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To which of the following herbicides, Palmer amaranth has developed resistance in Kansas?

- Glyphosate
- Atrazine
- Mesotrione
- 2,4-D
- All of the Above
- None of the Above

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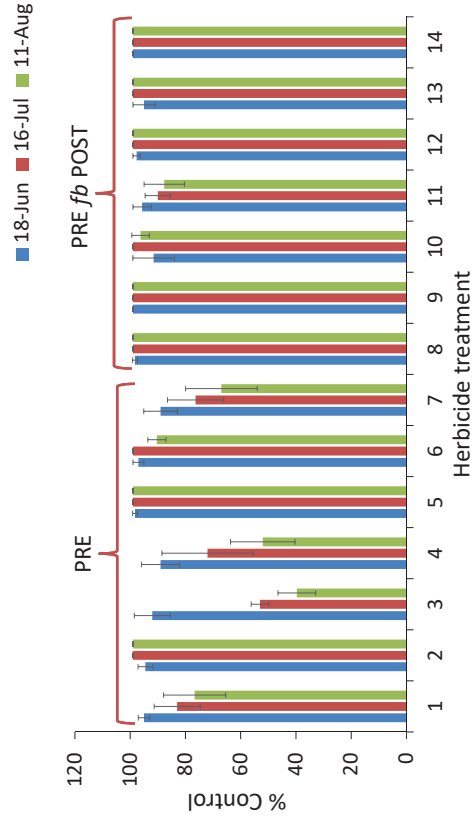
Herbicide strategies for controlling MHR Palmer amaranth in Enlist E3 Soybean

Herbicide Programs in Enlist E3 Soybean

Trt	Herbicide ^{1,2}	Rate, oz/A	Timing
1	Sonic	5	PRE
2	Trivence	8	PRE
3	Authority Supreme	10	PRE
4	Authority MTZ	14	PRE
5	Panther PRO	12	PRE
6	Fierce XLT	3.75	PRE
7	Boundary	20	PRE
8	Sonic <i>fb</i> Enlist One + Durango + Liberty	5 fb 32+32+32	PRE <i>fb</i> POST
9	Trivence <i>fb</i> Enlist One + Durango + Liberty	8 fb 32+32+32	PRE <i>fb</i> POST
10	Authority Supreme <i>fb</i> Enlist One + Durango + Liberty	10 fb 32+32+32	PRE <i>fb</i> POST
11	Authority MTZ <i>fb</i> Enlist One + Durango + Liberty	14 fb 32+32+32	PRE <i>fb</i> POST
12	Panther PRO <i>fb</i> Enlist One + Durango + Liberty	12 fb 32+32+32	PRE <i>fb</i> POST
13	Fierce XLT <i>fb</i> Enlist One + Durango + Liberty	3.75 fb 32+32+32	PRE <i>fb</i> POST
14	Boundary <i>fb</i> Enlist One + Durango + Liberty	20 fb 32+32+32	PRE <i>fb</i> POST

¹PRE treatments were applied on May 21 and POST were applied on June 23
²Appropriate adjuvants were included as dictated by each herbicide label

