Cloud cover %	100
Wind speed (mph)/direction	2-8/E
Rainfall (in) 1 wk after APP:	0.41
GPA:	15
PSI:	20
Nozzle:	XRFF11002
Nozzle spacing (in):	20
Boom Height (in):	20

Location Summary:

- Heavy waterhemp pressure: 50-110 plants/ft²
- glyphosate resistant population
- control at 45 days after treatment was very poor for many of the herbicides evaluated (data not shown)

Project Goal: Evaluate and demonstrate the effectiveness of multiple PRE-emergence soybean herbicides.

Site Description:

Location:	Lancaster, WI	Crop:	Soybean
Field #:	SIDS-NE	Variety:	AG21X7
Soil type:	Fayette silt loam	Planting Date:	5/23
% OM:	3.1	Emergence Date:	-
pH:	7.0	Population:	140,000
Fertilization:	none	Depth:	1.5 in
Previous crop:	Corn	Row spacing:	30 in
Tillage:	conventional	Plot Size:	10 x 25 ft
Weed species:	common waterhemp (AMATA), common lambsquarters (CHEAL)		

Herbicide Application Information:

Date:	5/26
Treatment:	PRE (A)
Air Temp (°F):	79
2" Soil Temp (°F):	80
Soil moisture [surface]:	moist
RH %:	56
Cloud cover %	20
Wind speed (mph)/direction	1-3/NE
Rainfall (in) 1 wk after APP:	2.46
GPA:	15
PSI:	20
Nozzle:	XRFF11002
Nozzle spacing (in):	20
Boom Height (in):	20

Location Summary:

- Lower waterhemp pressure: <10 plants/ft²

Products and use rates for the Brooklyn and Lancaster, WI trial locations.

Trt #	Treatment	Active Ingredient(s)	Formulation	SOA Group	Rate
1	Untreated Check				
2	Pursuit	imazethapyr	2 lb/gal	2	4 fl oz/a
3	Classic	chlorimuron	25% w/w	2	3 oz/a
4	FirstRate	cloransulam	84% w/w	2	0.6 oz/a
5	Tricor DF	metribuzin	75% w/w	5	10.7 oz/a
6	Spartan	sulfentrazone	4 lb/gal	14	8 fl oz/a
7	Valor SX	flumioxazin	51% w/w	14	3 oz/a
8	Sharpen	saflufenacil	2.85 lb/gal	14	1 fl oz/a
9	Warrant	acetochlor	3 lb/gal	15	24 fl oz/a
10	Warrant	acetochlor	3 lb/gal	15	48 fl oz/a
11	Dual II Magnum	S-metolachlor	7.64 lb/gal	15	13.4 fl oz/a
12	Dual II Magnum	S-metolachlor	7.64 lb/gal	15	26.7 fl oz/a
13	Outlook	dimethenamid-P	6 lb/gal	15	9 fl oz/a
14	Outlook	dimethenamid-P	6 lb/gal	15	18 fl oz/a
15	Zidua	pyroxasulfone	85% w/w	15	1.5 oz/a
16	Zidua	pyroxasulfone	85% w/w	15	3 oz/a
17	Authority Assist	imazethapyr + sulfentrazone	4 lb/gal	2, 14	10 fl oz/a
18	Sonic	cloransulam + sulfentrazone	70% w/w	2, 14	6.45 oz/a
19	Surveil	cloransulam + flumioxazin	48% w/w	2, 14	3.5 oz/a
20	Valor XLT	chlorimuron + flumioxazin	40.3% w/w	2, 14	3 oz/a
21	Broadaxe XC	sulfentrazone + S-metolachlor	7 lb/gal	14, 15	25 fl oz/a
22	Authority MTZ	metribuzin + sulfentrazone	45% w/w	5, 14	16 oz/a
23	Authority Supreme	sulfentrazone + pyroxasulfone	4.16 lb/gal	14, 15	8 fl oz/a
24	Verdict	saflufenacil + dimethenamid	5.57 lb/gal	14, 15	5 fl oz/a
25	Prefix	fomesafen + S-metolachlor	5.29 lb/gal	14, 15	2 pt/a
26	Fierce	flumioxazin + pyroxasulfone	76% w/w	14, 15	3 oz/a
27	Boundary	metribuzin + S-metolachlor	6.5 lb/gal	5, 15	1.8 pt/a
28	Canopy DF	chlorimuron + metribuzin	75% w/w	2, 5	2.25 oz/a
29	Enlite	chlorimuron + thifensulfuron + flumioxazin	47.9% w/w	2, 14	2.8 oz/a
30	Afforia	thifensulfuron + tribenuron + flumioxazin	50.8% w/w	2, 14	2.5 oz/a
31	Trivence	chlorimuron + metribuzin + flumioxazin	61.3% w/w	2, 5, 14	6 oz/a
32	Zidua PRO	imazethapyr + saflufenacil + pyroxasulfone	4.09 lb/gal	2, 14, 15	6 fl oz/a
33	Fierce XLT	chlorimuron + flumioxazin + pyroxasulfone	62.4% w/w	2, 14, 15	3.75 oz/a
34	Fierce MTZ	flumioxazin + pyroxasulfone + metribuzin	2.64 lb/gal	14, 15 5	1 pt/a

Project Goal: Evaluate and demonstrate the effectiveness of multiple PRE-emergence soybean herbicides.

Site Description:

Location:	Fon du Lac, WI	Crop:	Soybean
Field #:	W-1	Variety:	S20-J5X
Soil type:	Poygan silty clay loam	Planting Date:	6/10
% OM:	5.2	Emergence Date:	-
pH:	7.2	Population:	140,000
Fertilization:	-	Depth:	1
Previous crop:	soybean	Row spacing:	30 in
Tillage:	conventional	Plot Size:	10 x 25 ft
Weed species:	common waterhemp (AMATA)		

Herbicide Application Information:

Date:	6/11
Treatment:	PRE (A)
Air Temp (°F):	81
2" Soil Temp (°F):	70
Soil moisture [surface]:	dry
RH %:	27
Cloud cover %	25
Wind speed (mph)/direction	3-8/NE
Rainfall (in) 1 wk after APP:	-
GPA:	15
PSI:	24
Nozzle:	XRFF11002
Nozzle spacing (in):	20
Boom Height (in):	20

Location Summary:

- Moderate to heavy waterhemp pressure: 8-30 plants/ft²
- Suspected glyphosate resistant
- Higher organic matter soil
- Some active ingredients, particularly the group 15s and flumioxazin, did not perform as well at this location as the other two locations

Products and use rates for the trial at Fon du Lac, WI. Rates of some herbicides were adjusted from the other trial locations due to the higher percent organic matter at this location. Additionally, all treatments with chlorimuron (Classic) were dropped from the original protocol due to label restrictions of some of these products. The original treatment numbers are kept to ease comparison to the full treatment list.

Trt #	Treatment	Active Ingredient(s)	Formulation	SOA Group	Rate
1	Untreated Check				
2	Pursuit	imazethapyr	2 lb/gal	2	4 fl oz/a
4	FirstRate	cloransulam	84% w/w	2	0.75 oz/a
5	Tricor DF	metribuzin	75% w/w	5	16 oz/a
6	Spartan	sulfentrazone	4 lb/gal	14	12 fl oz/a
7	Valor SX	flumioxazin	51% w/w	14	3 oz/a
8	Sharpen	saflufenacil	2.85 lb/gal	14	1 fl oz/a
9	Warrant	acetochlor	3 lb/gal	15	24 fl oz/a
10	Warrant	acetochlor	3 lb/gal	15	48 fl oz/a
11	Dual II Magnum	S-metolachlor	7.64 lb/gal	15	13.4 fl oz/a
12	Dual II Magnum	S-metolachlor	7.64 lb/gal	15	26.7 fl oz/a
13	Outlook	dimethenamid-P	6 lb/gal	15	9 fl oz/a
14	Outlook	dimethenamid-P	6 lb/gal	15	18 fl oz/a
15	Zidua	pyroxasulfone	85% w/w	15	1.5 oz/a
16	Zidua	pyroxasulfone	85% w/w	15	3 oz/a
17	Authority Assist	imazethapyr + sulfentrazone	4 lb/gal	2, 14	12 fl oz/a
18	Sonic	cloransulam + sulfentrazone	70% w/w	2, 14	6.45 oz/a
19	Surveil	cloransulam + flumioxazin	48% w/w	2, 14	3.5 oz/a
21	Broadaxe XC	sulfentrazone + S-metolachlor	7 lb/gal	14, 15	30 fl oz/a
22	Authority MTZ	metribuzin + sulfentrazone	45% w/w	5, 14	18 oz/a
23	Authority Supreme	sulfentrazone + pyroxasulfone	4.16 lb/gal	14, 15	10 fl oz/a
24	Verdict	saflufenacil + dimethenamid	5.57 lb/gal	14, 15	5 fl oz/a
25	Prefix	fomesafen + S-metolachlor	5.29 lb/gal	14, 15	2 pt/a
26	Fierce	flumioxazin + pyroxasulfone	76% w/w	14, 15	3.75 oz/a
27	Boundary	metribuzin + S-metolachlor	6.5 lb/gal	5, 15	1.8 pt/a
30	Afforia	thifensulfuron + tribenuron + flumioxazin	50.8% w/w	2, 14	2.5 oz/a
32	Zidua PRO	imazethapyr + saflufenacil + pyroxasulfone	4.09 lb/gal	2, 14, 15	6 fl oz/a
34	Fierce MTZ	flumioxazin + pyroxasulfone + metribuzin	2.64 lb/gal	14, 15, 5	1.25 pt/a

Trial Summary:

This study was a joint effort between the [UW-Madison Nutrient and Pest Management Program](#) (NPM; Dan Smith and Richard Proost) and the WiscWeed team, and is an expansion on 2018 efforts. In addition to our field site at the [UW Lancaster Ag Research Station](#), in Lancaster, WI, this trial was replicated on two grower's fields with natural infestations of glyphosate resistant waterhemp in Brooklyn and Fon du Lac, WI. Treatments consisted of PRE-emergence soybean herbicides containing one, two and three different active ingredients and/or sites of action. Since we wanted to evaluate the residual activity of the PRE-emergence herbicide treatments throughout the season, no POST-emergence herbicides were sprayed to the research plots. Our intent was not to promote one product versus another, instead, demonstrate the value of using an effective PRE-emergence herbicide program.

While these results should be taken with a grain of salt (only one year of data), they clearly indicate the value of PRE-emergence herbicides and the programs that don't work. Moreover, the herbicide rates used in the study are the ones recommended by our industry colleagues and supported by us for the soil types at our locations, thus, valuable information for decision-makers.

Key Take Home Points from 2019 Data:

- Several PRE-emergence soybean herbicides evaluated provided good levels of waterhemp from 24-45 days after application. (Figures 83, 84, 85, 86, 87)
- Group 2 herbicides (e.g., Pursuit, Classic, First Rate) applied alone were NOT effective on waterhemp. The use of imazethapyr (e.g., Pursuit, Extreme, Thundermaster), which is a common practice in Wisconsin, did not provide satisfactory control of waterhemp. When using imazethapyr (which is an effective herbicide for control of several weed species) as part of the PRE-emergence herbicide program for waterhemp control, the tank mixture with or selection of herbicides that contain other effective active ingredient(s) is recommended.
- Half rates were included in addition to full rates of Group 15 herbicides as some may look to reduce rates to save on overall herbicide costs. The results from these experiments indicate the importance of using full rates as the full rates often improved the overall residual control compared to half rates.
- In general, the herbicides evaluated had higher levels of control at the site with lower waterhemp pressure (Lancaster) when compared to sites with heavy pressure (Brooklyn, Fon du Lac) (Table 3).
- Soil properties including soil texture, percent organic matter, pH, and geographic restrictions should be considered when selecting products and determining rates as these can have an impact on the efficacy of herbicides with residual activity and potential carryover into subsequent crops
- PRE-emergence herbicide programs containing multiple effective sites of action are recommended to broaden weed control spectrum and to lower selection for additional herbicide resistance.

Table 3. Waterhemp control (%) of multiple PRE applied soybean herbicides at Brooklyn, Lancaster, and Fon du Lac, WI in 2019.

		Brooklyn		Lancaster			Fon du Lac				
Trt #	Herbicide	24 DAT		25 DAT		45 DAT		27 DAT		42 DAT	
1	Untreated Check	0	(0.0)*	19	(13.1)	0	(0.0)	0	(0.0)	0	(0.0)
2	Pursuit	46	(6.9)	24	(4.8)	11	(2.5)	29	(25.6)	23	(18.5)
3	Classic	56	(8.8)	51	(14.4)	13	(5.0)	-	-	-	-
4	FirstRate	41	(20.7)	50	(11.5)	14	(4.8)	15	(7.1)	20	(14.1)
5	Tricor DF	91	(5.3)	98	(5.0)	73	(15.5)	93	(5.7)	89	(6.5)
6	Spartan	92	(5.3)	99	(2.5)	89	(6.3)	98	(2.2)	95	(5.8)
7	Valor SX	73	(14.6)	98	(5.0)	89	(4.8)	76	(21.9)	68	(17.7)
8	Sharpen	54	(18.1)	99	(2.5)	86	(4.8)	68	(19.4)	54	(19.3)
9	Warrant (half rate)	20	(12.2)	95	(5.8)	64	(20.6)	34	(28.1)	34	(27.8)
10	Warrant (full rate)	55	(14.2)	98	(2.9)	76	(4.8)	68	(23.3)	49	(28.4)
11	Dual II Magnum (half rate)	68	(9.4)	99	(2.5)	91	(4.8)	57	(24.4)	36	(29.5)
12	Dual II Magnum (full rate)	81	(8.0)	98	(5.0)	91	(3.0)	86	(5.7)	71	(8.3)
13	Outlook (half rate)	80	(9.0)	99	(2.5)	81	(8.5)	71	(9.4)	61	(14.2)
14	Outlook (full rate)	88	(3.4)	98	(5.0)	88	(2.9)	89	(3.5)	70	(5.0)
15	Zidua (half rate)	84	(5.6)	99	(2.5)	93	(2.9)	63	(20.8)	37	(15.3)
16	Zidua (full rate)	95	(3.3)	99	(2.5)	90	(4.1)	89	(6.0)	81	(10.3)
17	Authority Assist	94	(1.0)	99	(2.4)	93	(2.9)	98	(1.0)	94	(5.0)
18	Sonic	96	(1.0)	100	(0.5)	93	(5.0)	99	(1.3)	96	(4.4)
19	Surveil	90	(3.8)	100	(0.0)	89	(7.5)	72	(12.6)	57	(23.1)
20	Valor XLT	89	(1.5)	100	(0.0)	83	(6.5)	-	-	-	-
21	Broadaxe XC	94	(1.3)	100	(0.0)	91	(2.5)	98	(1.9)	93	(6.9)
22	Authority MTZ	96	(1.5)	100	(0.0)	89	(7.5)	99	(0.6)	96	(1.5)
23	Authority Supreme	98	(0.5)	100	(0.0)	93	(2.9)	99	(1.5)	96	(5.7)
24	Verdict	83	(8.4)	100	(0.0)	80	(13.5)	82	(7.3)	68	(17.6)
25	Prefix	94	(3.0)	100	(0.0)	91	(4.8)	92	(5.0)	83	(6.8)
26	Fierce	94	(3.6)	100	(0.0)	89	(6.3)	82	(13.7)	80	(10.0)
27	Boundary	95	(2.2)	100	(0.0)	89	(6.3)	91	(4.3)	79	(7.9)
28	Canopy DF	63	(8.8)	84	(22.9)	50	(36.3)	-	-	-	-
29	Enlite	85	(2.6)	100	(0.0)	91	(7.5)	-	-	-	-
30	Afforia	76	(7.3)	100	(0.0)	84	(7.5)	74	(15.5)	71	(11.0)
31	Trivence	82	(1.7)	100	(0.0)	88	(6.5)	-	-	-	-
32	Zidua PRO	92	(3.0)	100	(0.0)	91	(2.5)	93	(2.6)	87	(7.2)
33	Fierce XLT	96	(2.6)	100	(0.0)	96	(4.8)	-	-	-	-
34	Fierce MTZ	97	(1.8)	100	(0.0)	89	(6.3)	82	(20.2)	84	(12.1)

*Values in parenthesis are the standard deviations of the mean.

