Blue Section: **Weed Control in Corn and Soybean** Page

Canola control using pre-emergent and post herbicides. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Casselton, ND to evaluate volunteer RR canola control using PRE herbicides followed by POST herbicides. RR canola was planted on July 7, 2014. PRE treatments were applied on July 7, 2014 at 3:00 pm with 80.5 F air, 77.1 F soil at a four inch depth, 56% RH, 100% cloud cover, 4-6 mph NW wind, and adequate soil moisture. POST treatments were applied on July 24, 2014 at 12:00 pm with 73.5 F air, 73.3 F soil at a four inch depth, 50% RH, 100% cloud cover, 4-6 mph SE wind, adequate soil moisture, good crop vigor, and no dew present at a 4-6 leaf canola crop stage. Weed species present at the time of the POST treatments were: 3-5" (10-15/ft^2) redroot pigweed and 3-5" (5-10/ft^2) yellow foxtail. Soil characteristics were: 9.1% sand, 51.9% silt, 39% clay, Silty Clay Loam, 5.1 OM, and 7.8 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through 11002 TT nozzles for the PRE applications and delivering 8.5 gpa at 40 psi through 11001 TT nozzles for the POST applications. The experiment had a randomized complete block design with three replicates per treatment.

Adequate precipitation activated soil applied herbicides. With the exception of Verdict, most preemergence –applied herbicide were ineffective in canola control. Post products that contain mesotrione (Callisto) control canola. The active ingredient flumetsulam (Python) in SureStart II controlled canola.

Table. Canola control using pre-emergent and post herbicides. (Zollinger, Wirth, Adams)

Treatments	Rate (Product/A)	14 DA PRE Canola (% Control)	14 & 28 DA POST Canola (% control)
PRE/POST			
Rim+Thifen (Alluvex)+Abundit Extra+AMS	1oz+0.5oz+1qt+2lb	30	30
Abundit Extra+AMS	1qt+2lb		
Rim+Thifen (Alluvex)+Breakfree+Abundit Extra+AMS	1oz+0.5oz+1.5pt+1qt+2lb	37	22
Abundit Extra+AMS	1qt+2lb		
Rim+Thifen (Alluvex)+Breakfree ATZ Lite+Abundit Extra+AMS	1oz+0.5oz+2qt+1qt+2lb	73	72
Abundit Extra+AMS	1qt+2lb		
Rim+Thifen (Alluvex)+Atrazine+Abundit Extra+AMS	1oz+0.5oz+0.83lb+1qt+2lb	33	30
Abundit Extra+AMS	1qt+2lb		
Rim+Thifen (Alluvex)+Abundit Extra+AMS	1oz+0.5oz+1qt+2lb	28	99
Rim+Thifen+Iso (Resolve Q)+Abundit Extra+AMS	0.92oz+0.1oz+0.23oz+1qt+2lb		
Rim+Thifen (Alluvex)+Abundit Extra+AMS	1oz+0.5oz+1qt+2lb	25	99
Rim+Meso+Iso (Realm Q)+Abundit Extra+AMS	1.2oz+2.5oz+0.3oz+1qt+2lb		
Verdict+MSO+Abundit Extra+AMS	14fl oz+1% v/v+1qt+2lb	93	93
Abundit Extra+AMS	1qt+2lb		
POST			
SureStart II+NIS+28%	1.5pt+0.25% v/v+28% v/v	0	99
SureStart II+NIS+28%	2pt+0.25% v/v+28% v/v	0	99
LSD (0.05)		6	3

[1]Rim=Rimsulfuron; Thifen=Thifensulfuron; Meso=Mesotrione; Iso=Isoxadifen

PRE HPPD herbicides in corn. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Hillsboro, ND to evaluate weed control in roundup ready corn. PRE treatments were applied on June 10, 2014 at 6:45 am with 77 F air, 67 F soil at a four inch depth, 40% RH, 90% cloud cover, 5-8 mph SW wind, and adequate soil moisture. Soil characteristics were: 51% sand, 36% silt, 13% clay, loam, 4.1% OM, and 7.7 pH. Treatments were applied to the center 6.7 feet of the 9 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through TT11002 nozzles for the PRE applications. The experiment had a randomized complete block design with three replicates per treatment.

Acuron contain the the active ingredients in Lumax (metolachlor, atrazine, and mesotrione) and also contains a new HPPD herbicide bicyclopyrone which increases broadleaf weed weed control, especially large-seeded broadleaf weeds. A20540 does not contain atrazine and resulted in reduced weed control.

Table. PRE HPPD herbicides in corn (Zollinger, Wirth, Adams).

		14 DA PRE							28 DA PRE							42 DA PRE						
Treatment[1]	Rate	Corn	Cano	Rrpw	Colq	Wibw	Snfl	Cocb	Corn	Cano	Rrpw	Colq	Wibw	Snfl	Cocb	Corn	Cano	Rrpw	Colq	Wibw	Snfl	Cocb
	(Product/A)	%control							%control							%control						
PRE																						
(PRE) SureStart II	2pt	0	99	99	99	99	77	43	0	99	99	99	99	72	43	0	99	92	99	99	73	43
(PRE) SureStart II	2..5pt	0	99	99	99	99	95	99	0	99	99	99	99	93	99	0	99	96	99	99	90	99
(PRE) Corvus	4.5floz	0	99	99	99	87	63	57	0	99	99	99	80	58	50	0	99	99	99	82	45	47
(PRE) Rimsulfuron+Mesotrione	1oz+5oz	0	99	99	99	99	85	87	0	99	99	85	95	82	85	0	99	88	90	93	73	83
(PRE) Verdict	15floz	0	88	83	82	82	89	83	0	88	73	80	77	90	63	0	88	67	78	76	87	62
(PRE) Zemax	1.6qt	0	95	85	92	55	63	45	0	93	72	75	23	53	30	0	93	67	73	23	50	25
(PRE) Zemax	2qt	0	99	95	95	47	85	58	0	99	83	80	40	82	52	0	99	80	82	37	78	52
(PRE) Lumax EZ	3pt	0	99	99	99	99	99	99	0	99	99	99	99	82	85	0	99	57	70	80	58	37
(PRE) Lumax EZ	4pt	0	99	99	99	99	99	99	0	99	99	99	99	99	99	0	99	72	80	93	85	65
(PRE) Acuron	2qt	0	99	99	99	99	99	99	0	99	99	99	99	99	99	0	99	94	99	78	92	92
(PRE) Acuron	2.5qt	0	99	99	99	99	99	99	0	99	99	99	99	99	99	0	99	99	99	99	99	99
(PRE) A20540	2qt	0	99	99	99	47	99	40	0	99	99	99	23	92	25	0	99	99	99	23	88	23
LSD (0.05)		0	1	7	3	9	7	9	0	2	3	0	4	8	6	0	2	7	4	7	9	8

PRE tankmixes in corn. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Prosper, ND to evaluate weed control in corn using PRE applied herbicide mixtures. Roundup ready/Liberty Link corn was planted on May 27, 2014. PRE treatments were applied on May 27, 2014 at 4:00 pm with 90.0 F air, 67.0 F soil at a four inch depth, 35% RH, 100% cloud cover, 2-5 mph N wind, and adequate soil moisture. POST treatments were applied on July 2, 2014 at 11:15 pm with 73.0 F air, 59.1 F soil at a four inch depth, 45%RH, 0% cloud cover, 4-5 mph N wind, adequate soil moisture, excellent crop vigor, and no dew present at a V7-V8 corn crop stage. Weed species present at the time of the POST treatments were: 2-10" (3-20/yd^2) yellow foxtail, 3-10" (2-5/yd^2) common ragweed, 3-10" (2-5/yd^2) cocklebur, 2-6" (sparse) barnyard grass, and 18-24" (sparse) canada thistle. Soil characteristics were: 25% sand, 47% silt, 28% clay, clay loam, 4.2% OM, and 7.3 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through TT11002 nozzles for the PRE applications and delivering 8.5 gpa at 40 psi through TT11001 nozzles for the POST applications. The experiment had a randomized complete block design with three replicates per treatment.