MHR Palmer amaranth Control in Enlist E3 Soybean



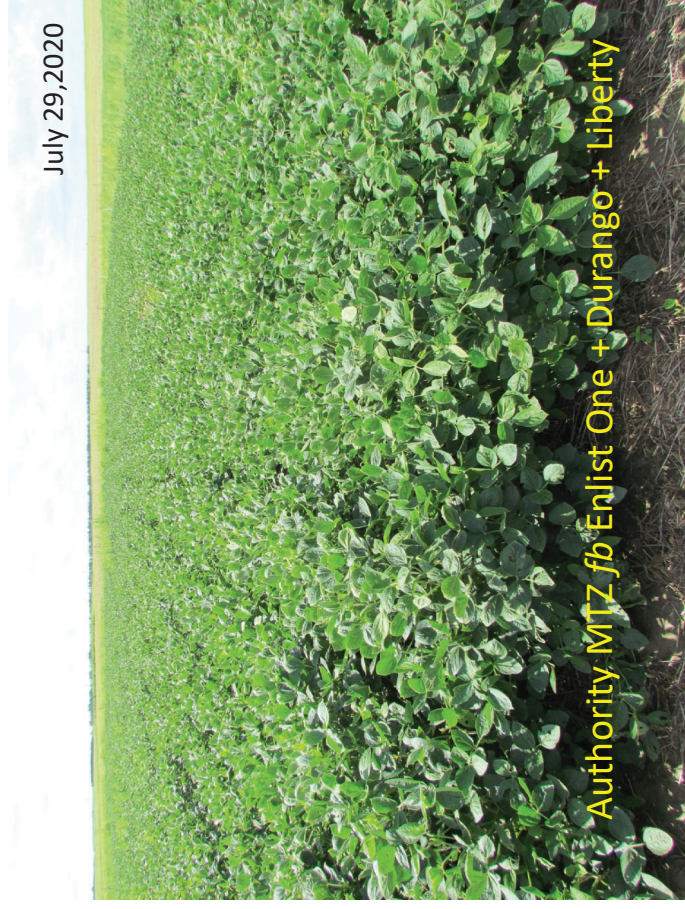
July 29, 2020

Authority MTZ- PRE alone



July 29, 2020

Authority MTZ fb Enlist One + Durango + Liberty



Integration of cover crops with herbicides for Palmer amaranth control in soybean



Materials and Methods

- Field Studies 2019 and 2020:
 - KSU Agriculture Research Center-Hays
 - Great Bend- Farmer's field
- Soybean variety: AG 39X7 Xtend
- Planting Dates: 2019/2020
 - Great Bend: June 4th / May 19th
 - Hays: June 6th / May 19th
- Cover Crop Selection
 - Great Bend- Cereal rye (35 lbs/ac)
 - Hays- Winter wheat (60 lbs/ac)



Herbicide Programs

Trt	Herbicide Programs ^{1,2}	Rate (oz/a)	Timing
1	Roundup	32	Burndown
2	Roundup + Panther MTZ	32 + 20	PRE
3	Roundup + Authority supreme	32 + 10	PRE
4	Roundup + Fierce XLT	32 + 3.75	PRE
5	Roundup + Panther MTZ <i>fb</i> Roundup + Xtendimax	32 + 20 <i>fb</i> 32 + 22	PRE <i>fb</i> POST
6	Roundup + Authority Supreme <i>fb</i> Roundup + Xtendimax	32 + 10 <i>fb</i> 32 + 22	PRE <i>fb</i> POST
7	Roundup + Fierce XLT <i>fb</i> Roundup + Xtendimax	32 + 3.75 <i>fb</i> 32 + 22	PRE <i>fb</i> POST

¹ All herbicide treatments were applied with appropriate adjuvants as dictated by each label

² All label guidelines were followed for POST applications of dicamba to prevent any drift to sensitive crops

Materials and Methods

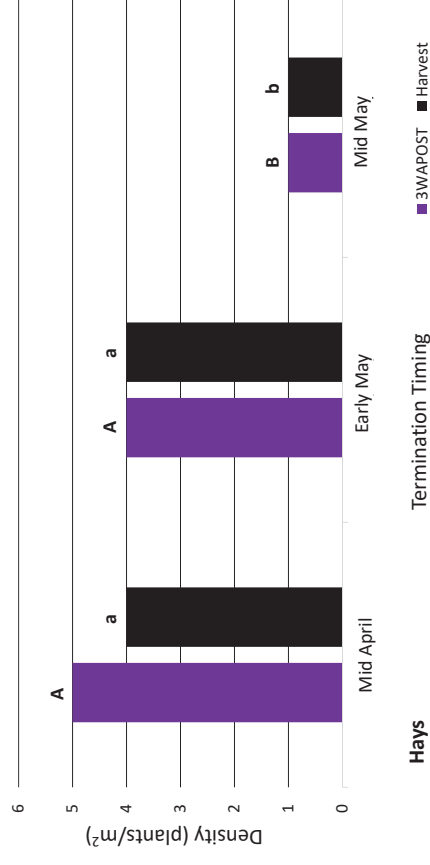
- Cover crop termination timing(s)
 - 1st Termination: Late April (4 weeks before planting)
 - 2nd Termination: Early May (2 weeks before planting)
 - 3rd Termination: Mid May (At planting)
- Herbicide application
 - 2019: PRE in combination with termination timing and POST on June 28
 - 2020: PRE in combination with termination timing and POST on June 26
- Data collection and statistical analyses
 - Percent soybean injury and grain yield
 - Visual Palmer amaranth control, plant density, and biomass at soybean harvest
 - All data subjected to ANOVA using PROC GLIMMIX in SAS
 - Means separated using Fisher's protected LSD test at $P < 0.05$