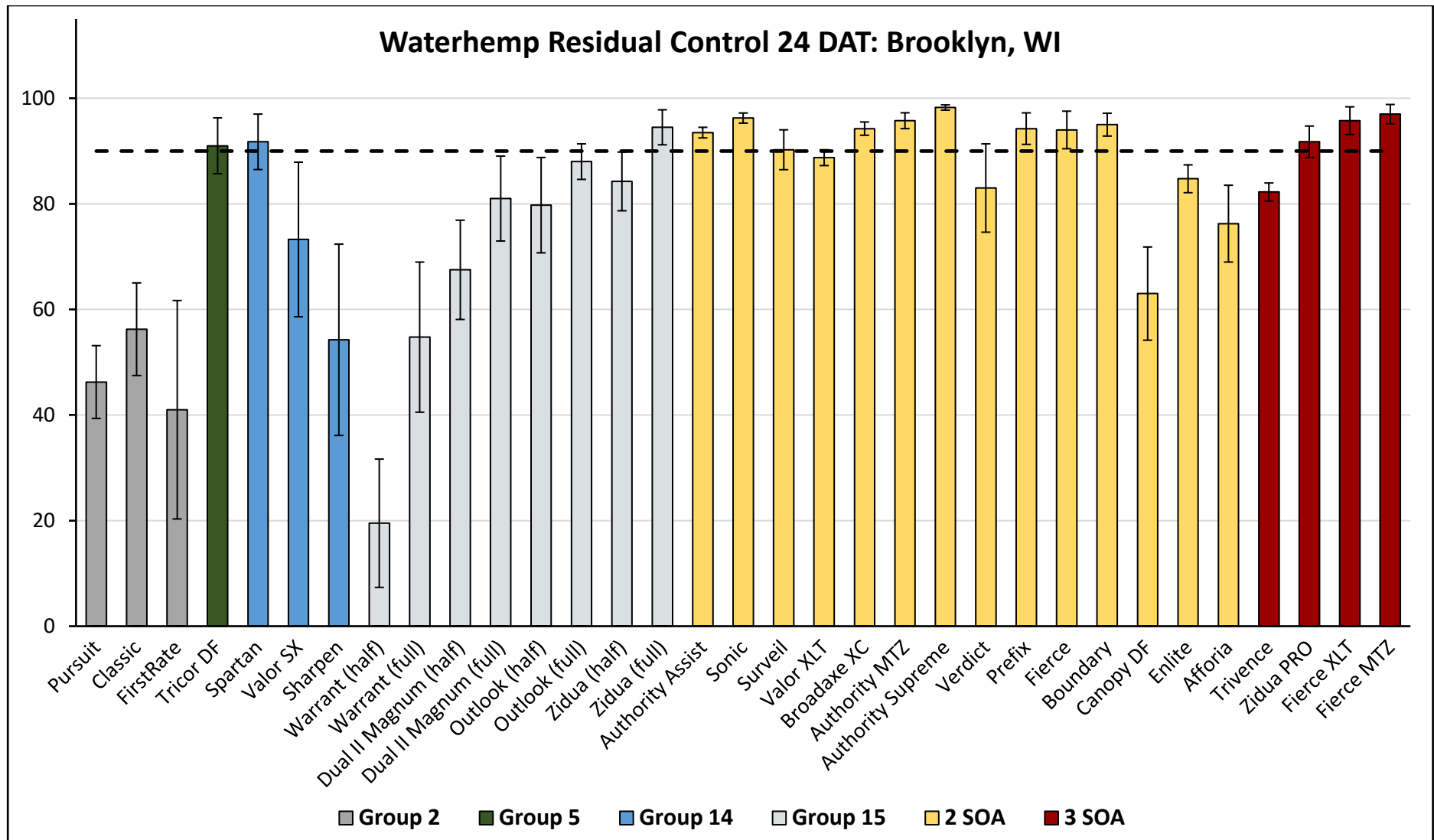


Figure 34. Waterhemp residual efficacy ratings for trial #19-BRO-SB11 24 days after treatment (DAT). Bars indicate the average % control \pm the standard deviation of four replications following a PRE herbicide application. Treatments are grouped and colored by herbicide sites of action (SOA). The dashed line indicates 90% control.

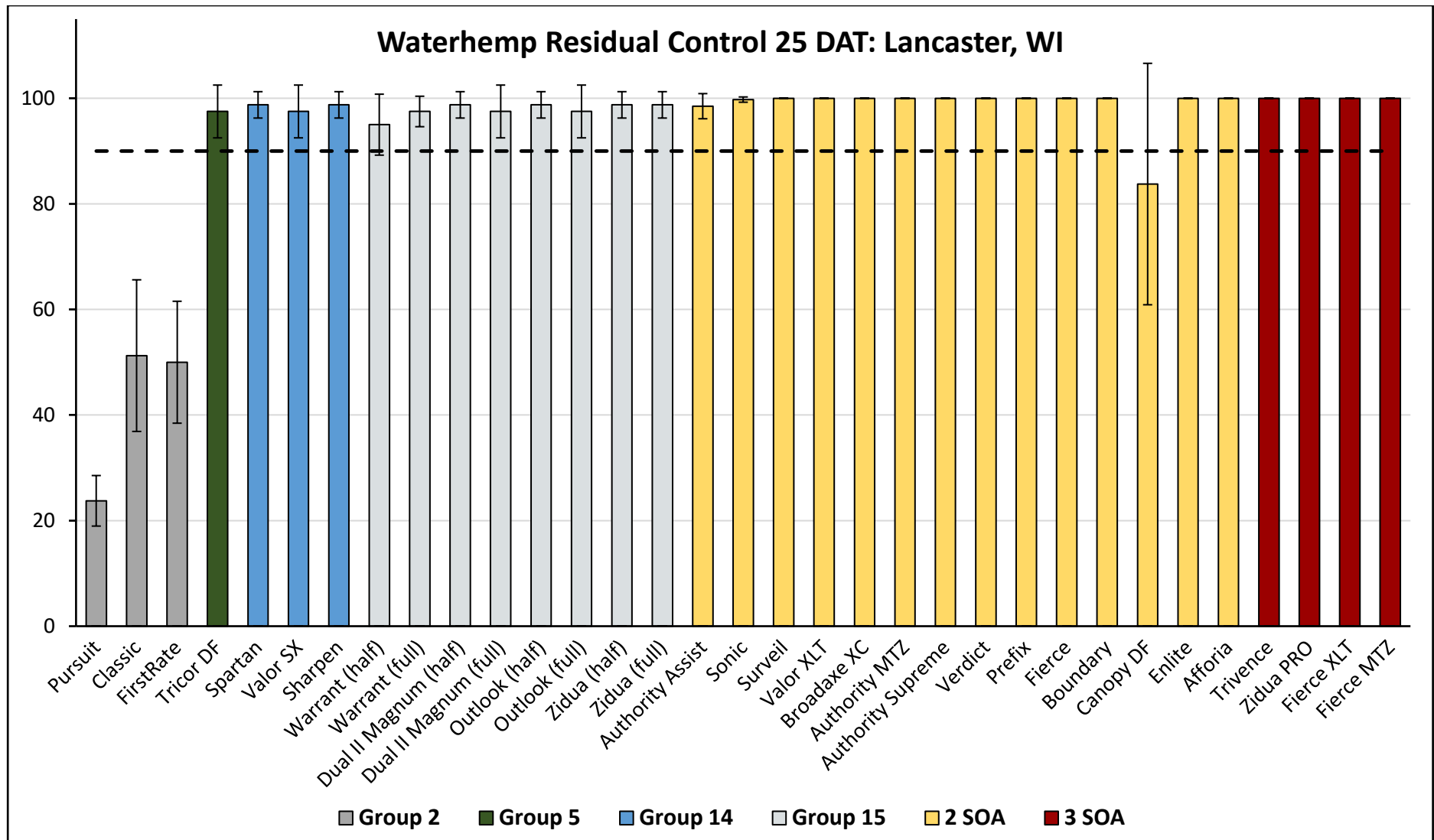


Figure 35. Waterhemp residual efficacy ratings for trial #19-LAN-SB11 25 days after treatment (DAT). Bars indicate the average % control \pm the standard deviation of four replications following a PRE herbicide application. Treatments are grouped and colored by herbicide sites of action (SOA). The dashed line indicates 90% control.

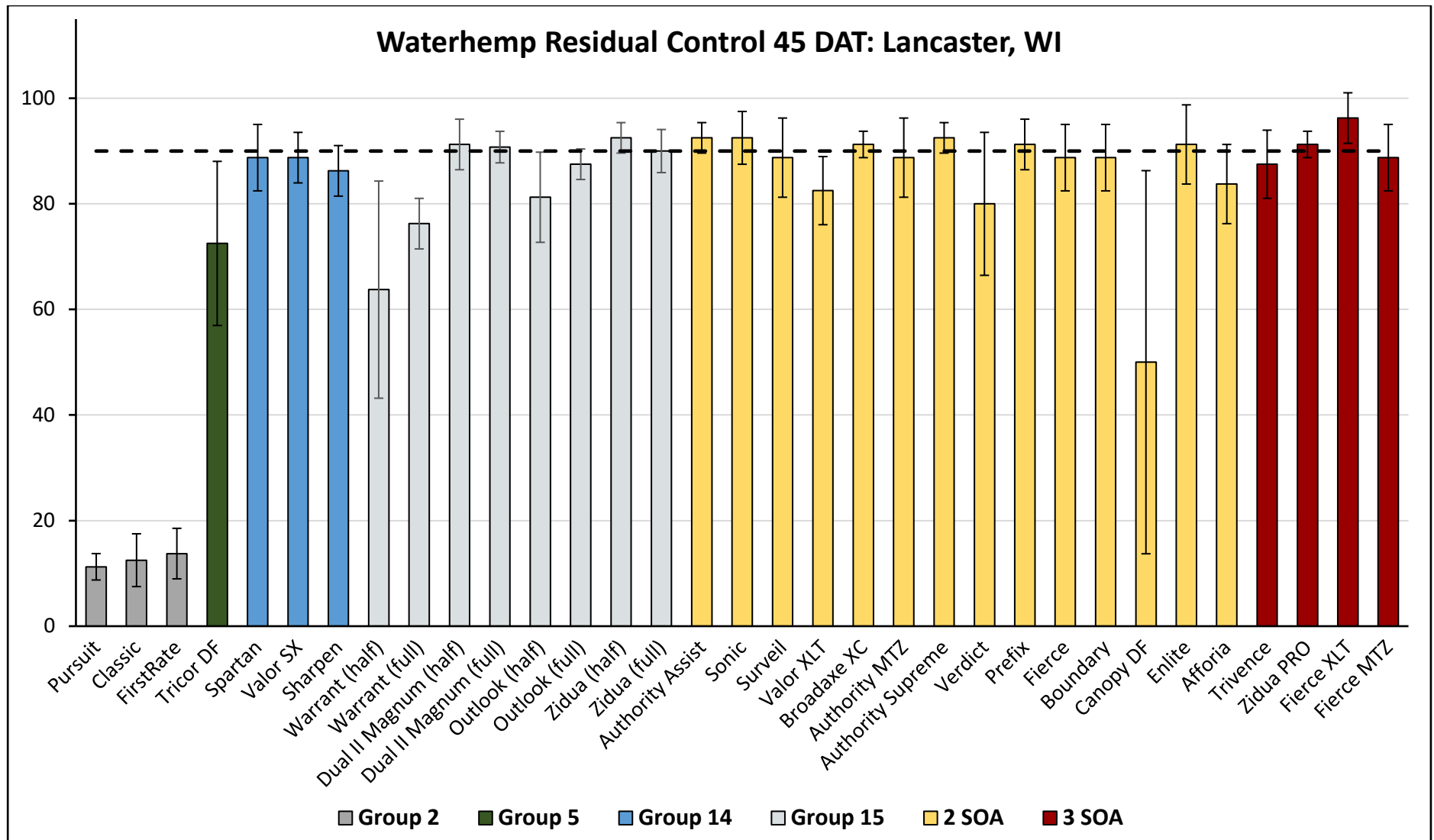


Figure 36. Waterhemp residual efficacy ratings for trial #19-LAN-SB11 45 days after treatment (DAT). Bars indicate the average % control \pm the standard deviation of four replications following a PRE herbicide application. Treatments are grouped and colored by herbicide sites of action (SOA). The dashed line indicates 90% control.