Post glyphosate application was sprayed July 2nd, just before 42 DA PRE rating. After POST application was sprayed, all ratings were 99%. There was no corn injury from any PRE applications at any rating time. At the time of PRE application there was already emerged common cocklebur which effected efficacy. PRE herbicides were adequately activated by spring moisture.

Table. PRE tankmixes in corn (Zollinger, Wirth, Adams).

		14 DA PRE								28 DA PRE							
Treatment	Rate	Yeft	Wimu	Rrpw	Colq	Hans	Mael	Corw	Cocb	Yeft	Wimu	Rrpw	Colq	Hans	Mael	Corw	Cocb
	(Product/A)	----------% control----------								----------% control----------							
PRE																	
(PRE) Callisto+Atrazine	6floz+1.25lb	95	95	95	95	95	93	93	20	95	95	95	95	95	93	93	83
(PRE) Callisto+Atrazine	3.9floz+0.81lb	90	90	90	91	87	87	87	20	99	99	99	99	99	99	99	70
(PRE) Callisto+Atrazine+Harness	6.28floz+1.67lb+42floz	99	99	99	99	99	99	99	20	99	99	99	99	99	99	99	92
(PRE) Callisto+Atrazine+Harness	4.08floz+1.08lb+27.3floz	99	99	99	99	99	99	99	20	99	99	99	99	99	99	99	82
(PRE) Callisto+Atrazine+Harness	6.5floz+0.83lb+44floz	99	99	99	99	99	99	99	20	99	99	99	99	99	99	99	68
(PRE) Callisto+Atrazine+Harness	4.23floz+0.54lb+28.6floz	99	99	99	99	99	99	99	20	99	99	99	99	99	99	99	68
(PRE) Callisto+Harness	6.5floz+44floz	99	99	99	99	99	99	99	20	99	99	99	99	99	99	99	57
(PRE) Callisto+Harness	4.23floz+28.6floz	99	99	99	99	99	99	99	20	99	99	99	99	99	99	99	72
(PRE) Callisto+Pruvin+Stinger	7.7floz+2oz+6.5floz	99	99	99	99	99	99	99	20	99	99	99	99	99	99	99	92
(PRE) Callisto+Pruvin+Stinger	5.78floz+1.5oz+4.9floz	99	99	99	99	99	99	99	20	99	99	99	99	99	99	99	80
(PRE) Zemax	2.4qt	99	99	99	99	99	99	99	20	99	99	99	99	99	99	99	65
(PRE) Zemax	1.56qt	83	83	83	83	82	82	82	20	83	83	83	83	82	82	82	80
(PRE) Lexar EZ	3.5qt	99	99	99	99	99	99	99	20	99	99	99	99	99	99	99	80
(PRE) Lexar EZ	2.275qt	99	99	99	99	99	99	99	20	99	99	99	99	99	99	99	78
(PRE) Lumax EZ	3.25qt	99	99	99	99	99	99	99	20	99	99	99	99	99	99	99	68
(PRE) Lumax EZ	2.11qt	83	83	83	83	82	80	80	20	99	99	99	99	99	99	99	62
(PRE) Halex GT	4pt	62	68	65	65	65	65	62	20	99	99	99	99	99	99	99	65
(PRE) Halex GT	2.6pt	50	50	50	50	50	50	50	20	99	99	99	99	99	99	67	37
LSD (0.05)		2	3	2	2	3	3	2	ns	1	1	1	1	1	2	3	11

PRE/EPOST tankmixes in corn. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Prosper, ND to evaluate weed control in corn. Roundup ready corn was planted on May 27, 2014. PRE treatments were applied on May 27, 2014 at 4:00 pm with 90.0 F air, 67.0 F soil at a four inch depth, 35% RH, 100% cloud cover, 2-5 mph N wind, and adequate soil moisture. EPOST treatments were applied on June 13, 2014 at 10:30 pm with 80.0 F air, 58.0 F soil at a four inch depth, 21%RH, 0% cloud cover, 2-4 mph E wind, adequate soil moisture, excellent crop vigor, and no dew present at a V3 corn crop stage. Weed species present at the time of the EPOST treatments were: emerging-2" (5/yd^2) yellow foxtail, emerging-bolt (1-5/yd^2) wild mustard, emerging-2" (5/yd^2) redroot pigweed, emerging-2" (5/yd^2) common lambsquarters, emerging-1" (5/yd^2) eastern black nightshade, emerging-vining (1-5/yd^2) wild buckwheat, emerging-3" (1-5/yd^2) common ragweed, and emerging-4" (1-20/ft^2) common cocklebur. Soil characteristics were: 25.2% sand, 46.5% silt, 28.3% clay, Clay Loam, 4.2% OM, and 7.3 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through TT11002 nozzles for the PRE applications and delivering 8.5 gpa at 40 psi through TT11001 nozzles for the EPOST applications. The experiment had a randomized complete block design with three replicates per treatment.

At the time of PRE application there was already emerged common cocklebur which effected efficacy. At the time of EPOST application, efficacy of common cocklebur was lower due to a dense, 4" tall stand. PRE herbicides were adequately activated by spring moisture.

Table. PRE/EPOST tankmixes in corn (Zollinger, Wirth, Adams).

		3 DAE		7 DA POST								28 & 42 DA POST								
Treatment[1]	Rate	Corn	Corn	Yeft	Wimu	Rrpw	Colq	Hans	Mael	Corw	Cocb	Corn	Yeft	Wimu	Rrpw	Colq	Hans	Mael	Corw	Cocb
PRE/POST	(Product/A)	-%inj	-%inj-	----------% control----------								-%inj-	----------%control----------							
(PRE) Anthem	10oz																			
(EPOST) RUPM+AMS	22floz+8.5lb/100gal	0	0	73	73	83	83	73	62	60	20	0	99	99	99	99	99	99	99	72
(PRE) Anthem ATZ	40floz																			
(EPOST) RUPM+AMS	22floz+8.5lb/100gal	0	0	83	83	83	83	83	73	62	20	0	99	99	99	99	99	99	99	72
(PRE) Anthem+Stanza	10oz+5oz																			
(EPOST) RUPM+AMS	22floz+8.5lb/100gal	0	0	95	95	95	95	95	83	72	20	0	99	99	99	99	99	99	99	99
(PRE) Anthem+Accolade	10oz+1.33oz																			
(EPOST) RUPM+AMS	22floz+8.5lb/100gal	0	0	95	95	95	95	92	92	73	20	0	99	99	99	99	99	99	99	99
(PRE) Anthem	10oz																			
(EPOST) Solstice+RUPM	3floz+22floz	0	0	72	63	67	67	63	63	55	13	0	99	99	99	99	99	99	99	98
+Superb HC+AMS	+1pt+8.5lb/100gal																			
(PRE) Anthem	10oz																			
(EPOST) Solstice+Liberty	3floz+22floz	0	0	73	73	73	73	72	65	55	20	0	99	99	99	99	99	99	99	99
+Superb HC+AMS	+1pt+8.5lb/100gal																			
(PRE) SureStart II	2pt																			
(EPOST) RUPM+AMS	22floz+8.5lb/100gal	0	0	73	85	95	95	95	93	57	30	0	99	99	99	99	99	99	99	94
(PRE) Zemax	1qt																			
(EPOST) RUPM+AMS	22floz+8.5lb/100gal	0	0	72	82	82	82	80	80	53	20	0	99	99	99	99	99	99	99	99
(PRE) Stanza	5oz																			
(EPOST) RUPM+Superb HC+AMS	22floz+1pt+8.5lb/100gal	0	0	75	77	77	77	75	72	58	20	0	99	99	99	99	99	99	99	93
(PRE) Accolade	1.33oz																			
(EPOST) RUPM+Superb HC+AMS	22floz+1pt+8.5lb/100gal	0	0	85	63	63	65	53	50	42	20	0	99	99	99	99	99	99	99	90
EPOST																				
(EPOST) Solstice+RUPM	3floz+22floz																			
+Superb HC+AMS	+1pt+8.5lb/100gal	0	0	0	0	0	0	0	0	0	0	0	63	99	99	99	99	99	99	89
(EPOST) Solstice+Superb HC+AMS	3floz+1pt+8.5lb/100gal	0	0	0	0	0	0	0	0	0	0	0	40	70	70	70	70	70	70	68
(EPOST) Halex GT	3.6pt	0	0	0	0	0	0	0	0	0	0	0	99	99	99	99	99	99	99	99
LSD (0.05)		ns	ns	3	9	7	8	6	6	5	3	ns	7	2	2	2	2	2	2	3