Cover Crop Biomass

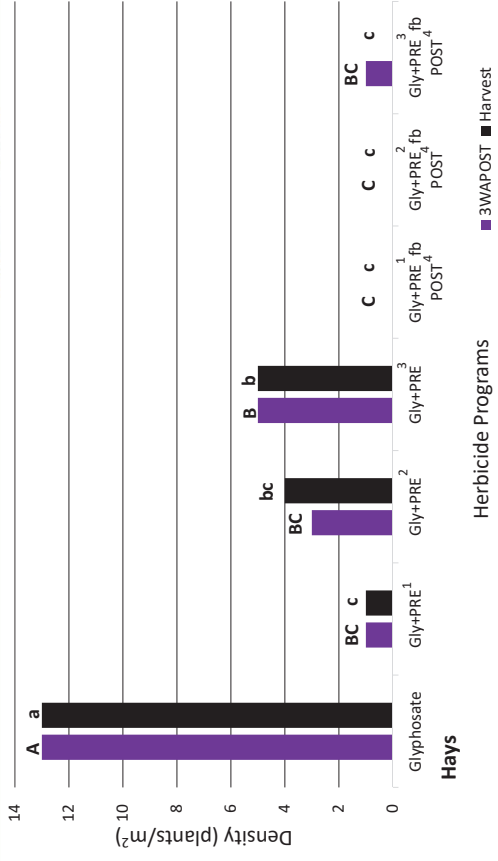
Hays Winter Wheat	Cover Crop Termination	Biomass (g/m ²)
1st Termination (Mid-April)	1st Termination (Mid-April)	219 C
2nd Termination (Early May)	2nd Termination (Early May)	337 B
3rd Termination (Mid-May)	3rd Termination (Mid-May)	733 A

Great Bend Cereal Rye	Cover Crop Termination	Biomass (g/m ²)
1st Termination (Mid-April)	1st Termination (Mid-April)	205 B
2nd Termination (Early May)	2nd Termination (Early May)	291 B
3rd Termination (Mid-May)	3rd Termination (Mid-May)	392 A