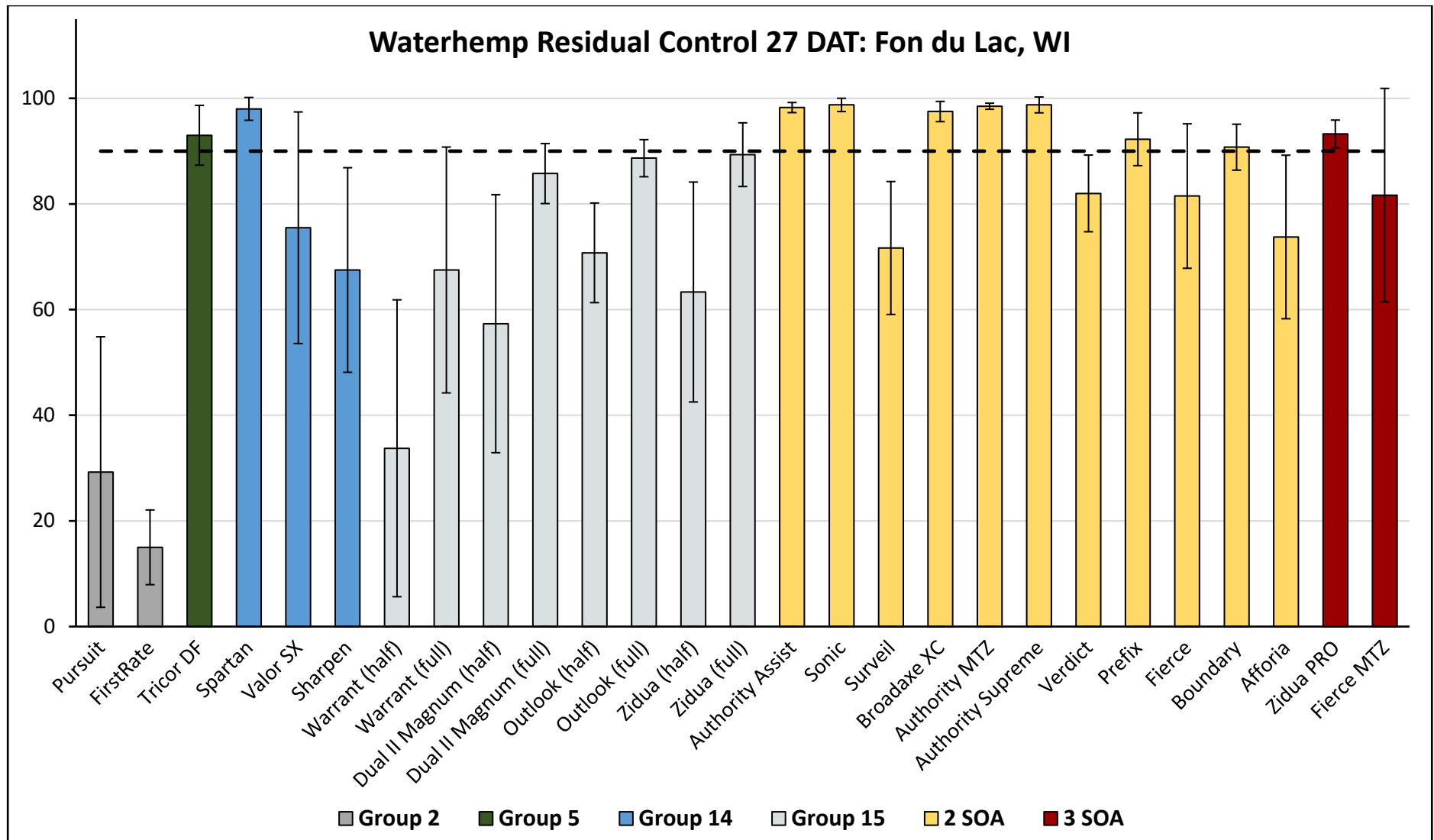


Figure 37. Waterhemp residual efficacy ratings for trial #19-FON-SB11 27 days after treatment (DAT). Bars indicate the average % control \pm the standard deviation of four replications following a PRE herbicide application. Treatments are grouped and colored by herbicide sites of action (SOA). The dashed line indicates 90% control.

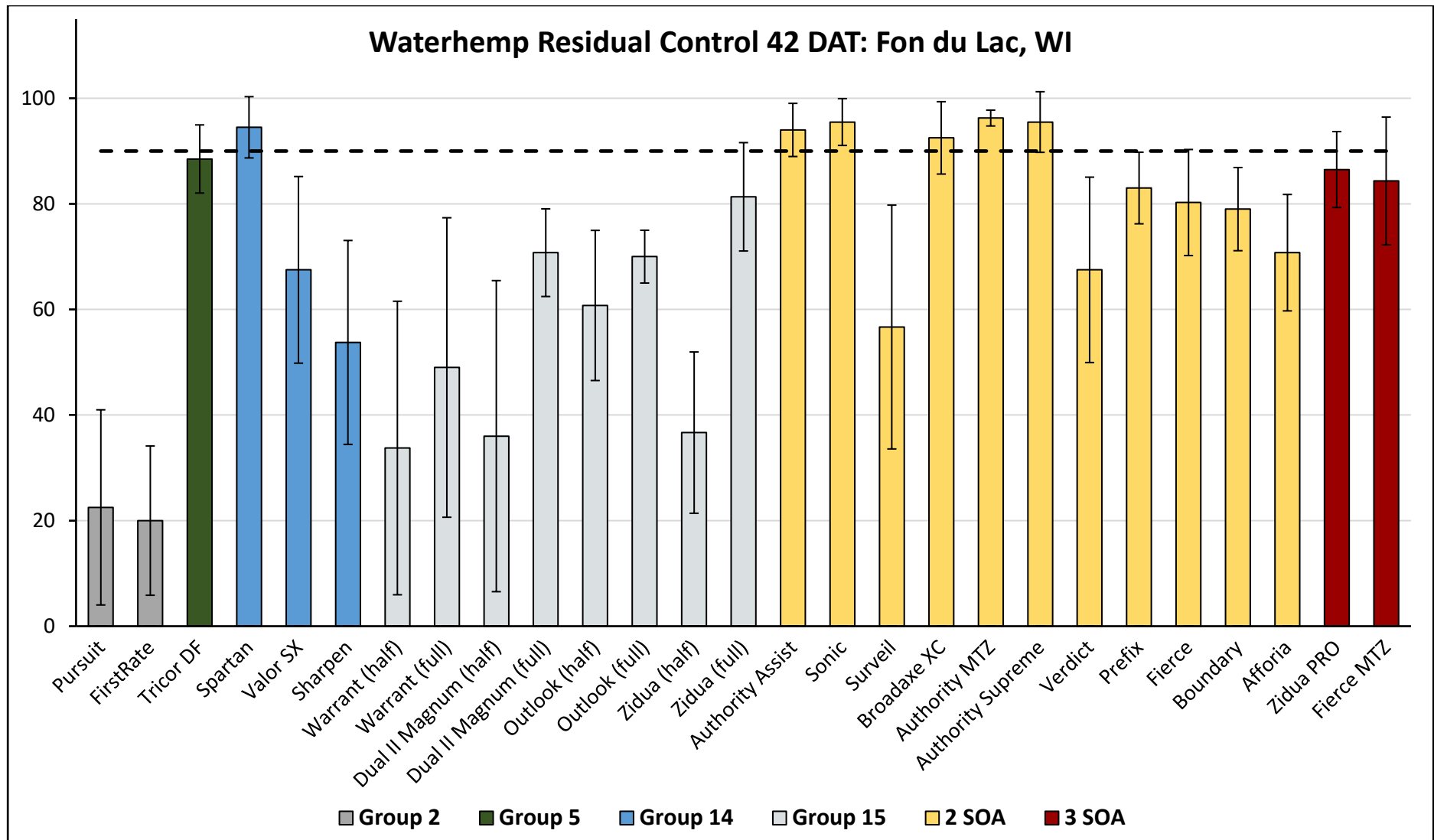


Figure 38. Waterhemp residual efficacy ratings for trial #19-FON-SB11 42 days after treatment (DAT). Bars indicate the average % control \pm the standard deviation of four replications following a PRE herbicide application. Treatments are grouped and colored by herbicide sites of action (SOA). The dashed line indicates 90% control.

Project Goal: Determine the utility of layering residual herbicides for waterhemp control in soybean.

Site Description:

Location:	Brooklyn, WI	Crop:	LLGT27 Soybean
Field #:	OB-1	Variety:	O'Briens OS-2519LLGT27
Soil type:	Kegonsa loam	Planting Date:	5/31
% OM:	2	Emergence Date:	-
pH:	7.1	Population:	140,000 seeds/acre
Fertilization:	none	Depth:	1
Previous crop:	Soybean	Row spacing:	30 in
Tillage:	conventional	Plot Size:	10 x 30 ft
Weed species:	glyphosate resistant common waterhemp (AMATA), common lambsquarters (CHEAL), fall panicum (PANDI), wild proso millet (PANMI)		

Herbicide Application Information:

Date:	6/3	6/27
Treatment:	PRE (A)	POST (B)
Air Temp (°F):	71	82
2" Soil Temp (°F):	68	72
Soil moisture [surface]:	moist	dry
RH %:	46	58
Cloud cover %	100	2
Wind speed (mph)/direction	2-8/E	1-4/NE
Rainfall (in) 1 wk after APP:	0.41	1.68
GPA:	15	15
PSI:	26	36
Nozzle:	XRFF11002	AIXR110015
Nozzle spacing (in):	20	20
Boom Height (in):	20	23

Crop and Weed Information at Application:

	Date:	6/3	6/27
Soybean	Height (in):	-	3
	Stage:	-	V2
AMATA	Height (in):	-	0.5-1
	Density:	-	4-10 ft ²

Project Goal: Determine the utility of layering residual herbicides for waterhemp control in soybean.

Site Description:

Location:	Lancaster, WI	Crop:	LLGT27 Soybean
Field #:	Home 11A-I	Variety:	Credenz CZ 2069 LLGT
Soil type:	Arenzville silt loam	Planting Date:	6/3
% OM:	2.6	Emergence Date:	-
pH:	7.5	Population:	140,000 seeds/acre
Fertilization:	none	Depth:	1.5 in
Previous crop:	corn	Row spacing:	30 in
Tillage:	conventional	Plot Size:	10 x 30 ft
Weed species:	common waterhemp (AMATA)		

Herbicide Application Information:

Date:	6/6	7/5
Treatment:	PRE (A)	POST (B)
Air Temp (°F):	82	86
2" Soil Temp (°F):	86	98
Soil moisture [surface]:	wet	dry
RH %:	60	60
Cloud cover %	50	40
Wind speed (mph)/direction	3/NW	2-4/NNE
Rainfall (in) 1 wk after APP:	0.68	0.73
GPA:	15	15
PSI:	25	25
Nozzle:	XRFF11002	XRFF11002
Nozzle spacing (in):	20	20
Boom Height (in):	20	22

Crop and Weed Information at Application:

	Date:	6/6	7/5
Soybean	Height (in):	-	10
	Stage:	-	V4
AMATA	Height (in):	-	0.5-16
	Density:	-	0-5/ft ²

Trt #	Treatment	Formulation	SOA Group	Rate	App Timing	App Code
1	Authority MTZ	45% w/w	5, 14	12 oz/a	A	PRE
2	Authority MTZ	45% w/w	5, 14	12 oz/a	A	PRE
	Liberty	2.34 lb/gal	10	32 fl oz/a	B	POST
	AMS			2 lb/a	B	POST
3	Authority MTZ	45% w/w	5, 14	12 oz/a	A	PRE
	Pursuit	2 lb/gal	2	4 fl oz/a	B	POST
	Liberty	2.34 lb/gal	10	32 fl oz/a	B	POST
	AMS			2 lb/a	B	POST
4	Authority MTZ	45% w/w	5, 14	12 oz/a	A	PRE
	Flexstar	1.88 lb/gal	14	1 pt/a	B	POST
	Liberty	2.34 lb/gal	10	32 fl oz/a	B	POST
	AMS			2 lb/a	B	POST
5	Authority MTZ	45% w/w	5, 14	12 oz/a	A	PRE
	Warrant	3 lb/gal	15	48 fl oz/a	B	POST
	Liberty	2.34 lb/gal	10	32 fl oz/a	B	POST
	AMS			2 lb/a	B	POST
6	Authority MTZ	45% w/w	5, 14	12 oz/a	A	PRE
	Dual II Magnum	7.64 lb/gal	15	1.25 pt/a	B	POST
	Liberty	2.34 lb/gal	10	32 fl oz/a	B	POST
	AMS			2 lb/a	B	POST
7	Authority MTZ	45% w/w	5, 14	12 oz/a	A	PRE
	Outlook	6 lb/gal	15	10 fl oz/a	B	POST
	Liberty	2.34 lb/gal	10	32 fl oz/a	B	POST
	AMS			2 lb/a	B	POST
8	Authority MTZ	45% w/w	5, 14	12 oz/a	A	PRE
	Zidua	85% w/w	15	1.5 oz/a	B	POST
	Liberty	2.34 lb/gal	10	32 fl oz/a	B	POST
	AMS			2 lb/a	B	POST
9	Authority MTZ	45% w/w	5, 14	12 oz/a	A	PRE
	Prefix	5.3 lb/gal	14, 15	2 pt/a	B	POST
	Liberty	2.34 lb/gal	10	32 fl oz/a	B	POST
	AMS			2 lb/a	B	POST
10	Authority MTZ	45% w/w	5, 14	12 oz/a	A	PRE
	Warrant Ultra	3.45 lb/gal	14, 15	50 fl oz/a	B	POST
	Liberty	2.34 lb/gal	10	32 fl oz/a	B	POST
	AMS			2 lb/a	B	POST

Trial Summary:

This study was a joint effort between the [UW-Madison Nutrient and Pest Management Program](#) (NPM; Dan Smith and Richard Proost) and the WiscWeed team. This trial was conducted on two grower's fields with natural infestations of waterhemp in Brooklyn and Lancaster, WI. The Brooklyn waterhemp population was known to be glyphosate resistant. A LLGT27 soybean variety was chosen so that Liberty could be used as part of the POST herbicide program.

Key Take Home Points from 2019 Data:

- The PRE application of Authority MTZ provided ~80-90% control at the time of POST application (data not shown)
- 2019 results indicate that the addition of a group 15 herbicide at the POST application did not improve late season waterhemp control relative to Liberty applied alone at either location (Figures 39, 41)
- The addition of fomesafen, an active ingredient in Flexstar, Prefix, and Warrant Ultra, to the tank at the POST application improved waterhemp control at Brooklyn, WI relative to Liberty applied alone or in tank mixes with other herbicides (Figure 39).
- Yield was significantly affected by herbicide program at Brooklyn (Figure 40).
 - Largely driven by the low yield of the PRE only treatment
 - Yield of PRE followed by POST herbicide programs were similar.
- Yield was not taken at the Lancaster site due to heavy rains that flooded the trial area.