[1]RUPM=Roundup Powermax

PRE/POST tankmix programs in corn. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Prosper, ND to evaluate weed control programs in corn. Roundup ready/Liberty Link corn was planted on May 27, 2014. PRE treatments were applied on May 27, 2014 at 4:00 pm with 90.0 F air, 67.0 F soil at a four inch depth, 35% RH, 100% cloud cover, 2-5 mph N wind, and adequate soil moisture. POST treatments were applied on June 13, 2014 at 10:30 am with 80.0 F air, 58.0 F soil at a four inch depth, 21%RH, 0% cloud cover, 2-4 mph E wind, adequate soil moisture, excellent crop vigor, and no dew present at a V3 corn crop stage. Weed species present at the time of the POST treatments were: emerging-2" (5/yd^2) yellow foxtail, emerging-bolt (1-5/yd^2) wild mustard, emerging-2" (5/yd^2) redroot pigweed, emerging-2" (5/yd^2) common lambsquarters, emerging-1" (5/yd^2) eastern black nightshade, emerging-vining (1-5/yd^2) wild buckwheat, emerging-3" (1-5/yd^2) common ragweed, and emerging-4" (1-20/ft^2) common cocklebur. Soil characteristics were: 25% sand, 47% silt, 28% clay, clay loam, 4.2% OM, and 7.3 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through TT11002 nozzles for the PRE applications and delivering 8.5 gpa at 40 psi through TT11001 nozzles for the POST applications. The experiment had a randomized complete block design with three replicates per treatment.

At all timings and across all treatments there was no corn injury. At 28 and 42 DA POST all treatments were 99%. At the time of PRE application there was already emerged common cocklebur which effected efficacy. At the time of POST application, efficacy of common cocklebur was lower due to a dense, 4" tall stand. PRE herbicides were adequately activated by spring moisture.

Table. PRE/POST tankmix programs in corn (Zollinger, Wirth, Adams).

		Prior to POST							14 DA POST						
Treatment[1]	Rate	Yeft	Wimu	Rrpw	Colq	Hans	Corw	Cocb	Yeft	Wimu	Rrpw	Colq	Hans	Corw	Cocb
	(Product/A)	----------% control----------							----------% control----------						
PRE															
(PRE) Keystone LA NXT+Hornet	1.33qt+3oz	99	99	99	99	99	99	37	99	99	99	99	99	99	45
PRE/POST															
(PRE) SureStart II	2pt														
(POST) Durango+AMS	1.5pt+2.5%v/v	99	99	99	99	99	99	30	99	99	99	99	99	99	93
(PRE) SureStart II	2.5pt														
(POST) Durango+AMS	1.5pt+2.5%v/v	99	99	99	99	99	99	30	99	99	99	99	99	99	90
(PRE) SureStart II	2.5pt														
(POST) Durango+Atrazine+AMS	1.5pt+0.56lb+2.5%v/v	99	99	99	99	99	99	30	99	99	99	99	99	99	78
(PRE) SureStart II	1.5pt														
(POST) SureStart II+Durango+AMS	1.5pt+1.5pt+2.5%v/v	70	70	70	70	70	70	20	99	99	99	99	99	99	92
(PRE) Rim+Meso+Breakfree ATZ	1oz+5oz+1.5qt														
(POST) Abundit Extra+AMS	1qt+2lb	99	99	99	99	99	99	30	99	99	99	99	99	99	93
(PRE) Rim+Meso+Breakfree ATZ	1oz+5oz+1.5qt														
(POST) Abundit Extra+Atrazine+AMS	1qt+0.56lb+2lb	99	99	99	99	99	99	30	99	99	99	99	99	99	93
(PRE) Rim+Meso+Breakfree	1oz+5oz+1.5pt														
(POST) Abundit Extra	1qt+2lb	99	99	99	99	99	99	30	99	99	99	99	99	99	95
(PRE) Rim+Meso+Breakfree	1oz+5oz+1.5pt														
(POST) Abundit Extra+Atrazine+AMS	1qt+0.56lb+2lb	99	99	99	99	99	99	30	99	99	99	99	99	99	78
(PRE) Lumax EZ	2.5qt														
(POST) Abundit Extra+AMS	1qt+2lb	99	99	99	99	99	99	30	99	99	99	99	99	99	90
LSD (0.05)		0	0	3	3	3	3	6	ns	ns	ns	ns	ns	ns	5

[1]Rim=Rimsulfuron; Meso=Mesotrione; Breakfree ATZ=Breakfree ATZ Lite

Glyphosate resistant kochia control at EPOST timing. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Barney, ND to evaluate control of glyphosate resistant kochia. EPOST treatments were applied on July 11, 2014 at 1:30 pm with 86.8 F air, 74.7 F soil at a four inch depth, 44% RH, 0% cloud cover, 5-7 mph NW wind, dry soil moisture, and no dew present. Weed species present at the time of the EPOST treatments were: 2-5" (3-5/yd^2) kochia, 3-5" (3-4/ft^2) common lambsquarters, 4-6" (2-4/yd^2) redroot pigweed, 6-8" (1/yd^2) cocklebur, cotyledon-2" (3-4/yd^2) common ragweed, and 10-12" (1-2/yd^2) volunteer corn. An increased density of (3-5/ft^2) kochia was located in the western portion of the study. Soil characteristics were: 38% sand, 39% silt, 23% clay, loam, 4.9% OM, and 7.7 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through TT11002 nozzles for the EPOST applications. The experiment had a randomized complete block design with three replicates per treatment.

This study represents the importance of utilizing different effective modes of action to control glyphosate resistant weeds (kochia). EPOST treatments of glyphosate and dicamba alone resulted in fair control on most weeds at 14 and 24 days after application. Spring tillage and wet soils prevented kochia emergence and multiple flushes throughout the growing season.

Table. Glyphosate Resistant Kochia control at EPOST timing (Zollinger, Wirth, Adams).