Palmer amaranth Density

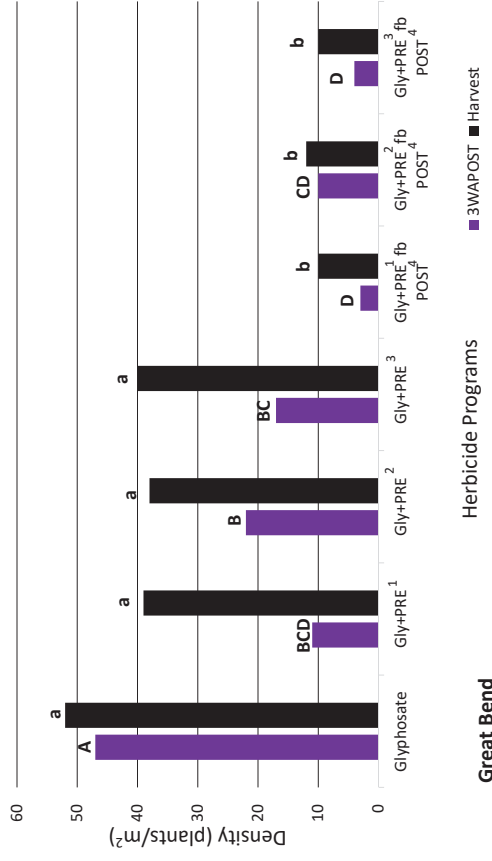


Palmer amaranth Density

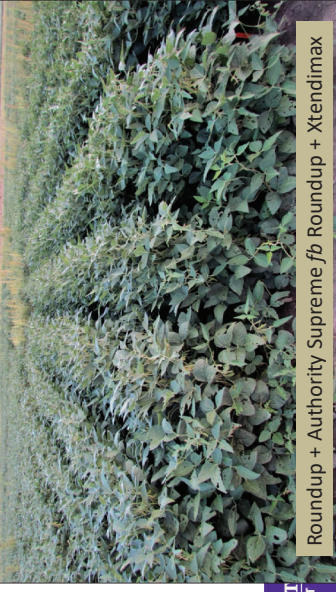
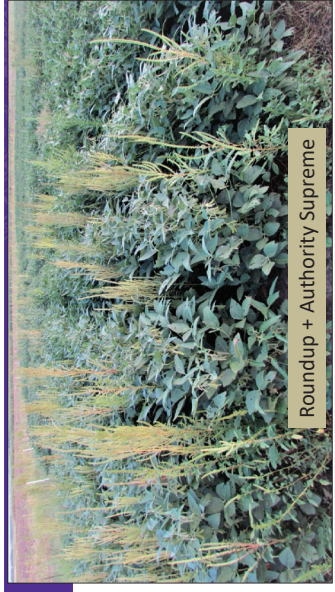
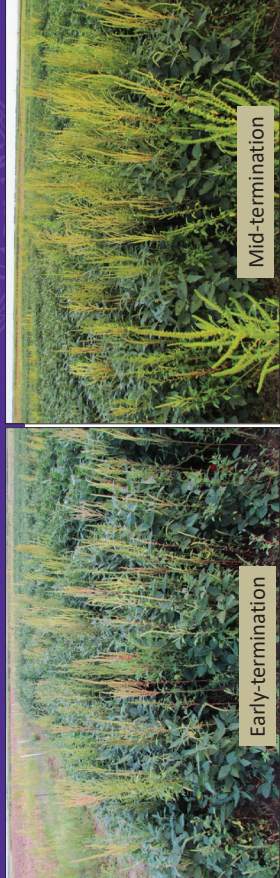


¹ PRE program of Panther MTZ
 ² PRE program of Authority Supreme
 ³ PRE program of Fierce XLT
 ⁴ POST program of Roundup + Xtendimax

Palmer amaranth Density



¹ PRE program of Panther MTZ
 ² PRE program of Authority Supreme
 ³ PRE program of Fierce XLT
 ⁴ POST program of Roundup + Xtendimax



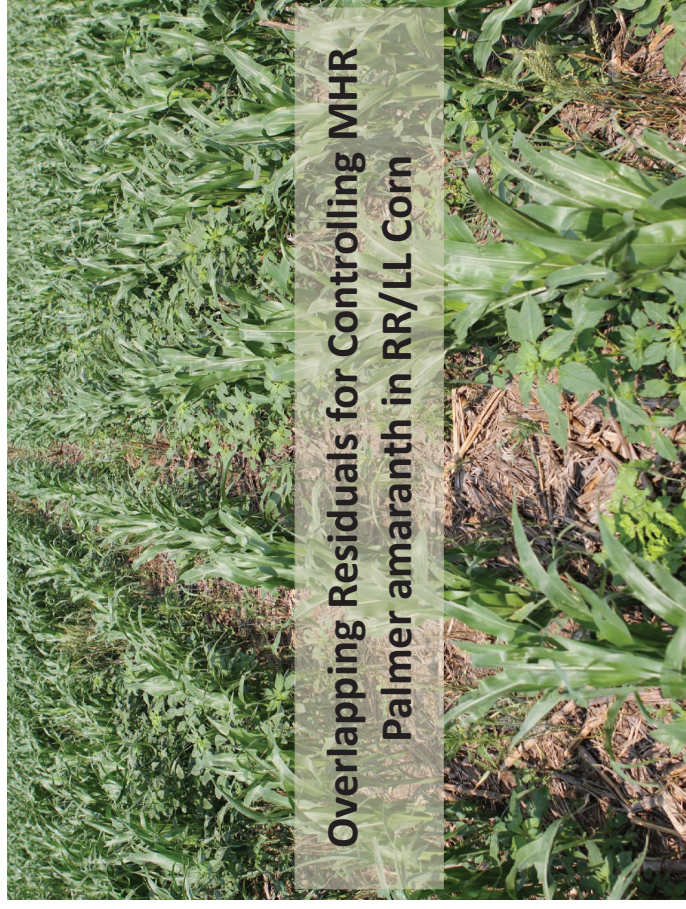
Soybean Grain Yield

Hays Yield

Cover Crop Termination	Yield (bu/a)
1st Termination (Mid-April)	22 A
2nd Termination (Early May)	23 A
3rd Termination (Mid-May)	17 B

GB Yield

Cover Crop Termination	Yield (kg/ha)
1st Termination (Mid-April)	48 a
2nd Termination (Early May)	47 a
3rd Termination (Mid-May)	48 a