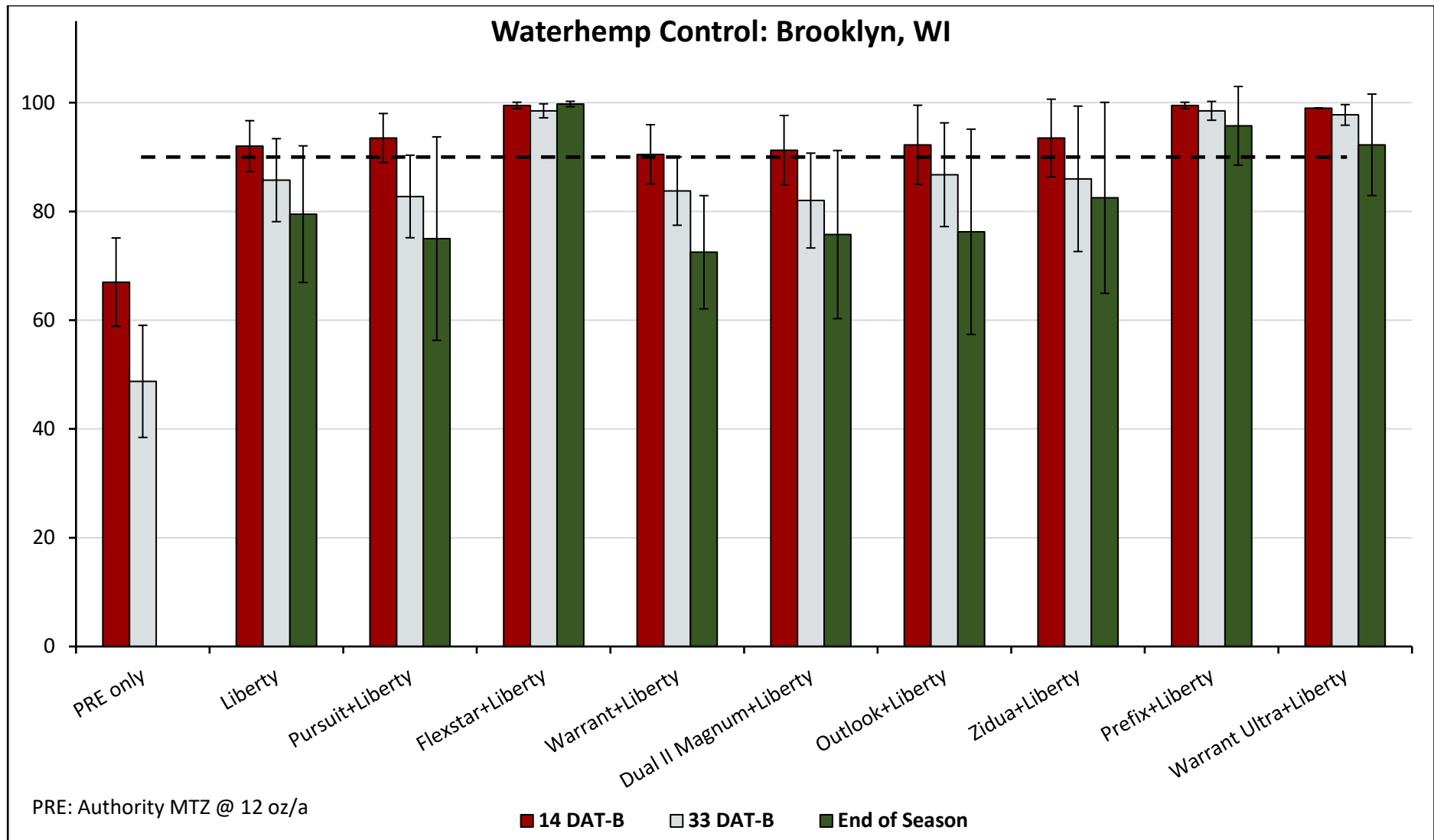


Figure 39. Waterhemp efficacy ratings for trial #19-BRO-SB12. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Products along the x axis were applied POST with AMS, see treatment list for rates. The dashed line indicates 90% control.

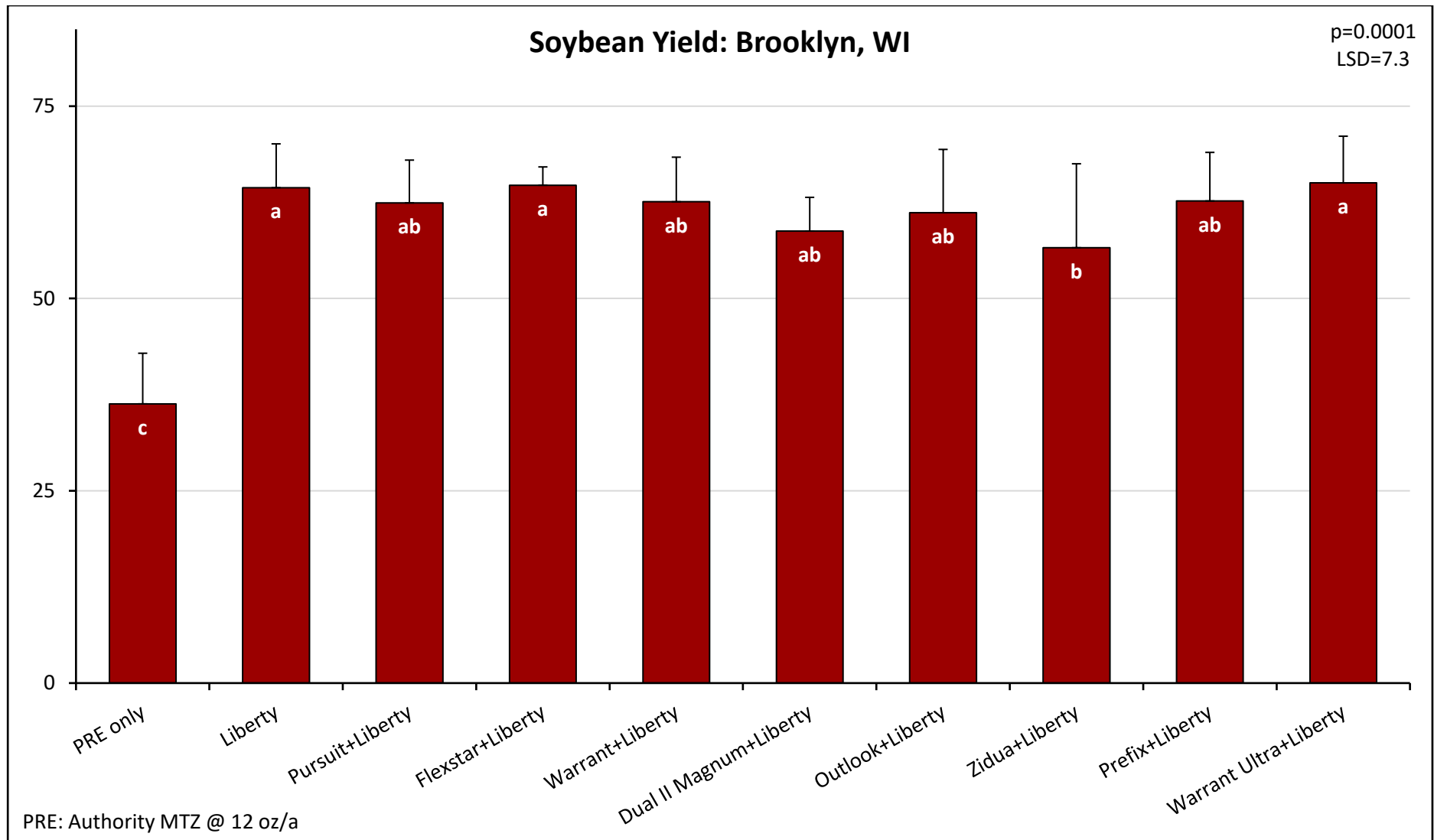


Figure 40. Grain yield for trial #19-BRO-SB12. Bars indicate the average yield in bushels per acre + the standard deviation of four replications. Products along the x axis were applied POST with AMS, see treatment list for rates. Bars with the same letter are not significantly different (p=0.0001).

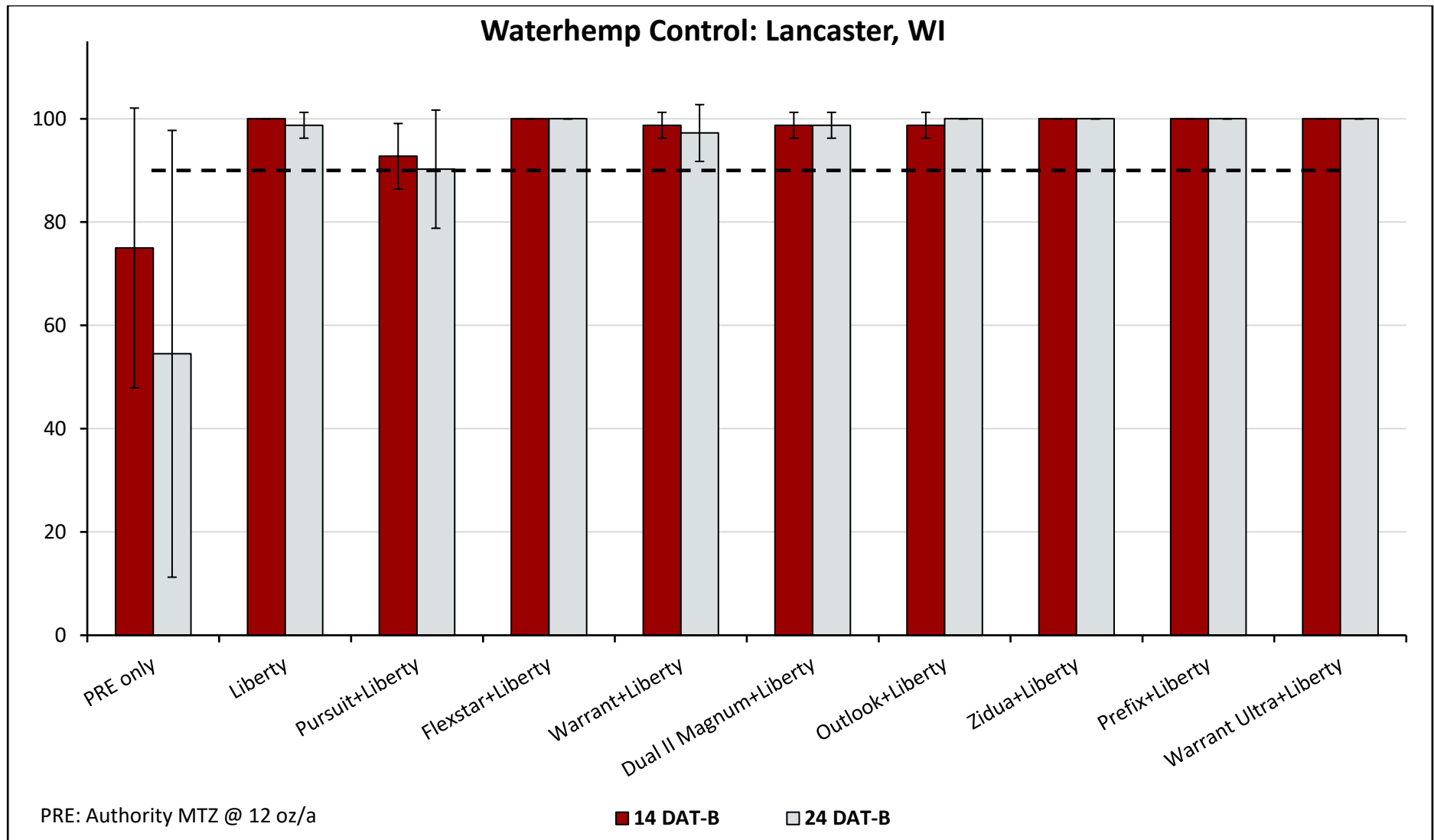


Figure 41. Waterhemp efficacy ratings for trial #19-LAN-SB12. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Products along the x axis were applied POST with AMS, see treatment list for rates. The dashed line indicates 90% control.

Project Goal: Evaluate and demonstrate the value of Liberty in the Enlist soybean weed control system.

Site Description:

Location:	Brooklyn, WI	Crop:	Enlist Soybean
Field #:	OB-1	Variety:	-
Soil type:	Kegonsa loam	Planting Date:	6/3
% OM:	2	Emergence Date:	-
pH:	7.1	Population:	140,000 seeds/acre
Fertilization:	none	Depth:	1.25
Previous crop:	Soybean	Row spacing:	30 in
Tillage:	conventional	Plot Size:	10 x 30 ft
Weed species:	glyphosate resistant common waterhemp (AMATA), common lambsquarters (CHEAL), fall panicum (PANDI), wild proso millet (PANMI)		

Herbicide Application Information:

Date:	6/4	7/1	7/18
Treatment:	PRE (A)	EPOST (B)	LPOST (C)
Air Temp (°F):	73	88	85
2" Soil Temp (°F):	61	80	84
Soil moisture [surface]:	very wet	wet	wet
RH %:	78	50	75
Cloud cover %	100	50	35
Wind speed (mph)/direction	1-5/SE	2-4/SW	2-6/SW
Rainfall (in) 1 wk after APP:	0.48	5.8	0.56
GPA:	15	15	15
PSI:	26	36	36
Nozzle:	XRFF11002	AIXR110015	AIXR110015
Nozzle spacing (in):	20	20	20
Boom Height (in):	20	23	26

Crop and Weed Information at Application:

	Date:	6/4	7/1	7/18
Soybean	Height (in):	-	2-4	9-11
	Stage:	-	V2	R1
AMATA	Height (in):	-	1-3	1-4
	Density:	-	3-7/ft ²	5-46/ft ²

Trt #	Treatment	Formulation	SOA Group	Rate	App Timing	App Code
1	Check					
2	Verdict	5.57 lb/gal	14, 15	5 fl oz/a	PRE	A
	Enlist Duo	3.3 lbae/gal	4, 9	3.5 pt/a	EPOST	B
3	Verdict	5.57 lb/gal	14, 15	5 fl oz/a	PRE	A
	Liberty	2.34 lb/gal	10	32 fl oz/a	EPOST	B
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	EPOST	B
	AMS			3 lb/a	EPOST	B
4	Verdict	5.57 lb/gal	14, 15	5 fl oz/a	PRE	A
	Enlist One	3.8 lbae/gal	4	24 fl oz/a	EPOST	B
	Liberty	2.34 lb/gal	10	32 fl oz/a	EPOST	B
	AMS			3 lb/a	EPOST	B
5	Verdict	5.57 lb/gal	14, 15	5 fl oz/a	PRE	A
	Enlist One	3.8 lbae/gal	4	24 fl oz/a	EPOST	B
	Liberty	2.34 lb/gal	10	32 fl oz/a	EPOST	B
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	EPOST	B
	AMS			3 lb/a	EPOST	B
6	Verdict	5.57 lb/gal	14, 15	5 fl oz/a	PRE	A
	Liberty	2.34 lb/gal	10	32 fl oz/a	EPOST	B
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	EPOST	B
	AMS			3 lb/a	EPOST	B
	Enlist Duo	3.3 lbae/gal	4, 9	3.5 pt/a	LPOST	C
7	Verdict	5.57 lb/gal	14, 15	5 fl oz/a	PRE	A
	Enlist Duo	3.3 lbae/gal	4, 9	3.5 pt/a	EPOST	B
	Liberty	2.34 lb/gal	10	32 fl oz/a	LPOST	C
	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	LPOST	C
	AMS			3 lb/a	LPOST	C

Trial Summary:

Soybean emergence was very poor due to heavy rains following planting. Soybean canopy development was very poor throughout the year due to poor emergence and wet conditions. There was no observable soybean injury from the EPOST herbicides 8 days after application. (data not shown). All herbicide treatments were effective at controlling common lambsquarters and grass species throughout the entire season (>95% control at all ratings). Waterhemp control varied at all rating dates (Figure 42). All treatments with Liberty initially had very good control (>95%) 8 days after the EPOST application. However, there was some waterhemp regrowth and new emergers after application, which led to poor end-of-season waterhemp control in the 2-pass programs. Adding Enlist with Liberty improved control when compared to the Liberty + Roundup tank mix, since the waterhemp population was glyphosate resistant. A 3-pass program was necessary to achieve acceptable levels of control at the end of the season. Yield data was not collected due to the poor and uneven soybean emergence and growth.