		14 DAA						28 DAA					
Treatment[1]	Rate	Rrpw	Wahe	Colq	Biww	Wibw	Koch	Rrpw	Wahe	Colq	Biww	Wibw	Koch
	(Product/A)	----------%control----------						----------%control----------					
EPOST													
(EPOST) RUPM+NIS+AMS	32floz+0.25%v/v+2.5lb	99	62	63	99	68	47	99	62	63	99	68	47
(EPOST) Clarity	1.5pt	57	57	57	57	47	47	57	57	57	57	47	47
(EPOST) RUPM+Clarity+NIS+AMS	32floz+1.5pt+0.25%v/v+2.5lb	99	77	77	99	99	75	99	77	77	99	99	75
(EPOST) RUPM+Clarity+Valor+NIS+AMS	32floz+1.5pt+3oz+0.25%v/v+2.5lb	99	99	99	99	99	99	99	99	99	99	99	99
(EPOST) RUPM+Clarity+Fierce+NIS+AMS	32floz+1.5pt+3.75oz+0.25%v/v+2.5lb	99	99	99	99	99	99	99	99	99	99	99	99
(EPOST) RUPM+Clarity+Valor+Sencor DF+NIS+AMS	32floz+1.5pt+3oz+4oz+0.25%v/v+2.5lb	99	99	99	99	99	99	99	99	99	99	99	99
(EPOST) RUPM+Clarity+Fierce+Sencor DF+NIS+AMS	32floz+1.5pt+3.75oz+4oz+0.25%v/v+2.5lb	99	99	99	99	99	99	99	99	99	99	99	99
(EPOST) RUPM+Clarity+Fierce+Sencor DF+NIS+AMS	32floz+1.5pt+4.5oz+6oz+0.25%v/v+2.5lb	99	99	99	99	99	99	99	99	99	99	99	99
(EPOST) RUPM+Clarity+Authority MTZ+NIS+AMS	32floz+1.5pt+15oz+0.25%v/v+2.5lb	99	99	99	99	99	99	99	99	99	99	99	99
(EPOST) Flexstar GT+TD Total+HSMOC+AMS	2.68pt+12floz+1.5pt+2.5lb	99	99	99	99	99	99	99	99	99	99	99	99
(EPOST) RUPM+Cobra+HSMOC+AMS	32floz+12.5floz+1.5pt+2.5lb	99	99	99	99	99	73	99	99	99	99	99	73
(EPOST) Flexstar GT+TD Total+NIS+AMS	2.68pt+12floz+0.25%v/v+2.5lb	99	99	99	99	99	65	99	99	99	99	99	65
(EPOST) RUPM+Cobra+PO+AMS	32floz+12.5floz+1.5pt+2.5lb	99	99	99	99	99	78	99	99	99	99	99	78
(EPOST) RUPM+Cobra+Resource+PO+AMS	32floz+12.5floz+4floz+1.5pt+2.5lb	99	99	99	99	99	83	99	99	99	99	99	83
LSD (0.05)		3	3	3	3	4	4	3	3	3	3	4	4

[1]NIS=R-11; HSMOC=Destiny HC; TD Total=Touchdown Total; PO=WCS Crop Oil

POST tankmixes in corn. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Prosper, ND to evaluate weed control in corn using POST applied herbicide mixtures. Roundup ready/Liberty Link corn was planted on May 27, 2014. POST treatments were applied on June 13, 2014 at 10:30 am with 80.0 F air, 58.0 F soil at a four inch depth, 21%RH, 0% cloud cover, 2-4 mph E wind, adequate soil moisture, excellent crop vigor, and no dew present at a V3 corn crop stage. Weed species present at the time of the EPOST treatments were: emerging-2" (5/yd^2) yellow foxtail, emerging-bolt (1-5/yd^2) wild mustard, emerging-2" (5/yd^2) redroot pigweed, emerging-2" (5/yd^2) common lambsquarters, emerging-1" (5/yd^2) eastern black nightshade, emerging-vining (1-5/yd^2) wild buckwheat, emerging-3" (1-5/yd^2) common ragweed, and emerging-4" (1-20/ft^2) common cocklebur. Soil characteristics were: 25% sand, 47% silt, 28% clay, clay loam, 4.2% OM, and 7.3 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 8.5 gpa at 40 psi through TT11001 nozzles for the POST applications. The experiment had a randomized complete block design with three replicates per treatment.

There was no injury to corn at any timing, in all treatments. At 28 and 42 days after post, all treatments gave excellent broadleaf control.

Table. POST tankmixes in corn (Zollinger, Wirth, Adams).

		7 DA POST							28 & 42 DA POST						
Treatment[1]	Rate	Yeft	Wimu	Rrpw	Colq	Hans	Corw	Cocb	Yeft	Wimu	Rrpw	Colq	Hans	Corw	Cocb
	(Product/A)	----------% control----------							----------% control----------						
POST															
(POST) Callisto+NIS	3fl oz+0.25%v/v	20	20	20	20	20	20	20	99	99	99	99	99	99	99
(POST) Callisto +RUPM+NIS+AMS	3fl oz +28fl oz+0.25%v/v+17lb/100gal	63	63	63	63	63	63	33	88	99	99	99	99	99	99
(POST) Callisto+Atrazine+NIS	3fl oz+0.66lb+0.25%v/v	30	30	30	30	30	30	20	62	99	99	99	99	99	99
(POST) Callisto+Atrazine +RUPM+NIS+AMS	3fl oz+0.66lb +28fl oz+0.25%v/v+17lb/100gal	70	70	70	70	70	70	20	99	99	99	99	99	99	99
(POST) Callisto+Atrazine +Harness+NIS	6.28fl oz+1.67lb +42fl oz+0.25%v/v	77	77	77	77	77	77	20	99	99	99	99	99	99	99
(POST) Callisto+Atrazine+Harness +RUPM+NIS+AMS	6.28fl oz+1.67lb+42fl oz +28fl oz+0.25%v/v+17lb/100gal	70	70	70	70	70	70	20	99	99	99	99	99	99	99
(POST) Callisto+Atrazine +Harness+NIS	6.5fl oz+0.83lb +44fl oz+0.25%v/v	78	78	78	78	78	78	22	99	99	99	99	99	99	96
(POST) Callisto+Atrazine+Harness +RUPM+NIS+AMS	6.5fl oz+0.83lb+44fl oz +28fl oz+0.25%v/v+17lb/100gal	77	77	77	77	77	77	20	99	99	99	99	99	99	99
(POST) Callisto+Harness+NIS	6.5fl oz+26fl oz+NIS	47	47	47	47	47	47	13	99	99	99	99	99	99	99
(POST) Callisto+Harness +RUPM+NIS+AMS	6.5fl oz+26fl oz +28fl oz+0.25%v/v+17lb/100gal	73	73	73	73	73	73	20	99	99	99	99	99	99	99
(POST) Pruvin+Callisto +Stinger+NIS	1.25oz+2.5fl oz +5fl oz+0.25%v/v	67	67	67	67	67	67	23	99	99	99	99	99	99	99
(POST) Privin+Callisto+Stinger +RUPM+NIS+AMS	1.25oz+2.5fl oz+5fl oz +28fl oz+0.25%v/v+17lb/100gal	63	63	63	63	63	89	37	99	99	99	99	99	99	99
(POST) Zemax+NIS	2.4qt+0.25%v/v	57	57	57	57	57	57	10	99	99	99	99	99	99	99
(POST) Zemax+Callisto +NIS+AMS	2.4qt+6.33fl oz +0.25%v/v+17lb/100gal	53	53	53	53	53	53	13	99	99	99	99	99	99	99
(POST) Lexar EZ+NIS	3.5qt+0.25%v/v	73	73	73	73	73	73	27	99	99	99	99	99	99	99
(POST) Lexar EZ +RUPM+NIS+AMS	3.5qt +28fl oz+0.25%v/v+17lb/100gal	73	73	73	73	73	73	27	99	99	99	99	99	99	99
(POST) Lumax EZ+NIS	3.25qt+0.25%v/v	77	77	77	77	77	77	30	99	99	99	99	99	99	99
(POST) Lumax EZ +RUPM+NIS+AMS	3.25qt +28fl oz+0.25%v/v+17lb/100gal	77	77	77	77	77	77	37	99	99	99	99	99	99	99
(POST) Halex GT+NIS+AMS	4pt+0.25%v/v+17lb/100gal	73	73	73	73	73	73	37	99	99	99	99	99	99	99
(POST) Halex GT +RUPM+NIS+AMS	4pt +28fl oz+0.25%v/v+17lb/100gal	77	77	77	77	77	77	50	99	99	99	99	99	99	99
LSD (0.05)		7	7	7	7	7	10	8	3	ns	ns	ns	ns	2	ns