Overlapping Residuals for Controlling MHR Palmer amaranth in RR/LL Corn

Overlapping Residuals in Corn

Trt	Herbicide ¹	Rate (oz/a)	Timing ^{2,3,4}	MOAs
1	Untreated	-	-	-
2	Clarity/Corvus/Aatrex/Roundup	8/5.6/24/27	PRE	4,5,9,27
3	Clarity/Acuron/Roundup	8/3/27	PRE	4,5,9,15,27
4	Clarity/Acuron/Aatrex/Roundup fb Acuron/Aatrex/Roundup	8/48/16/27 fb 48/16/27	PRE fb EPOST	4,5,9,15,27
5	Clarity/Acuron/Aatrex/Dual III Magnum/Callisto/Roundup fb Acuron/Aatrex/Dual II Magnum/Callisto/Roundup	8/48/16/16/1/27 fb 48/16/16/1/27	PRE fb EPOST	4,5,9,15,27
6	Clarity/Acuron/Callisto/Roundup fb Acuron/Callisto/Roundup	8/64/1/27 fb 32/1/27	PRE fb EPOST	4,5,9,15,27
7	Clarity/Acuron/Dual II Magnum/Roundup fb Acuron/Dual II Magnum/Roundup	8/64/16/27 fb 32/16/27	PRE fb EPOST	4,5,9,15,27
8	Clarity/Acuron/Aatrex/Roundup fb Acuron/Aatrex/Roundup	8/64/16/27 fb 32/16/27	PRE fb EPOST	4,5,9,15,27
9	Clarity/Acuron/Sencor/Roundup fb Acuron/Roundup	8/48/3/27 fb 48/27	PRE fb EPOST	4,5,9,15,27
10	Clarity/Acuron/Roundup fb Acuron/Roundup/Status	8/48/27 fb 48/27/2.5	PRE fb LPOST	4,5,9,15,19,27
11	Clarity/Acuron/Roundup fb Acuron/Liberty	8/48/27 fb 48/27	PRE fb LPOST	4,5,9,10,15,27

¹ All treatments included nonionic surfactant (NIS) at 0.25% v/v and AMS at 2% wt/v
² PRE herbicides were applied on April 24, in 2018, and June 5, in 2019
³ EPOST herbicides were applied on May 17, in 2018 and June 18, in 2019
⁴ LPOST herbicides were applied on June 1, in 2018 and July 27, in 2019

Herbicide	Rate (oz/a)	3 WAPRE	2 WAEPOST	2 WALPOST	Yield (bu/A)
Untreated	-	-	-	-	90 b
Clarity/Corvus/Aatrex/Roundup	8/5.6/24/27	90 a	82 b	72 c	137 a
Clarity/Acuron/Roundup	8/3/27	92 a	81 b	77 c	143 a
Clarity/Acuron/Aatrex/Roundup fb Acuron/Aatrex/Roundup	8/48/16/27 fb 48/16/27	92 a	95 a	92 a	156 a
Clarity/Acuron/Aatrex/Dual II Magnum/Callisto/Roundup fb Acuron/Aatrex/Dual II Magnum/Callisto/Roundup	8/48/16/16/1/27 fb 48/16/16/1/27	93 a	95 a	91 ab	138 a
Clarity/Acuron/Callisto/Roundup fb Acuron/Callisto/Roundup	8/64/1/27 fb 32/1/27	91 a	96 a	91 ab	152 a
Clarity/Acuron/Dual II Magnum/Roundup fb Acuron/Dual II Magnum/Roundup	8/64/16/27 fb 32/16/27	90 a	92 a	87 ab	149 a
Clarity/Acuron/Aatrex/Roundup fb Acuron/Aatrex/Roundup	8/64/16/27 fb 32/16/27	91 a	96 a	87 ab	144 a
Clarity/Acuron/Sencor/Roundup fb Acuron/Roundup	8/48/3/27 fb 48/27	92 a	93 a	90 ab	141 a
Clarity/Acuron/Roundup fb Acuron/Roundup/Status	8/48/27 fb 48/27/2.5	89 a	75 c	86 c	145 a
Clarity/Acuron/Roundup fb Acuron/Liberty	8/48/27 fb 48/27	90 a	75 bc	86 c	147 a