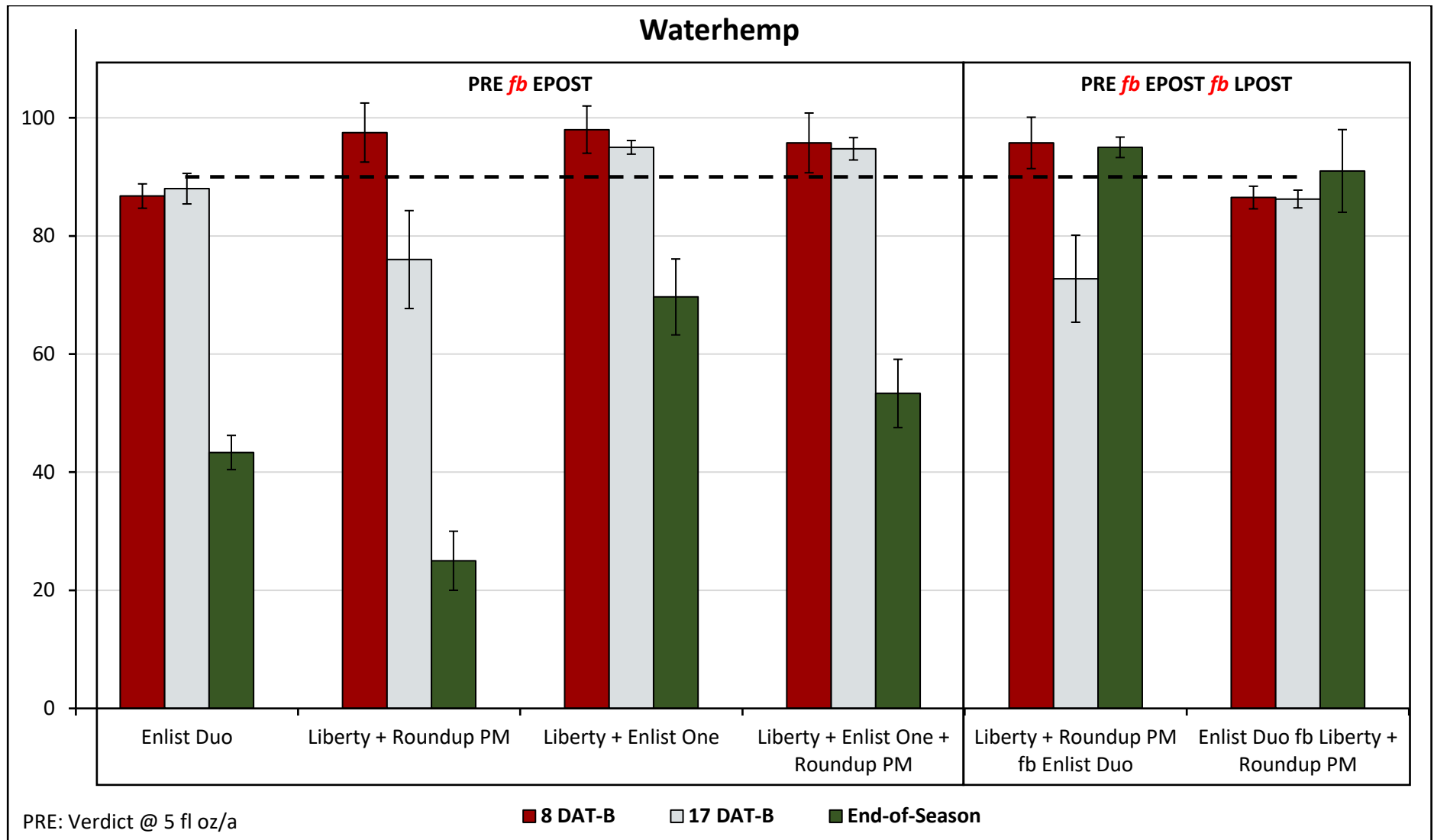


Figure 42. Waterhemp efficacy ratings for trial #19-BRO-SB17. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Products along the x axis were applied EPOST and/or LPOST, see treatment list for rates. The dashed line indicates 90% control.

Project Goal: Evaluate the efficacy and crop safety of Valent herbicides in a Liberty Link system.

Site Description:

Location:	Brooklyn, WI	Crop:	LLGT27 Soybean
Field #:	OB-1	Variety:	O'Briens OS-2519LLGT27
Soil type:	Kegonsa loam	Planting Date:	5/31
% OM:	2	Emergence Date:	-
pH:	7.1	Population:	140,000 seeds/acre
Fertilization:	-	Depth:	1
Previous crop:	Soybean	Row spacing:	30 in
Tillage:	Conventional	Plot Size:	10 x 30 ft
Weed species:	glyphosate resistant waterhemp (AMATA), common lambsquarters (CHEAL), velvetleaf (ABUTH), fall panicum (PANDI), wild proso millet (PANMI)		

Herbicide Application Information:

Date:	6/3	6/27	7/1	7/11
Treatment:	PRE (A)	EPOST (B)	POST (C)	LPOST (D)
Air Temp (°F):	71	82	88	77
2" Soil Temp (°F):	69	72	80	79
Soil moisture [surface]:	moist	dry	wet	dry
RH %:	46	58	50	67
Cloud cover %	100	2	50	10
Wind speed (mph)/direction	2-8/E	1-4/NE	2-4/SW	2-7/N
Rainfall (in) 1 wk after APP:	0.41	1.68	5.8	1.33
GPA:	15	20	20	20
PSI:	26	36	36	36
Nozzle:	XRFF11002	AIXR110015	AIXR110015	AIXR110015
Nozzle spacing (in):	20	20	20	20
Boom Height (in):	20	23	23	25

Crop and Weed Information at Application:

	Date:	6/3	6/27	7/1	7/11
Soybean	Height (in):	-	2.5	5	9
	Stage:	-	V2	V3	V6
AMATA	Height (in):	-	1-4	1-4	2-10
	Density:	-	50-85/ft ²	0.5-11/ft ²	9-45/ft ²
CHEAL	Height (in):	-	1-4	-	-
	Density:	-	0.5-6/ft ²	-	-
ABUTH	Height (in):	-	1-4	-	-
	Density:	-	sparse	-	-
Grass	Height (in):	-	1-4	1-3	-
	Density:	-	sparse	0-0.1/ft ²	-

Trt #	Treatment	Formulation	SOA Group	Rate	App Timing	App Code
1	Check					
2	Scout (glufosinate)	2.34 lb/gal	10	32 fl oz/a	EPOST	B
	AMS			3 lb/a	EPOST	B
	Scout (glufosinate)	2.34 lb/gal	10	32 fl oz/a	LPOST	D
	AMS			3 lb/a	LPOST	D
3	Scout (glufosinate)	2.34 lb/gal	10	32 fl oz/a	EPOST	B
	Perpetuo*	2.3 lb/gal	14, 15	6 fl oz/a	EPOST	B
	AMS			3 lb/a	EPOST	B
	Scout (glufosinate)		10	32 fl oz/a	LPOST	D
	AMS	2.34 lb/gal		3 lb/a	LPOST	D
4	Fierce EZ	3.04 lb/gal	14, 15	6 fl oz/a	PRE	A
	Scout (glufosinate)	2.34 lb/gal	10	32 fl oz/a	POST	C
	AMS			3 lb/a	POST	C
5	Fierce MTZ	2.64 lb/gal	5, 14, 15	1 pt/a	PRE	A
	Scout (glufosinate)	2.34 lb/gal	10	32 fl oz/a	POST	C
	AMS			3 lb/a	POST	C
6	Fierce EZ	3.04 lb/gal	14, 15	6 fl oz/a	PRE	A
	Scout (glufosinate)	2.34 lb/gal	10	32 fl oz/a	POST	C
	Perpetuo*	2.3 lb/gal	14, 15	6 fl oz/a	POST	C
	AMS			3 lb/a	POST	C
7	Fierce MTZ	2.64 lb/gal	5, 14, 15	1 pt/a	PRE	A
	Scout (glufosinate)	2.34 lb/gal	10	32 fl oz/a	POST	C
	Perpetuo*	2.3 lb/gal	14, 15	6 fl oz/a	POST	C
	AMS			3 lb/a	POST	C
8	Authority MTZ	45% w/w	5, 14	11 oz/a	PRE	A
	Scout (glufosinate)	2.34 lb/gal	10	32 fl oz/a	POST	C
	Anthem Maxx	4.3 lb/gal	14, 15	2.5 fl oz/a	POST	C
	AMS			3 lb/a	POST	C
9	Zidua PRO	4.09 lb/gal	2, 14, 15	4.5 fl oz/a	PRE	A
	Scout (glufosinate)	2.34 lb/gal	10	32 fl oz/a	POST	C
	Perpetuo*	2.3 lb/gal	14, 15	6 fl oz/a	POST	C
	AMS			3 lb/a	POST	C

*Perpetuo is a new premix from Valent of flumiclorac and pyroxasulfone. Perpetuo is formulated as a suspension concentrate that contains 0.59 lb flumiclorac and 1.71 lb pyroxasulfone per gallon. Perpetuo is pending EPA registration.

Trial Summary:

There was only minor soybean injury (<3%) observed from the PRE herbicides 22 days after application (data not shown). All treatments provided >90% control of common lambsquarters, velvetleaf, and annual grasses throughout the entire growing season (data not shown). Fierce EZ, Fierce MTZ, and Zidua PRO provided >93% control of waterhemp early in the season, whereas control with Authority MTZ was 86% (Figure 43). Adding a product containing pyroxasulfone to the tank with Scout at the POST application slightly improved waterhemp control at the end of the season. Soybean yield did not differ among the herbicide treatments (data not shown). Yield across all herbicide treatments was 73 bu/acre, while the untreated check was 32 bu/acre, a 56% reduction. While the 2-pass POST only system did provide good control at mid-season and did not lead to a yield reduction, there were escapes that survived and produced seed at the end of the year. A POST only system is also not a recommended strategy for waterhemp management as it places higher selection pressure on a single SOA (glufosinate in this trial), which will likely lead to resistance in the future.

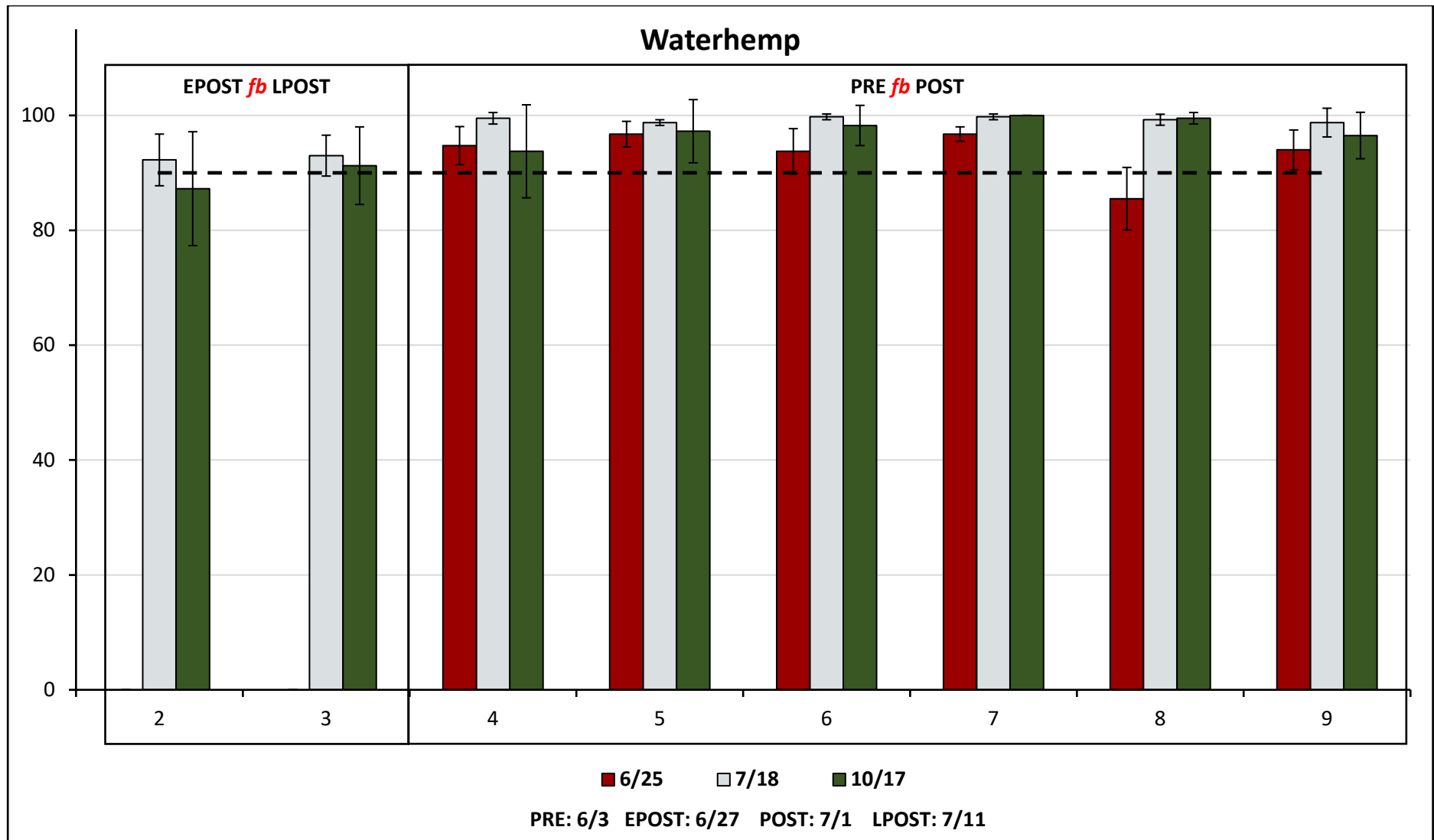


Figure 43. Waterhemp efficacy ratings for trial #19-BRO-SB26. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. The dashed line indicates 90% control.

Project Goal: Evaluate commonly used burndown herbicide programs applied in the fall and the spring for control of dandelion.