[1]RUPM=Roundup Powermax; NIS=Nonionic Surfactant

Tolpyralate in corn. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Prosper, ND to evaluate weed control and crop tolerance to tolpyralate. Roundup ready/Liberty Link corn was planted on May 27, 2014. PRE treatments were applied on May 27, 2014 at 4:00 pm with 90.0 F air, 67.0 F soil at a four inch depth, 35% RH, 100% cloud cover, 2-5 mph N wind, and adequate soil moisture. EPOST treatments were applied on June 13, 2014 at 10:30 pm with 80.0 F air, 58.0 F soil at a four inch depth, 21%RH, 0% cloud cover, 2-4 mph E wind, adequate soil moisture, excellent crop vigor, and no dew present at a V3 corn crop stage. Weed species present at the time of the EPOST treatments were: emerging-2" (5/yd^2) yellow foxtail, emerging-bolt (1-5/yd^2) wild mustard, emerging-2" (5/yd^2) redroot pigweed, emerging-2" (5/yd^2) common lambsquarters, emerging-1" (5/yd^2) eastern black nightshade, emerging-vining (1-5/yd^2) wild buckwheat, emerging-3" (1-5/yd^2) common ragweed, and emerging-4" (1-20/ft^2) common cocklebur. Soil characteristics were: 25% sand, 47% silt, 28% clay, clay loam, 4.2% OM, and 7.3 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through TT11002 nozzles for the PRE applications and delivering 8.5 gpa at 40 psi through TT11001 nozzles for the EPOST applications. The experiment had a randomized complete block design with three replicates per treatment.

Tolpyralate is an HPPD mode of action active ingredient applied at EPOST. At the time of PRE application there was already emerged common cocklebur which effected efficacy. At the time of EPOST application, efficacy of common cocklebur was lower due to a dense, 4" tall stand. PRE herbicides were adequately activated by spring moisture. Using common cocklebur as an indicator species we can see that tolpyralate gave significantly less efficacy than mesotrione and topramezone. The addition of glyphosate or glufosinate may have resulted in antagonistic effects when tankmixed with tolpyralate and atrazine.

Table. Tolpyralate in corn (Zollinger, Wirth, Adams).

			7 DAE/PTP								28 & 42 DA EPOST							
Treatment[1]		Rate	Corn	Yeft	Wimu	Rrpw	Colq	Hans	Corw	Cocb	Corn	Yeft	Wimu	Rrpw	Colq	Hans	Corw	Cocb
		(Product/A)	-%inj-	----------	----------	----------	% control	----------	----------	----------	-%inj-	----------	----------	----------	%control	----------	----------	----------
PRE																		
(PRE)	Dual II Magnum	1.67pt	0	90	60	95	90	70	0	0	0	99	50	90	90	40	10	0
PRE/EPOST																		
(PRE)	Dual II Magnum	1.67pt																
(EPOST)	Tolpyralate	1floz	0	90	60	95	90	70	0	0	0	99	99	99	99	99	99	77
	+Atrazine+MSO+28%	1pt+1%v/v+2.5%v/v																
(PRE)	Dual II Magnum	1.67pt																
(EPOST)	Tolpyralate	1.37floz	0	90	60	95	90	70	0	0	0	99	99	99	99	99	99	81
	+Atrazine+MSO+28%	1pt+1%v/v+2.5%v/v																
(PRE)	Dual II Magnum	1.67pt																
(EPOST)	Tolpyralate+RUPM	1floz+22floz	0	90	60	95	90	70	0	0	0	99	99	99	99	99	99	69
	+Atrazine+HSMOC+28%	1pt+1%v/v+2.5%v/v																
(PRE)	Dual II Magnum	1.67pt																
(EPOST)	Tolpyralate+RUPM	1.37floz+22floz	0	90	60	95	90	70	0	0	0	99	99	99	99	99	99	69
	+Atrazine+HSMOC+28%	1pt+1%v/v+2.5%v/v																
(PRE)	Dual II Magnum	1.67pt																
(EPOST)	Tolpyralate+Liberty	1floz+22floz	0	90	60	95	90	70	0	0	0	99	99	99	99	99	99	66
	+Atrazine+HSMOC+28%	1pt+1%v/v+2.5%v/v																
(PRE)	Dual II Magnum	1.67pt																
(EPOST)	Tolpyralate+Liberty	1.37floz+22floz	0	90	60	95	90	70	0	0	0	99	99	99	99	99	99	68
	+Atrazine+HSMOC+28%	1pt+1%v/v+2.5%v/v																
(PRE)	Dual II Magnum	1.67pt																
(EPOST)	Callisto	3floz	0	90	60	95	90	70	0	0	0	99	99	99	99	99	99	96
	+Atrazine+PO+28%	1pt+1%v/v+2.5%v/v																
(PRE)	Dual II Magnum	1.67pt																
(EPOST)	Impact	1floz	0	90	60	95	90	70	0	0	0	99	99	99	99	99	99	96
	+Atrazine+PO+28%	1pt+1%v/v+2.5%v/v																
LSD (0.05)			ns	ns	ns	ns	ns	ns	ns	ns	ns	2	2	2	2	2	2	3

[1]RUPM=Roundup Powermax; HSMOC=Destiny HC; PO=WCS Crop Oil

Resistant common ragweed control using Enlist Duo (Study 1). Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Mayville, ND to evaluate glyphosate resistant common ragweed control using Enlist. DKC 33-35 corn was planted on May 21, 2014. PRE treatments were applied on May 21, 2014 at 1:10 pm with 65.0 F air, 59.0 F soil at a four inch depth, 45% RH, 80% cloud cover, 8-10 mph NW wind, and adequate soil moisture. POST treatments were applied on June 13, 2014 at 6:15 am with 56.0 F air, 58.0 F soil at a four inch depth, 74% RH, 0% cloud cover, 1-3 mph W wind, adequate soil moisture, good crop vigor, and dew present at a V4 corn crop stage. Weed species present at the time of the POST treatments were: emerging-1" (5/yd^2) common lambsquarters, and emerging-1" (5-10/ft^2) common ragweed. Soil characteristics were: 70.6% sand, 20.6% silt, 8.8% clay, Sandy Loam, 2.8% OM, and 6.8 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through TT11002 nozzles for the PRE applications and delivering 8.5 gpa at 40 psi through TT11001 nozzles for the POST applications. The experiment had a randomized complete block design with three replicates per treatment.

This study represents the importance of the use of a PRE herbicide and utilizing different effective modes of action to control glyphosate resistant weeds (common ragweed). EPOST and POST treatments of glyphosate resulted in good control on common ragweed weeds at 14 and 28 days after POST. The use of Lumax EZ (mesotrione+s-metolachlor+atrazine) and Corvus (isoxaflutole+thiencarbazone) as PRE herbicides helped give excellent control of all weeds at 14 and 28 days after POST.

Table. Resistant common ragweed control using Enlist Duo (Study 1) (Zollinger, Wirth, Adams).