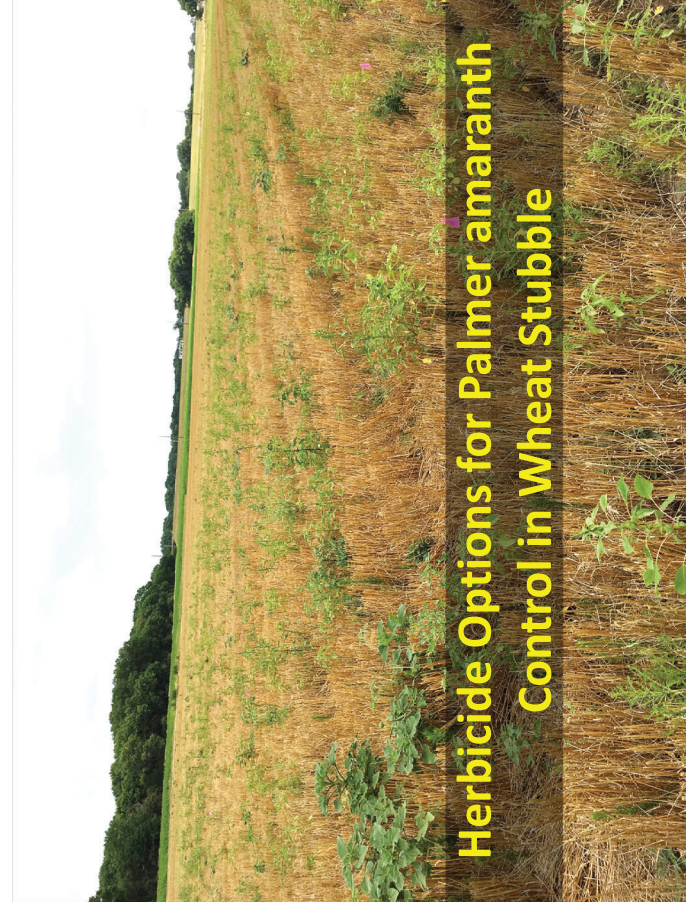
5 WAPRE

5 WAPRE/ 2 WAEPOST

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 Clarity + Corvus + Aatrex+ Roundup (PRE)

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 Clarity + Acuron + AAtrex + Roundup (PRE) fb
 Acuron + AAtrex + Roundup (EPOST)

Herbicide	Rate (oz/a)	Program Cost (\$/A)	Gross Income (\$/A)	Net Return (\$/A)
Untreated	-	0	357 b	357 c
Clarity/Corvus/Aatrex/Roundup	8/5.6/24/27	59	543 a	478 ab
Clarity/Acuron/Roundup	8/3/27	72	564 a	487 ab
Clarity/Acuron/Aatrex/Roundup fb	8/48/16/27 fb	81	619 a	526 a
Acuron/Aatrex/Roundup	48/16/27	102	548 a	435 bc
Clarity/Acuron/Aatrex/Dual II	8/48/16/16/1/27 fb			
Magnum/Callisto/Roundup fb	48/16/16/1/27			
Acuron/Aatrex/Dual II				
Magnum/Callisto/Roundup				
Clarity/Acuron/Callisto/Roundup fb	8/64/1/27 fb	84	602 a	506 ab
Acuron/Callisto/Roundup	32/1/27			
Clarity/Acuron/Dual II Magnum/Roundup fb	8/64/16/27 fb	95	589 a	483 ab
Acuron/Dual II Magnum/Roundup	32/16/27			
Clarity/Acuron/Aatrex/Roundup fb	8/64/16/27 fb	81	568 a	476 ab
Acuron/Aatrex/Roundup	32/16/27			
Clarity/Acuron/Sencor/Roundup fb	8/48/3/27 fb	83	559 a	464 ab
Acuron/Roundup	48/27			
Clarity/Acuron/Roundup fb	8/48/27 fb	90	574 a	472 ab
Acuron/Roundup/Status	48/27/2.5			
Clarity/Acuron/Roundup fb	8/48/27 fb	88	581 a	481 ab
Acuron/Liberty	48/27			



Herbicide Options for Palmer amaranth Control in Wheat Stubble

Control of volunteer Enlist[®] corn in Enlist[®] E3[®] soybean



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Herbicide Programs for Enlist Corn Control