Site Description:

Location:	Arlington, WI	Crop:	none
Field #:	451	Variety:	-
Soil type:	Plano silt loam	Planting Date:	-
% OM:	3.3	Emergence Date:	-
pH:	6.9	Population:	-
Fertilization:	none	Depth:	-
Previous crop:	fallow	Row spacing:	-
Tillage:	no-till	Plot Size:	10 x 25 ft
Weed species:	dandelion (TAROF), mouse-ear chickweed (CERVU)		

Herbicide Application Information:

Date:	10/23/18	4/23/19
Treatment:	Fall	Spring
Air Temp (°F):	55	68
2" Soil Temp (°F):	50	70
Soil moisture [surface]:	moist	moist
RH %:	53	29
Cloud cover %	0	10
Wind speed (mph)/direction	4-7/NW	3-8/NNW
Rainfall (in) 1 wk after APP:	0.11	0.52
GPA:	15	15
PSI:	30	37
Nozzle:	TTI 110015	TTI 110015
Nozzle spacing (in):	20	20
Boom Height (in):	20	22

Crop and Weed Information at Application:

	Date:	10/23/18	4/23/19
TAROF	Height (in):		1-6
	Density:	4-8/ft ²	9-18/ft ²
CERVU	Height (in):		0.25-1
	Density:	0-4/ft ²	0-32/ft ²

Trt #	Treatment	Formulation	SOA Group	Rate	App Timing	App Code
1	Check					
2	Roundup PowerMAX AMS	4.5 lbae/gal	10	22 fl oz/a 2.5% v/v	Fall Fall	A A
3	Roundup PowerMAX AMS	4.5 lbae/gal	10	22 fl oz/a 2.5% v/v	Spring Spring	B B
4	Roundup PowerMAX 2,4-D amine* COC AMS	4.5 lbae/gal 3.8 lbae/gal	10 4	22 fl oz/a 1 pt/a 1% v/v 2.5% v/v	Fall Fall Fall Fall	A A A A
5	Roundup PowerMAX 2,4-D amine* COC AMS	4.5 lbae/gal 3.8 lbae/gal	10 4	22 fl oz/a 1 pt/a 1% v/v 2.5% v/v	Spring Spring Spring Spring	B B B B
6	Roundup PowerMAX Clarity COC AMS	4.5 lbae/gal 4 lbae/gal	10 4	22 fl oz/a 1 pt/a 1% v/v 2.5% v/v	Fall Fall Fall Fall	A A A A
7	Roundup PowerMAX Clarity COC AMS	4.5 lbae/gal 4 lbae/gal	10 4	22 fl oz/a 1 pt/a 1% v/v 2.5% v/v	Spring Spring Spring Spring	B B B B
8	Roundup PowerMAX 2,4-D amine* Clarity COC AMS	4.5 lbae/gal 3.8 lbae/gal 4 lbae/gal	10 4 4	22 fl oz/a 1 pt/a 1 pt/a 1% v/v 2.5% v/v	Fall Fall Fall Fall Fall	A A A A A
9	Roundup PowerMAX 2,4-D amine* Clarity COC AMS	4.5 lbae/gal 3.8 lbae/gal 4 lbae/gal	10 4 4	22 fl oz/a 1 pt/a 1 pt/a 1% v/v 2.5% v/v	Spring Spring Spring Spring Spring	B B B B B
10	Roundup PowerMAX Tricor DF AMS	4.5 lbae/gal 75% w/w	10 5	22 fl oz/a 4 oz/a 2.5% v/v	Fall Fall Fall	A A A
11	Roundup PowerMAX Tricor DF AMS	4.5 lbae/gal 75% w/w	10 5	22 fl oz/a 4 oz/a 2.5% v/v	Spring Spring Spring	B B B

Adjuvants: AMS=Amsol, COC=Crop Oil

*2,4-D amine = Weedar 64

Trt #	Treatment	Formulation	SOA Group	Rate	App Timing	App Code
12	Roundup PowerMAX	4.5 lbae/gal	10	22 fl oz/a	Fall	A
	2,4-D amine*	3.8 lbae/gal	4	1 pt/a	Fall	A
	Tricor DF	75% w/w	5	4 oz/a	Fall	A
	COC			1% v/v	Fall	A
	AMS			2.5% v/v	Fall	A
13	Roundup PowerMAX	4.5 lbae/gal	10	22 fl oz/a	Spring	B
	2,4-D amine*	3.8 lbae/gal	4	1 pt/a	Spring	B
	Tricor DF	75% w/w	5	4 oz/a	Spring	B
	COC			1% v/v	Spring	B
	AMS			2.5% v/v	Spring	B
14	Roundup PowerMAX	4.5 lbae/gal	10	22 fl oz/a	Fall	A
	Clarity	4 lbae/gal	4	1 pt/a	Fall	A
	Tricor DF	75% w/w	5	4 oz/a	Fall	A
	COC			1% v/v	Fall	A
	AMS			2.5% v/v	Fall	A
15	Roundup PowerMAX	4.5 lbae/gal	10	22 fl oz/a	Spring	B
	Clarity	4 lbae/gal	4	1 pt/a	Spring	B
	Tricor DF	75% w/w	5	4 oz/a	Spring	B
	COC			1% v/v	Spring	B
	AMS			2.5% v/v	Spring	B
16	Roundup PowerMAX	4.5 lbae/gal	10	22 fl oz/a	Fall	A
	2,4-D amine*	3.8 lbae/gal	4	1 pt/a	Fall	A
	Clarity	4 lbae/gal	4	1 pt/a	Fall	A
	Tricor DF	75% w/w	5	4 oz/a	Fall	A
	COC			1% v/v	Fall	A
	AMS			2.5% v/v	Fall	A
17	Roundup PowerMAX	4.5 lbae/gal	10	22 fl oz/a	Spring	B
	2,4-D amine*	3.8 lbae/gal	4	1 pt/a	Spring	B
	Clarity	4 lbae/gal	4	1 pt/a	Spring	B
	Tricor DF	75% w/w	5	4 oz/a	Spring	B
	COC			1% v/v	Spring	B
	AMS			2.5% v/v	Spring	B

Adjuvants: AMS=Amsol, COC=Crop Oil

*2,4-D amine = Weedar 64

Trial Summary:

This trial was established to evaluate commonly used burndown herbicide programs applied in the fall and the spring for control of winter annuals. Dandelion was the predominant species in the trial area. Mouse-ear chickweed was also present in the study area. Weed control ratings were taken approximately 21 days after both the fall and spring herbicide application timings.

Fall Rating: The Roundup + Clarity tank mix resulted in the best dandelion control (Figure 44). The addition of metribuzin did not enhance dandelion control; however, it did improve the control of mouse-ear chickweed.

Spring Rating: Dandelion control exceeded 90% for all fall applied treatments; however, none of the spring applied treatments provided greater than 60% control (Figure 45). The Roundup + Clarity tank mix again resulted in the best dandelion control among the spring applied treatments. All treatments, both fall and spring, provided satisfactory control of mouse-ear chickweed.

Data from this trial suggests that dandelion control is greater with fall burndown applications. If it is not possible to make an effective herbicide application in the fall, increasing the rate of glyphosate would likely enhance the control of established dandelion with a spring burndown application.

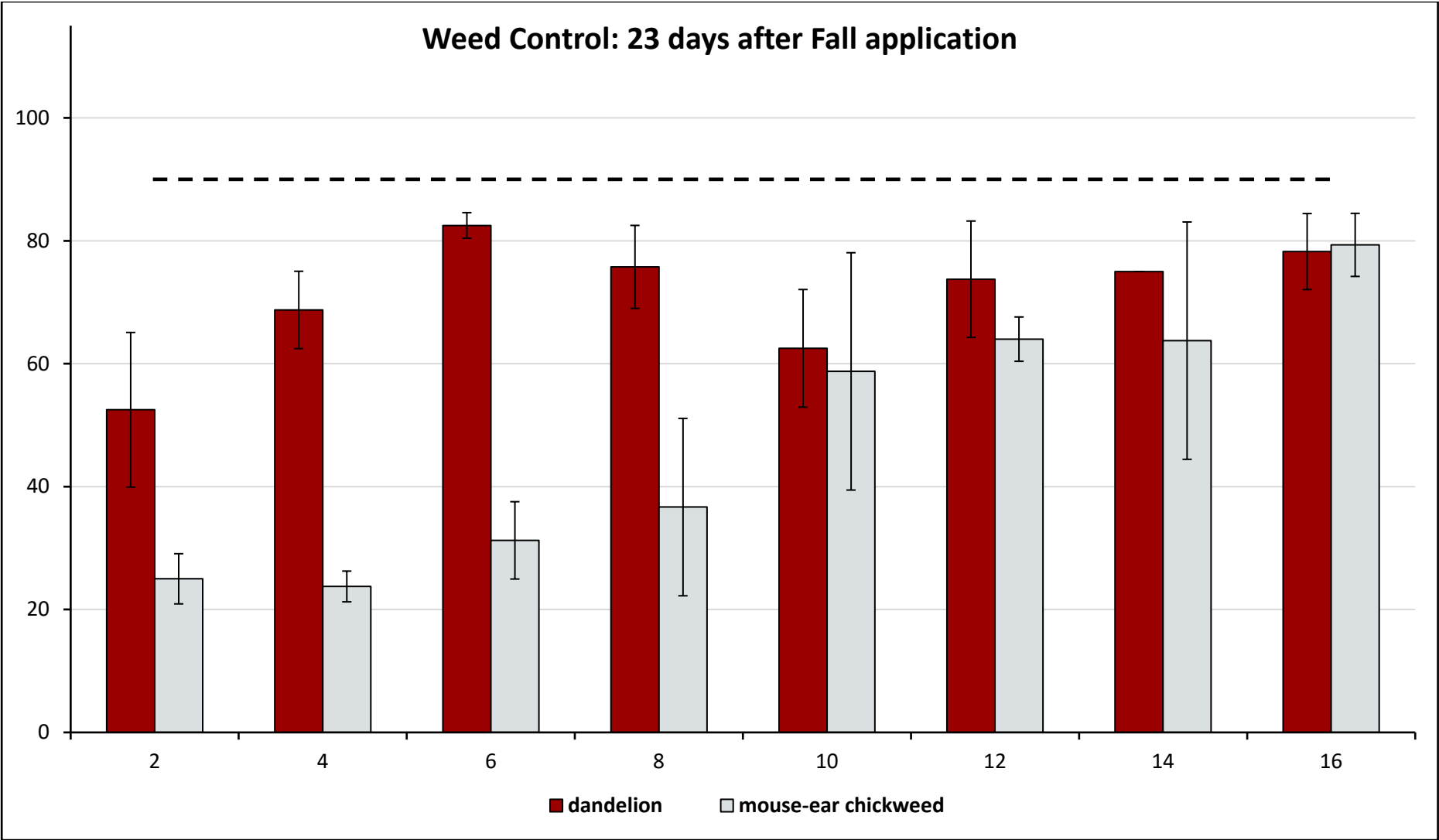


Figure 44. Efficacy ratings for trial #19-ARL-BG01. Bars indicate the average % control \pm the standard deviation of four replications following a fall herbicide application. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. Only treatments that were applied in the fall are shown. The dashed line indicates 90% control.

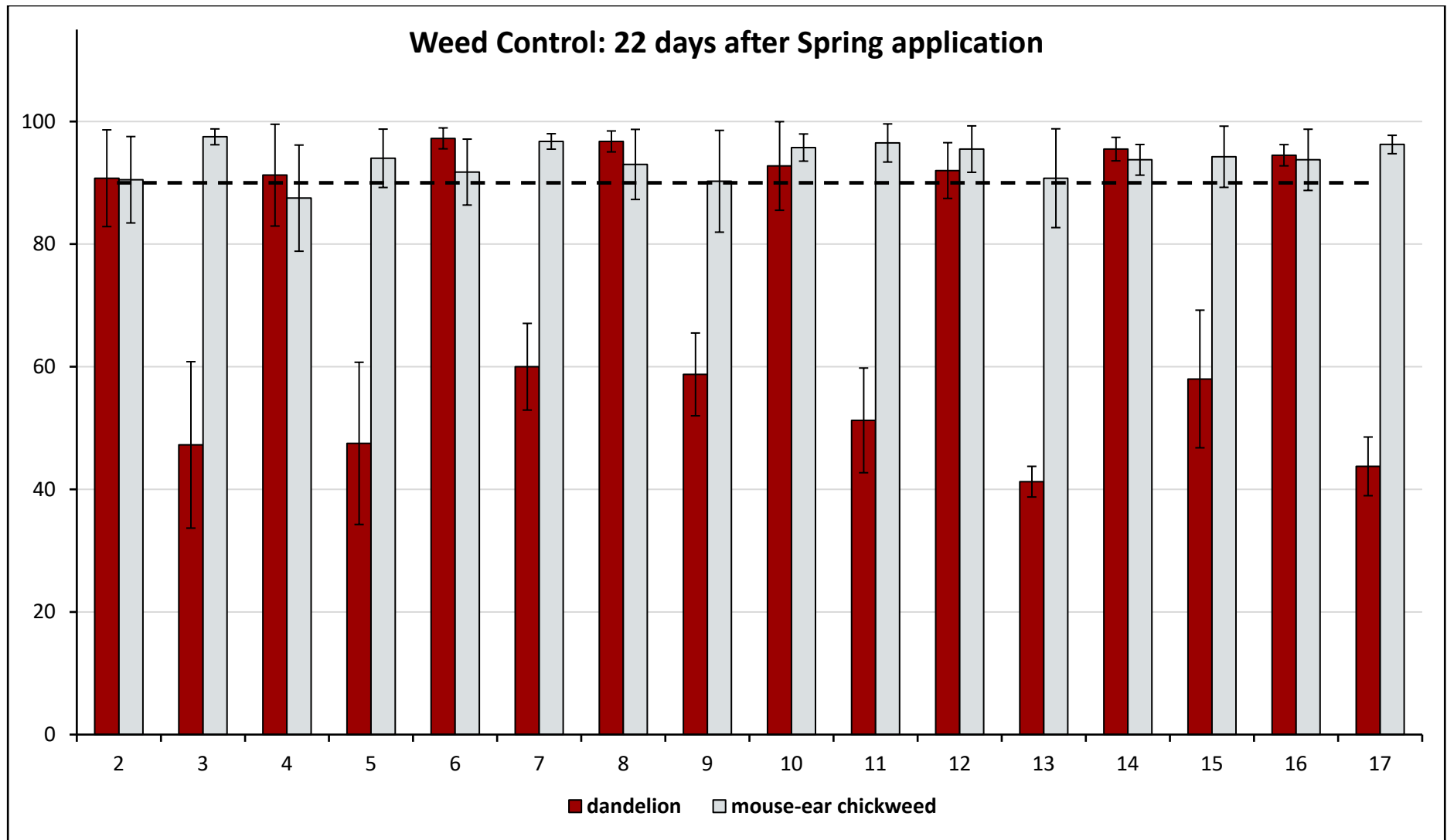


Figure 45. Efficacy ratings for trial #19-ARL-BG01. Bars indicate the average % control \pm the standard deviation of four replications following herbicide applications. Numbers on the x-axis correspond to the herbicide treatment list for the respective trial number. Odd treatment numbers are the same as the previous even numbered treatment except applied in the spring. The dashed line indicates 90% control.