		Prior to POST			14 DA POST			28 DA POST		
Treatment[1]	Rate	Rrpw	Colq	Corw	Rrpw	Colq	Corw	Rrpw	Colq	Corw
	(Product/A)	-----% control-----			-----% control-----			-----%control-----		
PRE/POST										
(PRE) SureStart II	2pt	99	99	95	99	99	89	99	99	83
(POST) Durango+AMS	1.5pt+8.5lb/100gal									
(PRE) SureStart II	2pt	99	99	95	99	99	99	99	99	99
(POST) Enlist Duo+AMS	3.5pt+8.5lb/100gal									
(PRE) SureStart II	2pt	99	99	96	99	99	99	99	99	99
(POST) Enlist Duo+AMS	4.67pt+8.5lb/100gal									
(PRE) Harness Xtra 5.6	2qt	99	99	96	99	99	99	99	99	99
(POST) RUPM+Clarity+AMS	1.33pt+1pt+8.5lb/100gal									
(PRE) Corvus	5fl oz	99	99	96	99	99	99	99	99	99
(POST) Durango+AMS	1.5pt+8.5lb/100gal									
(PRE) Lumax EZ	2.7qt	99	99	96	99	99	99	99	99	99
(POST) Durango+AMS	1.5pt+8.5lb/100gal									
(PRE) Verdict	15fl oz	99	99	95	99	99	92	99	99	92
(POST) Durango+AMS	1.5p+8.5lb/100gal									
LSD (0.05)		ns	ns	2	ns	ns	4	ns	ns	4

[1]RUPM=Roundup Powermax

Resistant common ragweed control using Enlist Duo (Study 2). Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Mayville, ND to evaluate glyphosate resistant common ragweed control using SureStart and Enlist Duo at different timings. DKC 33-35 corn was planted on May 21, 2014. PRE treatments were applied on May 21, 2014 at 1:10 pm with 65.0 F air, 59.0 F soil at a four inch depth, 45% RH, 80% cloud cover, 8-10 mph NW wind, and adequate soil moisture. EPOST treatments were applied on June 4, 2014 1:00 pm with 89.0 F air, 75.0 F soil at a four inch depth, 25% RH, 50% cloud cover, 0-2 mph SW wind, adequate soil moisture, good crop vigor, and no dew present at a V2 corn crop stage. Weed species present at the time of the EPOST treatments were: seedling (5-6/ft^2) common ragweed, seedling (2/ft^2) common lambsquarters, and seedling (3/ft^2) amaranth. POST treatments were applied on June 13, 2014 at 6:15 am with 56.0 F air, 58.0 F soil at a four inch depth, 74% RH, 0% cloud cover, 1-3 mph W wind, adequate soil moisture, good crop vigor, and no dew present at a V4 corn crop stage. Weed species present at the time of the POST treatments were: emerging-1" (5/yd^2) common lambsquarters, and emerging-1" (5-10/ft^2) common ragweed. Soil characteristics were: 70.6% sand, 20.6% silt, 8.8% clay, Sandy Loam, 2.8% OM, and 6.8 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through TT11002 nozzles for the PRE applications, delivering 8.5 gpa at 40 psi through TT11001 nozzles for the EPOST and POST applications. The experiment had a randomized complete block design with three replicates per treatment.

This study represents the importance of the use of a PRE herbicide and utilizing different effective modes of action to control glyphosate resistant weeds (common ragweed).

Table. Resistant common ragweed control using Enlist Duo (Study 2). (Zollinger, Wirth, Adams)

		Prior to POST			14 DA POST			28 DA POST		
Treatment[1]	Rate	Colq	Wibw	Corw	Colq	Wibw	Corw	Colq	Wibw	Corw
	(Product/A)	-----% control------			----% control-----			-----%control-----		
PRE/EPOST										
(PRE) SureStart II	2pt	99	99	94	99	99	83	99	99	83
(EPOST) Durango+AMS	2pt+8.5lb/100gal									
(PRE) SureStart II	1.5pt	99	99	92	99	99	88	99	99	87
(EPOST) Enlist Duo+AMS	3.5pt+8.5lb/100gal									
(PRE) SureStart II	1.5pt	99	99	93	99	99	92	99	99	88
(EPOST) Enlist Duo+AMS	4.67pt+8.5lb/100gal									
(PRE) Harness Xtra 5.6	3pt	99	99	99	99	99	99	99	99	99
(EPOST) RUPM+Clarity+AMS	1.77pt+1pt+8.5lb/100gal									
(PRE) Corvus	5fl oz	99	99	99	99	99	99	99	99	99
(EPOST) Durango+AMS	2pt+8.5lb/100gal									
(PRE) SureStart II	2pt	99	99	82	99	99	87	99	99	90
(EPOST) Durango+AMS	2pt+8.5lb/100gal									
EPOST										
(EPOST) RUPM+Clarity+AMS	1.77pt+1pt+8.5lb/100gal	99	99	95	99	99	90	99	99	83
(EPOST) Halex GT+NIS+AMS	3.6pt+0.25% v/v+8.5lb/100gal	96	96	53	96	96	90	96	96	91
PRE/POST										
(PRE) SureStart II	1.5pt	99	99	77	99	99	92	99	99	95
(POST) Enlist Duo+AMS	3.5pt+8.5lb/100gal									
(PRE) SureStart II	1.5pt	99	99	82	99	99	90	99	99	95
(POST) Enlist Duo+AMS	4.67pt+8.5lb/100gal									
(PRE) Harness Xtra 5.6	3pt	99	99	70	99	99	95	99	99	95
(POST) RUPM+Clarity+AMS	1.77pt+1pt+8.5lb/100gal									
POST										
(POST) Halex GT+NIS+AMS	3.6pt+0.25% v/v+8.5lb/100gal	0	0	0	99	99	50	99	99	57
(POST) Durango+AMS	2pt+8.5lb/100gal	0	0	0	99	99	47	99	99	40
(POST) Enlist Duo+AMS	3.5pt+8.5lb/100gal	0	0	0	99	99	70	99	99	75
(POST) Enlist Duo+AMS	4.67pt+8.5lb/100gal	0	0	0	99	99	88	99	99	93
(POST) RUPM+Clarity+AMS	1.77pt+1pt+8.5lb/100gal	0	0	0	99	99	68	99	99	95
LSD (0.05)		1	1	7	1	1	11	1	1	6

[1]RUPM=Roundup Powermax, NIS=Nonionic Surfactant

Corn response to initial timing of weed control, Carrington, 2014.
(Greg Endres and Mike Ostlie)

Trial objective was to generate additional data for a ND corn database showing the yield response based on timing of initial herbicide application for weed control. Experimental design was a randomized complete block with four replications. The dryland field trial was established at the NDSU Carrington Research Extension Center on conventionally-tilled Heimdal-Emrick loam soil with 3.0% organic matter and 6.3 pH. Croplan '2520RR' was planted at 32,000 seeds/A in 22-inch rows on May 16. Corn plant emergence across the trial was May 26. Weed species included green and yellow foxtail, common lambsquarters, common ragweed, Eastern black and hairy nightshade, kochia, prostrate and redroot pigweed, volunteer soybean and wild buckwheat. Herbicides were applied using a CO_2 hand-boom sprayer with 8001 flat fan nozzles delivering 17.5 gal/A (PRE) or 12 gal/A (POST) at 35 PSI. Balance Flexx at 6 fl oz/A plus Aatrex 4L at 16 fl oz/A were PRE applied May 16 as the planting time treatment with 60 degrees F, 21% RH, and 10 mph wind to a dry soil surface. Rain at 0.24 inches occurred on May 19 and totaled 0.55 inches on May 30. Glyphosate (Roundup PowerMax) at 22 fl oz/A plus Status at 5 oz/A and Class Act NG at 2.5% v/v was the POST treatment. The PRE treatment was followed by POST herbicides on June 3 to supplement initial weed control. Average weed densities (plants/ft^2) measured on June 11: grass = 1 and broadleaf = 25. Timing of POST1 herbicide application was June 10 with 70 degrees F, 57% RH, and 8 mph wind to V3 stage (3-collar and 8- to 10-inch height) corn and weeds averaging 3 inches in height (range of 0.5 to 6 inches). Timing of POST2 herbicide application was June 21 with 79 degrees F, 60% RH, and 4 mph wind to V5-6 stage (5- to 6-collar and 15-inch height) corn and weeds averaging 9 inches in height (range of 3 to 19 inches). Timing of POST3 herbicide application was July 2 with 54 degrees F, 90% RH, and 7 mph wind to V7 stage (7-collar and 24- to 28-inch height) corn and weeds averaging 24 inches in height (range of 1 to 36 inches. The trial was harvested with a plot combine on October 3.