Trt	Herbicide Programs 1,2	Rate (fl oz/a)	Timing ³
1	Select Max	16	EPOST
2	Poast Plus	24	EPOST
3	Select Max + Enlist One	16 + 32	EPOST
4	Poast Plus + Enlist One	24 + 32	EPOST
5	Select Max	16	LPOST
6	Poast Plus	24	LPOST
7	Select Max + Enlist One	16 + 32	LPOST
8	Poast Plus + Enlist One	24 + 32	LPOST
9	Untreated	-	-
10	Handweeded	-	-

¹Select Max treatments included NIS at 0.25 %v/v

²Poast Plus treatments included COC at 1 %v/v and AMS at 2 % w/v

³EPOST were applied at V3-V4, corn and LPOST were applied at V7-V8

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Herbicide Programs ^{a, b}	Rate (oz/a)	Herbicide groups	2019 % control at 4 WAT	2020 % control at 4 WAT
Nontreated	-	-	0	0
Roundup PowerMax	32	9	96	87
Clarity	16	4	82	76
2,4-D amine	32	4	87	79
Roundup PowerMax + Clarity	32+16	9 & 4	94	91
Roundup PowerMax + 2,4-D amine	32+32	9 & 4	98	95
Clarity + Aatrex	16+16	4 & 5	86	73
Clarity + 2,4-D amine	16+32	4	91	81
Gramoxone	48	22	99	98
Gramoxone + Aatrex	48+16	22 & 5	100	98
Gramoxone + Sencor	48+5	22 & 5	100	98
Gramoxone + Valor	48+2	22 & 14	100	97
Gramoxone + 2,4-D amine	48+32	22 & 4	100	98
Gramoxone + Spartan	48+4	22 & 14	100	98
Gramoxone + Authority Supreme	48+10	22 & 14, 15	100	98
Gramoxone + Panther MTZ	48+15	22 & 14, 15	99	94
Sharpen	2	14	93	89
Sharpen + Aatrex	2+16	14 & 5	93	79
Sharpen + Sencor	2+5	14 & 5	95	89
Sharpen + 2,4-D amine	2+32	14 & 4	97	88
Kochiavore	16	4	71	75
Huskie + Aatrex	15+16	6, 27 & 5	64	73
Liberty	36	10	92	89
Liberty + 2,4-D amine + Roundup PowerMax	36+32+32	10, 4, 9	98	97
Liberty + Clarity + Roundup PowerMax	36+16+32	10, 4, 9	97	96

^a Herbicide treatments were applied on 2 to 2.5 ft tall Palmer amaranth plants showing inflorescence

^b Initiation in postharvest wheat stubble

^c All treatments were applied with appropriate adjuvants as dictated by each herbicide label

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Increased adoption of HR corn resulted in volunteer corn being a problem in soybean grown in rotation

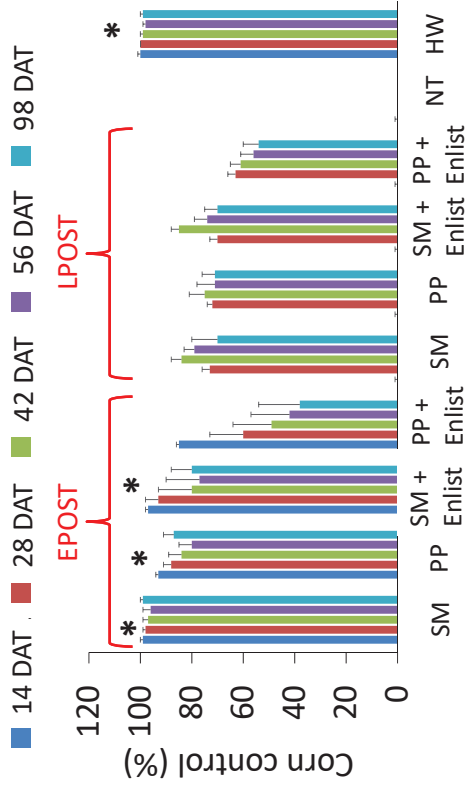
Enlist[®] corn:

- Developed by Corteva Agriscience
- Resistance to 2,4-D, glyphosate, and glufosinate
- Resistance to aryloxyphenoxypropionate (FOPs) herbicides in corn



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Volunteer Enlist Corn Control in Enlist Soybean



Volunteer Enlist Corn Control 28 DAT EPOST



Questions?

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