Project Goal: Evaluate the burndown efficacy of Engenia, Enlist One, and Liberty on various broadleaf weed species.

Site Description:

Location:	Arlington, WI	Crop:	none
Field #:	360	Variety:	-
Soil type:	Plano silt loam	Planting Date:	-
% OM:	3.4	Emergence Date:	-
pH:	6.6	Population:	-
Fertilization:	-	Depth:	-
Previous crop:	corn	Row spacing:	-
Tillage:	conventional	Plot Size:	10 x 25 ft
Weed species:	common ragweed (AMBEL), common lambsquarters (CHEAL), velvetleaf (ABUTH), eastern black nightshade (SOLPT), smartweed (POLPE)		

Herbicide Application Information:

Date:	7/12
Treatment:	POST (A)
Air Temp (°F):	79
2" Soil Temp (°F):	75
Soil moisture [surface]:	dry
RH %:	58
Cloud cover %	0
Wind speed (mph)/direction	4-8/W
Rainfall (in) 1 wk after APP:	2.51
GPA:	15
PSI:	36
Nozzle:	Trts 2,3: TTI 110015 Trt 4: AIXR 110015
Nozzle spacing (in):	20
Boom Height (in):	26

Crop and Weed Information at Application:

	Date:	7/12
AMBEL	Height (in):	3-9
	Density:	1-2/ft ²
CHEAL	Height (in):	1-5
	Density:	1-7/ft ²
ABUTH	Height (in):	2-4
	Density:	0.1-1/ft ²
SOLPT	Height (in):	2-5
	Density:	0-1/ft ²
POLPE	Height (in):	2-4
	Density:	0-4/ft ²

Trt #	Treatment	Formulation	SOA Group	Rate	App Timing	App Code
1	Check					
2	Engenia NIS	5 lbae/gal	4	12.8 fl oz/a 0.25% v/v	POST POST	A A
3	Enlist One NIS	3.8 lbae/gal	4	32 fl oz/a 0.25% v/v	POST POST	A A
4	Liberty AMS	2.34 lb/gal	10	32 fl oz/a 2.5 lb/a	POST POST	A A

Adjuvants: NIS=Induce

Trial Summary:

This trial evaluated the burndown efficacy of Engenia, Enlist One, and Liberty on various broadleaf weed species. Efficacy ratings were taken multiple times following the POST application; however only data from 25 DAT is presented (Figure 46). Weed control depended on weed species and the product used. Engenia had >90% control for all species except velvetleaf. Enlist One had very poor eastern black nightshade and smartweed control. Liberty had >90% control for all broadleaf species evaluated. When choosing a product to control emerged weeds it is important to scout the species present in the field.

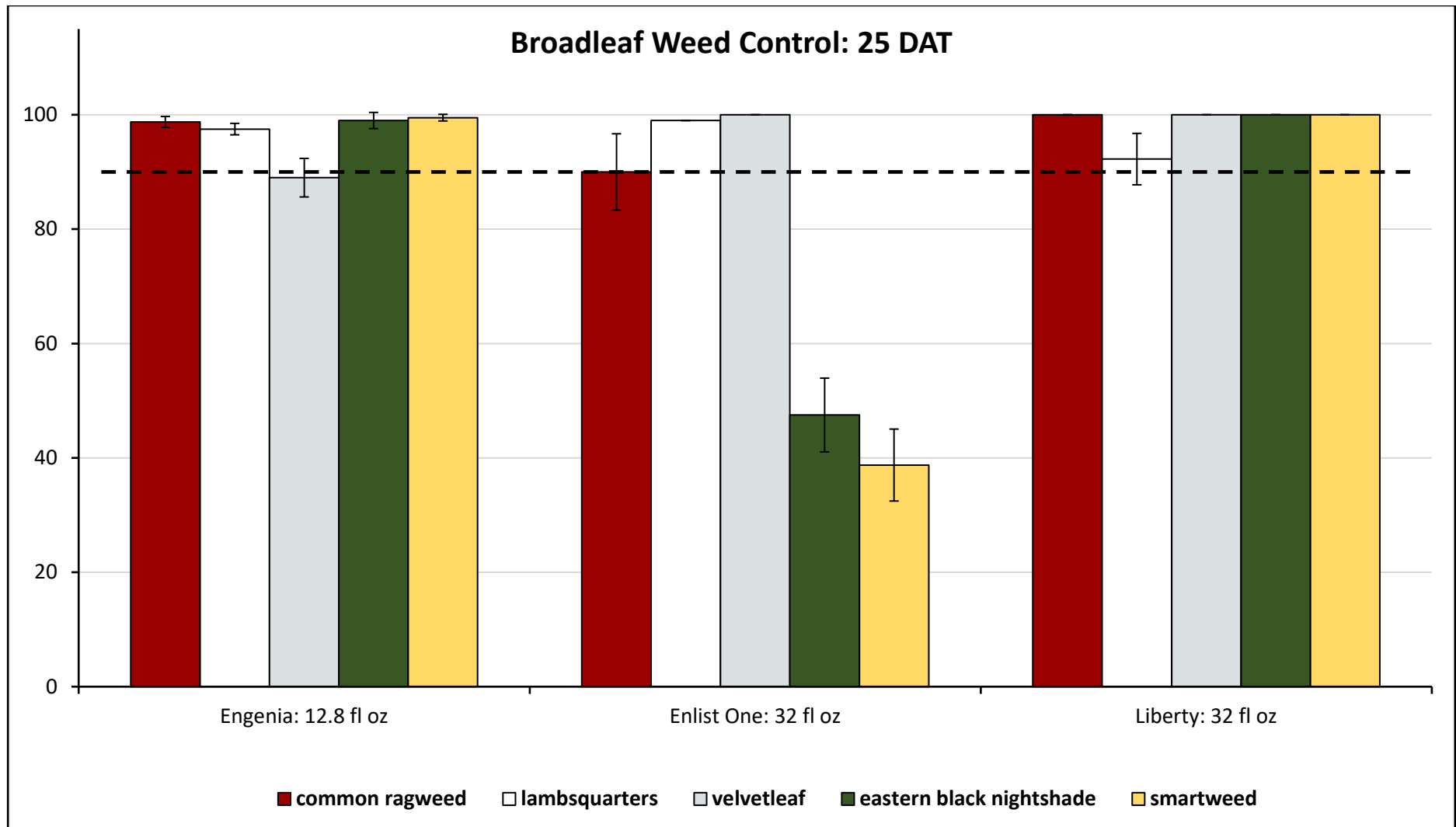


Figure 46. Broadleaf efficacy ratings for trial #19-ARL-BG03. Bars indicate the average % control \pm the standard deviation of four replications 25 days after a POST herbicide application. Products along the x axis were applied POST with appropriate adjuvants, see treatment list for rates. The dashed line indicates 90% control.

Project Goal: Evaluate and demonstrate the effectiveness of multiple single active ingredient postemergence corn and soybean herbicides.

Site Description:

Location:	Brooklyn, WI	Crop:	none
Field #:	OB-1	Variety:	-
Soil type:	Kengonsa silt loam	Planting Date:	-
% OM:	2	Emergence Date:	-
pH:	7.1	Population:	-
Fertilization:	none	Depth:	-
Previous crop:	soybean	Row spacing:	-
Tillage:	conventional	Plot Size:	10 x 25 ft
Weed species:	glyphosate resistant common waterhemp (AMATA)		

Herbicide Application Information:

Date:	6/27
Treatment:	POST (A)
Air Temp (°F):	82
2" Soil Temp (°F):	72
Soil moisture [surface]:	dry
RH %:	58
Cloud cover %	2
Wind speed (mph)/direction	2-4/NE
Rainfall (in) 1 wk after APP:	1.68
GPA:	15
PSI:	35
Nozzle:	TTI 110015
Nozzle spacing (in):	20
Boom Height (in):	23

Crop and Weed Information at Application:

	Date:	6/27
waterhemp	Height (in):	0.5-3
	Density:	60-150/ft ²

Project Goal: Evaluate and demonstrate the effectiveness of multiple single active ingredient postemergence corn and soybean herbicides.

Site Description:

Location:	Lancaster, WI	Crop:	none
Field #:	SIDS-SE	Variety:	-
Soil type:	Fayette silt loam	Planting Date:	-
% OM:	2.5	Emergence Date:	-
pH:	6.8	Population:	-
Fertilization:	none	Depth:	-
Previous crop:	soybean	Row spacing:	-
Tillage:	conventional	Plot Size:	10 x 25 ft
Weed species:	common waterhemp (AMATA)		

Herbicide Application Information:

Date:	7/5
Treatment:	POST (A)
Air Temp (°F):	87
2" Soil Temp (°F):	-
Soil moisture [surface]:	moist
RH %:	60
Cloud cover %	70
Wind speed (mph)/direction	3/NW
Rainfall (in) 1 wk after APP:	0.73
GPA:	15
PSI:	24
Nozzle:	XRFF 11002
Nozzle spacing (in):	20
Boom Height (in):	23

Crop and Weed Information at Application:

	Date:	7/5
waterhemp	Height (in):	1-3
	Density:	-

Trt #	Treatment	Formulation	SOA Group	Rate	App Timing	App Code
1	Pursuit	3 lb/gal	2	4 fl oz/a	POST	A
	COC			1.25% v/v	POST	A
	AMS			2 lb/a	POST	A
2	Classic	25% w/w	2	0.75 oz/a	POST	A
	COC			1% v/v	POST	A
	AMS			2 lb/a	POST	A
3	FirstRate	84% w/w	2	0.3 oz/a	POST	A
	COC			1.2% v/v	POST	A
	AMS			2 lb/a	POST	A
4	Python	80% w/w	2	1 oz/a	POST	A
	COC			1% v/v	POST	A
	AMS			2 lb/a	POST	A
5	XtendiMax	2.89 lbae/gal	4	22 fl oz/a	POST	A
	Class Act Ridion			1% v/v	POST	A
6	Enlist One	3.8 lbae/gal	4	24 fl oz/a	POST	A
	AMS			2 lb/a	POST	A
7	Stinger	3 lbae/gal	4	6 fl oz/a	POST	A
8*	Aatrex	4 lb/gal	5	2 pt/a	POST	A
	COC			1 qt/a	POST	A
9	Buctril	2 lb/gal	6	1.5 pt/a	POST	A
10	Basagran 5L	5 lb/gal	6	1.6 pt/a	POST	A
	COC			1% v/v	POST	A
	AMS			2 lb/a	POST	A
11	Roundup PowerMAX	4.5 lbae/gal	9	32 fl oz/a	POST	A
	AMS			2 lb/a	POST	A
12	Liberty	2.34 lb/gal	10	32 fl oz/a	POST	A
	AMS			2 lb/a	POST	A
13	Cobra	2 lb/gal	14	12.5 fl oz/a	POST	A
	COC			1.5 pt/a	POST	A
	AMS			2 lb/a	POST	A
14	Flexstar	1.88 lb/gal	14	1 pt/a	POST	A
	MSO			1% v/v	POST	A
	AMS			2 lb/a	POST	A
15	Cadet	0.91 lb/gal	14	0.9 fl oz/a	POST	A
	COC			1% v/v	POST	A
	AMS			2 lb/a	POST	A
16	Resource	0.86 lb/gal	14	8 fl oz/a	POST	A
	COC			1 qt/a	POST	A
	AMS			2 lb/a	POST	A

Trt #	Treatment	Formulation	SOA Group	Rate	App Timing	App Code
17	Callisto	4 lb/gal	27	3 fl oz/a	POST	A
	COC			1% v/v	POST	A
	AMS			2 lb/a	POST	A
18	Laudis	3.5 lb/gal	27	3 fl oz/a	POST	A
	MSO			1% v/v	POST	A
	AMS			2 lb/a	POST	A
19	Armezon	2.8 lb/gal	27	0.75 fl oz/a	POST	A
	MSO			1% v/v	POST	A
	AMS			2 lb/a	POST	A
20	Balance Flexx	2 lb/gal	27	5 fl oz/a	POST	A
	MSO			1% v/v	POST	A
	AMS			2 lb/a	POST	A

Adjuvants: COC = Crop Oil; MSO=Premium MSO; Non-AMS water conditioner=Class Act Ridion

*Treatment 8, Aatrex, was not applied at the Brooklyn location due to atrazine restrictions.

Trial Summary:

This study was a joint effort between the [UW-Madison Nutrient and Pest Management Program](#) (NPM; Dan Smith and Richard Proost) and the WiscWeed team. This trial was conducted on a growers fields in Brooklyn, WI with a heavy infestation of waterhemp and at the [UW Lancaster Ag Research Station](#). The Brooklyn waterhemp population was known to be glyphosate resistant, and we suspect the Lancaster population is segregating to be glyphosate resistant. Treatments consisted of postemergence (POST) corn and soybean herbicides containing one active ingredient. Using a single active ingredient or site of action herbicide is not recommended for POST waterhemp control due to resistance concerns. Our intent was not to promote the use of a single herbicide, but rather, demonstrate the value of each herbicide active ingredient for the control of emerged waterhemp. While these results should be taken with a grain of salt (only one year of data), they clearly indicate that POST waterhemp control can be very challenging (Figure 47).