Corn plants with PRE or POST1 herbicide application for initial weed control generally were taller and had earlier silk dates compared to corn with later POST initial weed control or the untreated check (Table). Green color of corn plants generally lessened with delay in initial weed control. Plant lodge and seed moisture at harvest generally were similar among herbicide treatments and less than the untreated check. PRE and POST1 weed control provided greater seed yield compared to delayed POST weed control or the untreated check. Test weight with PRE-timed weed control was less compared to POST2 and POST3 weed control.

Table. Corn response to timing of initial application of herbicides for weed control, Carrington, 2014.

Treatment	Plant[1]						Seed		
Factor	Height (cm)		Leaf color (0-9)		Silk date	Lodge	Yield	Test weight	Moisture (harvest)
	11-Jul	1-Aug	11-Jul	1-Aug	Jday	27-Sep	bu/A	lb/bu	%
Weed control[2]									
untreated check	97	142	6	5	217	10	59.5	52.7	17.5
PRE/POST	122	196	9	9	210	2	162.0	54.2	15.6
POST1	120	199	8	8	210	1	159.1	54.5	14.9
POST2	104	189	7	7	212	2	138.8	55.2	15.5
POST3	109	157	5	6	213	4	125.6	55.2	15.6
LSD (0.05)	15	26	2	2	2	5	18.7	1.0	0.5
mean	111	176	7	7	212	4	129.0	54.4	15.8
CV (%)	8.5	9.4	14.2	14.9	0.6	81.9	9.4	1.2	2.0

[1]Leaf color: 0=yellow, 9=dark green; Lodge: number of plants/3 rows with lodged stems below ears.

[2]PRE=May 16 (fb POST June 3); POST1=June 10; POST2=June 21; POST3=July 7.

Glyphosate resistant kochia control using liberty. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Barney, ND to evaluate kochia control in soybean. Roundup ready soybean was planted on May 28, 2014. PRE treatments were applied on May 28, 2014 at 3:15 pm with 89.0 F air, 72.0 F soil at a four inch depth, 18% RH, 0% cloud cover, 3-8 mph S wind, and adequate soil moisture. EPOST treatments were applied on July 2, 2014 at 11:15 am with 72.0 F air, 60.0 F soil at a four inch depth, 42% RH, 5% cloud cover, 4-6 mph N wind, moist soil moisture, and no dew present at V2 soybeans. Soil characteristics were: 38% sand, 39% silt, 23% clay, loam, 4.9% OM, and 7.7 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through TT11002 nozzles for the PRE and POST applications. The experiment had a randomized complete block design with three replicates per treatment.

This study represents the importance of utilizing different effective modes of action to control glyphosate resistant weeds (kochia). Spring tillage and wet soils resulted in low kochia emergence and a lack of multiple flushes throughout the growing season. All treatments resulted in 99% efficacy at with 0% soybean injury.

Table. Glyphosate resistant kochia control using Liberty (Zollinger, Wirth, Adams).

		Prior to POST						14 and 28 DA EPOST					
Treatment[1]	Rate	Soy	Rrpw	Wahe	Colq	Biww	Koch	Soy	Rrpw	Wahe	Colq	Biww	Koch
	(Product/A)	-%inj-	----------%control----------					-%inj-	----------%control----------				
PRE/EPOST/LPOST													
(PRE) Valor XLT	3.5oz												
(EPOST) Liberty+Zidua+AMS	29floz+2oz+8.5lb/100gal												
(LPOST) Liberty+AMS	29floz+8.5lb/100gal	0	99	99	99	99	99	0	99	99	99	99	99
PRE/MPOST/LPOST													
(PRE) Authority First	6.5oz												
(MPOST) Liberty+AMS	29floz+8.5lb/100gal												
(LPOST) Liberty+AMS	29floz+8.5lb/100gal	0	99	99	99	99	99	0	99	99	99	99	99
(PRE) Fierce	3.5oz												
(MPOST) Liberty+AMS	29floz+8.5lb/100gal												
(LPOST) Liberty+AMS	29floz+8.5lb/100gal	0	99	99	99	99	99	0	99	99	99	99	99
(PRE) Valor	3oz												
(MPOST) Liberty+Dual II Magnum +AMS	36floz+1.33pt +8.5lb/100gal												
(LPOST) Liberty+Select Max+AMS	29floz+6floz+8.5lb/100gal	0	99	99	99	99	99	0	99	99	99	99	99
(PRE) Valor	3oz												
(MPOST) Liberty+Dual II Magnum +Select Max+AMS	36floz+1.33pt +6floz+8.5lb/100gal												
(LPOST) Liberty+AMS	29floz+8.5lb/100gal	0	99	99	99	99	99	0	99	99	99	99	99
(PRE) Authority Max	10oz												
(MPOST) Liberty+Dual II Magnum +Select Max+AMS	36floz+1.33pt +6floz+8.5lb/100gal												
(LPOST) Liberty+AMS	29floz+8.5lb/100gal	0	99	99	99	99	99	0	99	91	99	99	99
(PRE) Sharpen+Zidua	1floz+2oz												
(MPOST) Liberty+Select Max+AMS	36floz+6floz+8.5lb/100gal												
(LPOST) Liberty+AMS	29floz+8.5lb/100gal	0	99	99	99	99	99	0	99	99	99	99	99
EPOST/MPOST													
(EPOST) Liberty+Prefix+AMS	29floz+32floz+8.5lb/100gal												
(MPOST) Liberty+Warrant +Select Max+AMS	29floz+3pt +6floz+8.5lb/100gal	0	99	99	99	99	99	0	99	99	99	99	99
(EPOST) Liberty+Warrant+AMS	36floz+3pt+8.5lb/100gal												
(MPOST) Liberty+Cadet +Select Max+AMS	36floz+0.7floz +6floz+8.5lb/100gal	0	99	99	99	99	99	0	99	99	99	99	99
(EPOST) Liberty+Select Max+AMS	36floz+6floz+8.5lb/100gal												
(MPOST) Liberty+Warrant+AMS	29floz+3pt+8.5lb/100gal	0	99	99	99	99	99	0	99	99	99	99	99
(EPOST) Liberty+Warrant+AMS	36floz+3pt+8.5lb/100gal												
(MPOST) Liberty+Select Max+AMS	29floz+6floz+8.5lb/100gal	0	99	99	99	99	99	0	99	99	99	99	99
LSD (0.05)		ns	ns	ns	ns	ns	ns	ns	ns	7	ns	ns	ns

Glufosinate control of kochia. Howatt, Roach, and Harrington. No crop was seeded at this location near Rogers, North Dakota. Treatments were applied to 4 to 10 inch kochia on June 13 with 69°F, 46% relative humidity, 20% cloud cover, 2 to 5 mph wind velocity at 250°, and most soil at 62°F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 38 psi through 11002 TT nozzles to a 7 foot wide area the length of 10 by 30 foot plots. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	Kocz 6/20	Kocz 6/26	Kocz 7/15
	oz ai/A	%	%	%
Gluf+AMS	6.4+48	76	65	76
Gluf+AMS	8.5+48	81	84	84
Gluf+AMS	10.5+48	86	87	85
Gluf+AMS	12.8+48	92	91	92
Gluf+Atra+AMS	6.4+8+48	60	86	85
Gluf+Metr+AMS	6.4+6+48	65	91	91
Gluf+Temb+AMS	6.4+1.3+48	82	89	88
CV		6	4	3
LSD (P=0.05)		7	5	4

Kochia control tended to increase with increasing glufosinate rate. Glufosinate at 12.8 oz/A was required to exceed 90% control. Even though kochia was fairly large, control of kochia with glufosinate was consistent across evaluation dates. Evidence of regrowth was not present. Addition of metribuzin increased control from 76% to 91%. Addition of tembotrione or atrazine increased control to the mid 80s.