Key Take Home Points from 2019 Data:

- Waterhemp control was generally greater at Lancaster.
 - Much denser population at Brooklyn likely resulted in reduced herbicide interception by smaller plants lower in the weed canopy.
 - Used flat fan nozzles at Lancaster vs. TTIs at Brooklyn. Flat fans provide better coverage.
- Trials will be repeated in 2020 and the appropriate nozzles will be used for each herbicide.
- None of the group 2 or 6 herbicides controlled waterhemp at either location.
- Cobra and Flexstar (group 14) consistently provided the best control at both locations.
- Not all active ingredients within a given SOA group are equal (see groups 4, 14, and 27 data)
- POST herbicide programs containing multiple effective sites of action are recommended to broaden weed control spectrum and to lower selection for additional herbicide resistance.
- Using an effective PRE herbicide to reduce the density and size of waterhemp can help improve POST efficacy

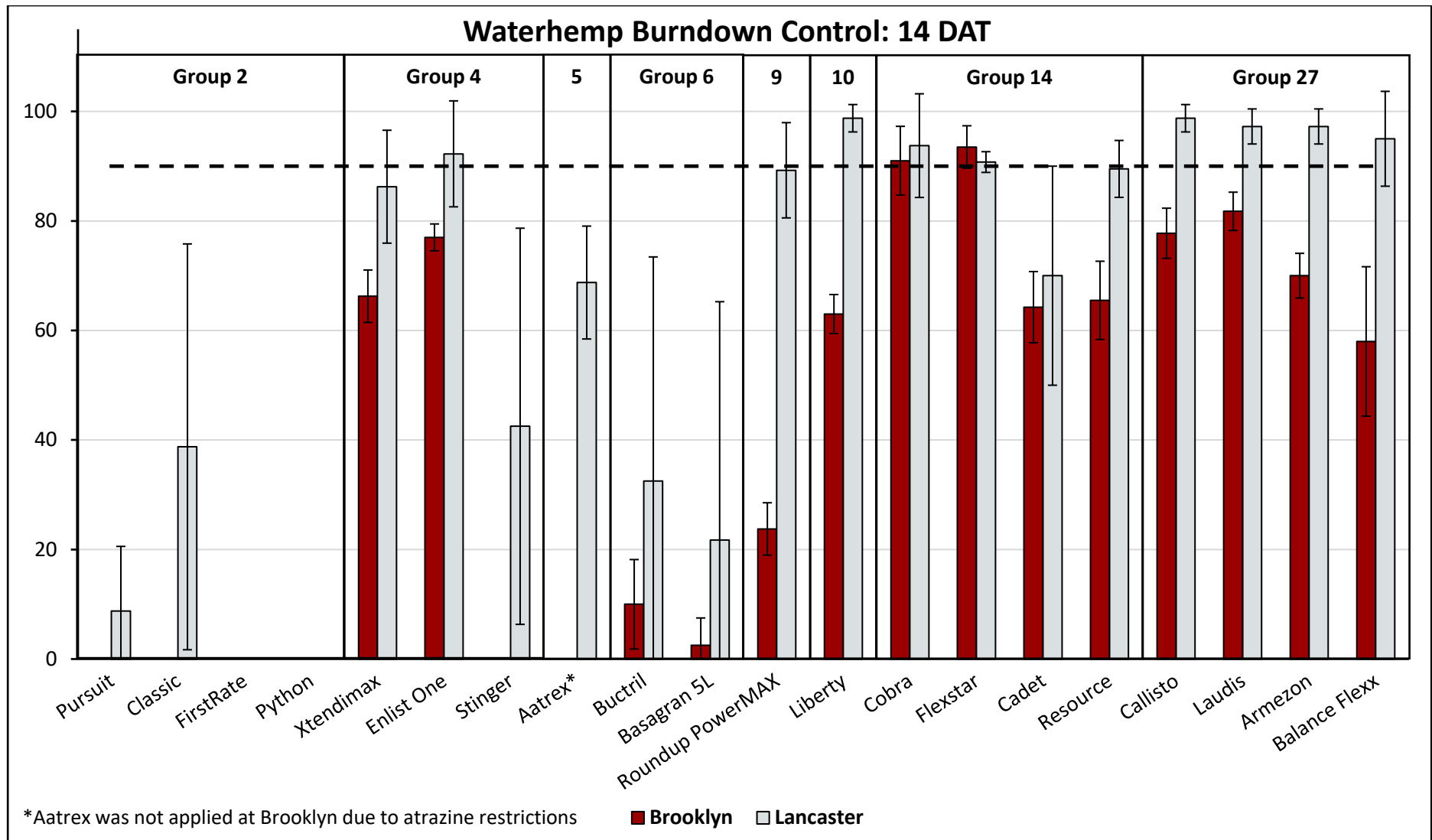


Figure 47. Waterhemp burndown efficacy ratings for trials #19-BRO-BG04 and #19-LAN-BG04 14 days after treatment (DAT). Bars indicate the average % control \pm the standard deviation of four replications following a POST herbicide application. Products along the x axis are grouped by herbicide site of action and were applied with appropriate adjuvants, see treatment list for rates. The dashed line indicates 90% control.

Table 4. 2019 Temperature and Precipitation Summary

Location	Month	Precipitation (in)			Average Temperature (F)		
		2019	30-year norm**	2019 departure	2019*	30-year norm**	2019 departure
Arlington*	May	6.77	3.69	3.08	54.6	55.7	-1.1
	June	5.55	4.68	0.87	65.4	65.6	-0.2
	July	4.63	4.16	0.47	72.8	69.4	3.4
	August	6.02	3.90	2.12	66.0	67.3	-1.3
	September	5.75	3.54	2.21	63.6	59.3	4.3
	Total	28.72	19.97	8.75	-	-	-
Brooklyn* (30-year norm from Stoughton NOAA station)	May	5.92	3.85	2.07	56.2	57.8	-1.6
	June	4.14	4.34	-0.2	67.4	67.4	0
	July	9.98	3.85	6.13	74.5	71.7	2.8
	August	1.24	4.42	-3.18	68.2	69.5	-1.3
	September	7.40	3.60	3.8	65.9	61.2	4.7
	Total	28.69	20.07	8.62	-	-	-
Janesville (30-year norm from Beloit NOAA station)	May	7.27	3.80	3.47	55.6	58.7	-3.1
	June	4.15	4.73	-0.58	67.3	68.6	-1.3
	July	4.12	3.85	0.27	75.5	72.5	3
	August	4.49	4.27	0.22	69.2	70.8	-1.6
	September	11.62	3.65	7.97	65.9	62.9	3
	Total	31.65	20.30	11.35	-	-	-
Lancaster*	May	5.64	4.13	1.51	55.2	57.3	-2.1
	June	4.67	5.26	-0.59	66.8	66.9	-0.1
	July	6.34	4.32	2.02	73.9	70.8	3.1
	August	3.18	4.20	-1.02	67.5	69.0	-1.5
	September	18.57	3.14	15.43	65.0	60.8	4.2
	Total	38.40	21.05	17.35	-	-	-

*2019 data recorded from on-site weather stations. 2019 Janesville data was taken from a NOAA weather station at Rock County Regional Airport.

**Source: Wisconsin State Climatology Office; 30-year normals from 1981 to 2010.

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Index of Weed Species Evaluated

Weed (common name)	Bayer Code	Page Number(s)
chickweed, mouse-ear	CERVU	106, 107
dandelion	TAROF	106, 107
foxtail, giant	SETFA	37, 44, 53, 70
grasses, annual	GGGAN	3, 8, 14, 15, 20, 24, 51, 74, 96, 100
lambsquarters, common	CHEAL	8, 12, 20, 40, 44, 53, 63, 69, 74, 96, 100, 110
nightshade, eastern black	SOLPT	50, 110
pigweed, redroot	AMARE	15
ragweed, common	AMBEL	12, 20, 38, 45, 48, 53, 110
ragweed, giant	AMBTR	4, 9, 21, 32, 57
smartweed	POLPE	110
velvetleaf	ABUTH	8, 12, 23, 26, 39, 44, 49, 53, 64, 74, 100, 110
waterhemp, common	AMATA	27, 33, 34, 57, 62, 68, 74, 75, 82, 83, 84, 85, 86, 87, 92, 94, 97, 101, 115

Index of Adjuvants

Adjuvant Brand	Adjuvant Type	Page Number(s)
Amsol	ammonium sulfate (liquid)	2, 7
Bronc	ammonium sulfate (liquid)	53
Class Act Ridion	water conditioner (non-AMS)	36, 43, 56, 59, 67, 113
Crop Oil	crop oil concentrate	19, 103, 113
Destiny HC	high surfactant methylated seed oil	12
Induce	nonionic surfactant	2, 7, 43
Intact	drift retardant and deposition aid	36, 43, 56, 59, 67
N-PAK	ammonium sulfate (liquid)	36
Prefer 90	nonionic surfactant	12, 19, 109
Premium MSO	methylated seed oil	2, 7, 43, 113
S-Sul	ammonium sulfate (dry)	12, 19, 43, 73, 90, 96, 99, 103, 109, 113
Superb HC	high surfactant petroleum oil concentrate	7, 12

Index of Herbicides Evaluated

Herbicide	Active Ingredient(s)	Page Number(s)
2,4-D amine	2,4-D amine	103
Aatrex/Atrazine4L	atrazine	7, 30, 113
Acuron	bicyclopyrone+mesotrione+ atrazine+S-metolachlor	2, 7, 30
Acuron Flexi	bicyclopyrone + mesotrione + S-metolachlor	12, 19, 30
Afforia	thifensulfuron + tribenuron + flumioxazin	78, 80
Anthem Maxx	pyroxasulfone + fluthiacet	73, 99
Armezon	topramezone	30, 113
Armezon PRO	topramezone + dimethenamid-P	30
Authority Assist	sulfentrazone + imazethapyr	73, 78, 80
Authority Edge*	sulfentrazone + pyroxasulfone	73
Authority First DF	sulfentrazone + cloransulam	47, 73
Authority MTZ	sulfentrazone + metribuzin	47, 78, 80, 90, 99
Authority Supreme	sulfentrazone + pyroxasulfone	73, 78, 80
Balance Flexx	isoxaflutole	2, 12, 30, 113
Basagran 5L	bentazon	113
Bicep Lite II Magnum	S-metolachlor + atrazine	30
Boundary	S-metolachlor + metribuzin	43, 67, 73, 78, 80
Broadaxe XC	S-metolachlor + sulfentrazone	43, 67, 78, 80
Buctril	bromoxynil	113
Cadet	fluthiacet	113
Callisto	mesotrione	12, 30, 113
Callisto Xtra	mesotrione + atrazine	7
Canopy DF	chlorimuron + metribuzin	78
Capreno	tembotrione + thiencazabazone	2, 7, 12, 30
Clarity	dicamba (DGA salt)	19, 103
Classic	chlorimuron-ethyl	78, 113
Cobra	lactofen	59, 113
Corvus	isoxaflutole + thiencazabazone	2, 7, 12, 30
Degree XTRA	acetochlor + atrazine	2
DiFlexx	dicamba (DGA salt)	2, 19, 30
DiFlexx DUO	dicamba + tembotrione	2, 19, 30
Dual II Magnum	S-metolachlor	30, 43, 78, 80, 90
Durango DMA	glyphosate (DMA salt)	53
Engenia	dicamba (BAPMA salt)	59, 67
Engenia PRO*	dicamba + pyroxasulfone	43
Enlist Duo	2,4-D (choline salt) + glyphosate	53, 96
Enlist One	2,4-D (choline salt)	53, 96, 113
Enlite	chlorimuron + thifensulfuron + flumioxazin	78
Fierce	flumioxazin + pyroxasulfone	59, 78, 80
Fierce EZ	flumioxazin + pyroxasulfone	43, 99

Herbicide	Active Ingredient(s)	Page Number(s)
Fierce MTZ	flumioxazin + pyroxasulfone + metribuzin	43, 78, 80, 99
Fierce XLT	flumioxazin + pyroxasulfone + chlorimuron	73, 78
FirstRate	cloransulam-methyl	47, 78, 80, 113
Flexstar	fomesafen	90, 113
Flexstar GT	fomesafen + glyphosate	43
Halex GT	S-metolachlor + mesotrione + glyphosate	2, 7, 12, 19, 30
Harness	acetochlor	7, 12, 30
Harness MAX	acetochlor + mesotrione	2, 19, 30
Harness XTRA	acetochlor + atrazine	30
Harness Xtra 5.6L	acetochlor + atrazine	2, 7
Hornet WDG	clopyralid + flumetsulam	30
Impact	topramezone	7
ImpactZ	topramezone + atrazine	7
Laudis	tembotrione	12, 30, 113
Liberty	glufosinate	30, 36, 53, 73, 90, 96, 109, 113
Mauler	metribuzin	36, 59
Moccasin MTZ	S-metolachlor + metribuzin	47
Outlook	dimethenamid-P	30, 47, 59, 78, 80, 90
Perpetuo*	flumiclorac + pyroxasulfone	99
Prefix	S-metolachlor + fomesafen	43, 67, 78, 80, 90
Princep 4L	simazine	12, 30
Prowl H2O	pendimethalin	43
Pursuit	imazethapyr	78, 80, 90, 113
Python	flumetsulam	30, 113
Realm Q	rimsulfuron + mesotrione	19, 30
Resicore	clopyralid + acetochlor + mesotrione	2, 30
Resolve SG	rimsulfuron	30
Resource	flumiclorac	113
Roundup PowerMAX	glyphosate (potassium salt)	7, 12, 19, 36, 43, 56, 59, 67, 96, 103, 113
Scout	glufosinate	99
Select Max	clethodim	59
Sharpen	saflufenacil	78, 80
Shutdown	sulfentrazone	47
Sonic	sulfentrazone + cloransulam	53, 78, 80
Spartan	sulfentrazone	43, 78, 80
Status	dicamba (sodium salt) + diflufenzopyr	12
Stinger	clopyralid	30, 113
Surestart II	acetochlor + clopyralid + flumetsulam	19, 30
Surveil	flumioxazin + cloransulam	78, 80
Tavium	dicamba (DGA salt) w/VaporGrip® + S-metolachlor	43, 67

Herbicide	Active Ingredient(s)	Page Number(s)
Tricor DF	metribuzin	43, 73, 78, 80, 103
TripleFlex II	acetochlor + clopyralid + flumetsulam	12
Tripzin ZC	pendimethalin + metribuzin	47
Trivence	chlorimuron + flumioxazin + metribuzin	78
Valor SX	flumioxazin	36, 43, 47, 56, 59, 67, 78, 80
Valor XLT	flumioxazin + chlorimuron	73, 78
Verdict	saflufenacil + dimethenamid-P	30, 59, 78, 80, 96
Warrant	acetochlor	7, 12, 36, 56, 59, 78, 80, 90
Warrant Ultra	acetochlor + fomesafen	36, 59, 90
XtendiMax	dicamba (DGA salt) with VaporGrip® Technology	36, 43, 56, 59, 67, 113
Zidua	pyroxasulfone	78, 80, 90
Zidua PRO	pyroxasulfone + saflufenacil + imazethapyr	43, 59, 67, 73, 78, 80, 99
Zidua SC	pyroxasulfone	30

*Authority Edge, Engenia PRO, and Perpetuo are pending EPA approval as of January 2020.

Index of Trial Sponsors

Company	Trial Number (s)*
AMVAC	CN04
BASF	SB07 , SB11 , SB17 , SB18, SB19, BG03
Bayer Crop Science	CN01, CN02 , CN03, CN04 , CN05 , SB01, SB02 , SB03, SB04 , SB11 , SB13 , SB22, SB23, SB24
Corteva Agriscience	SB20 , SB29
FMC	CN06, SB09 , SB11
Helm Agro	CN04, CN12
Sipcam Agro	CN08
Syngenta	CN04 , CN05 , SB05, SB06, SB07 , SB08, SB11
Valent	SB07 , SB11 , SB26
West Central	BG05, BG06
Wisconsin Corn Promotion Board	CN09 , CN11
Wisconsin Soybean Marketing Board	SB11 , SB12
Wisconsin Weed Science	CN09 , CN11 , SB11 , SB12 , SB13 , BG01 , BG04

*Not all trials listed were presented in this research report.