Timing of winter rye removal for weed control in soybeans

Mike Ostlie and Steve Zwinger

Soybean production in North Dakota is currently threatened by numerous factors which include glyphosate resistant weeds, root and foliar diseases, soil erosion, and creeping salinity. Winter rye is growing in popularity due to a number of different niches it can fill in a crop rotation. Besides being harvested for grain, rye can also be used as a forage or cover crop. One of the main benefits it provides as a cover crop is weed control through a combination of allelopathy and heavy competition. The strengths of rye can also be used to supplement the weaknesses of soybeans. Rye can be used to break up disease cycles, provide weed suppression, provide winter cover, use excess spring moisture, or be used for fall or spring grazing; all while still utilizing the growing season for a cash crop.

A study was conducted at the Carrington Research Extension Center in 2014 to evaluate weed control and soybean yields under different scenarios of removing rye. The treatments consisted of a no-rye check, plots with rye tilled into the soil or sprayed prior to planting soybeans, treatments where rye was either mowed, harvested for forage or sprayed at anthesis, and a treatment where rye was left for the duration of the soybean growing season. The rye was planted on 9/26 2013. Soybeans were planted on 6/3 2014 into rye that was just entering the boot stage. A supplemental glyphosate application was made to all soybeans (except in treatments 6 and 7) on June 16.

Kochia control varied by rep, based on plant stand, and ranged from 30-70%. When averaged across treatments, there was no pre-existing treatment differences in kochia stand prior to implementing the rye removal strategies. The weed suppression was largely in the form of reduced kochia growth and vigor, but not necessarily reduced plant numbers. Soybean growth and development did not appear to be influenced by the presence of rye, nor the removal strategies (other than mechanical damage) through the June 16 rye removal treatments, when rye was at anthesis and the soybeans were developing their first true leaves. The weed suppression of the Hancock rye disappeared once the rye began the senescence process and the canopy opened up. At that point, the stunted kochia within the canopy began more vigorous growth. By the middle of August, this rye variety on its own lost most of its effectiveness on kochia. The other treatments, aided by the application of glyphosate continued to maintain a high level of suppression, even though the rye had been removed quite some time ago. The most impressive treatment was the application of glyphosate at anthesis, in which the rye carcasses remained intact (retaining some canopy coverage) until soybean harvest, although there was not statistically more weed control than treatments 3-5. This data suggests that the longer the rye remains in the field, up until anthesis, the better the weed control. There is also preliminary data to suggest that different rye varieties have different levels of allelopathy (data not shown). Hancock is a variety that appears to be effective until flowering, while some other varieties appear to maintain a higher level of allelopathic activity for longer. This could possibly be related to reallocating resources for seed production in some of these varieties.

In the treatments where rye remained past anthesis, soybean yields were heavily influenced (~75% reduction compared to other treatments). Meanwhile, in the plot where rye was harvested as grain, the rye yielded 27 bu/a. Letting the rye remain until soybean harvest reduced those yields to roughly eight bu/a. When rye was harvested as grain, the total bu/a for the soybeans and rye was roughly the same as the soybean bu/a for most other treatments. If soybeans were $10/bu and rye was $6/bu (based on recent pricing) that would put the total revenue from producing the two crops at roughly the same level

as producing only the soybeans. Rye harvested as a forage resulted in over one ton of dry matter per acre, plus over 35 bu/a soybeans. However, in field scale operations, the soybean yield would likely be lower due to the mechanical damage from the baling operation and bale removal, although the soybeans may still be small enough to recover from some of the damage. The highest soybean yield was achieved with the pre-plant burndown of the rye. This likely resulted in lower early season competition with the soybeans. It was different from the tilled treatment for two possible reasons; 1) due to the dry conditions at the end of the growing season, the no-till nature of the burndown treatment provided a moisture bonus to those plots, or 2) incorporating rye residue into the soil caused some allelopathic damage to the soybeans. The no-rye check plot had a fairly low yield as well. Much of that is attributed to lack of weed control early in the season, as all other plots retained an average of ~50% kochia suppression.

Overall, the rye and soybeans grew well together. The rye recovered remarkably well from the soybean planting operation, and the soybeans grew through the rye canopy with ease for the first month or so (through rye anthesis). The soybeans didn't seem heavily influenced by any direct rye allelopathic effects. This could be due to the soybean planting operation clearing a path around the soybean root zone. The soybean yields could have been higher in the treatments involving rye that was harvested as grain if more moisture was received during the latter portion of the growing season, making the incrome from of harvesting both crops potentially similar to harvesting a single soybean crop, but with the added benefits of low input costs and more winter cover. Treatments that had rye growing until anthesis or beyond would also provide more ground cover for the winter. This means that a single winter rye crop could provide cover for the winters prior to and after soybean production. Ultimately, the rye was a benefit to the soybean production system in most scenarios. The decision about a specific method and time of removal could be left to an individual producer to fit within existing production framework and objectives.

Table 1. Weed control and yield of soybeans based on different winter rye removal strategies

Treatment	ne of Remo	Kochia Control 28-May	15-Jul	18-Aug	Yield Test Weight	Soybean	Rye	Rye Biomass Fresh	Dry
		%	%		lb/bu	bu/a	bu/a	lb/a	lb/a
1 no rye		0	-	62.5	56.3	29.0	-	-	-
2 rye tilled	27-May	46.3	-	66.3	57.2	37.4	-	-	-
3 rye sprayec	27-May	50	-	76.3	57.3	48.0	-	-	-
4 rye mowed	16-Jun[2]	53.7	-	77.5	56.9	37.1	-	-	-
5 rye forage	16-Jun	60	-	77.5	56.8	36.2	-	5258.5	2155.1
6 rye left sta	na	55	38.8	16.3	57.3	9.7	7.8	-	-
7 rye harvest	6-Aug	53.8	45	16.3	57.3	12.1	27.6	-	-
8 rye sprayec	16-Jun	46.3	-	88.8	56.6	32.7	-	-	-
LSD (0.05)		NS	9.1	12.9	0.3	8.4			

[1]Spray application was glyphosate
[2]Soybeans first true leaves, rye @ anthesis

soybeans planted 6/3
soybeans harvested 10/8
rye planted 9/26, 2013
previous crop: flax

Employing fall vs spring herbicides to combat glyphosate-resistant kochia in soybeans

Mike Ostlie and Greg Endres

Glyphosate-resistant (GR) kochia has risen to the forefront of growing issues facing soybean producers in central North Dakota. There are several factors that contribute towards kochia problems in soybeans: 1) post-emergence broadleaf weed control options in soybeans are limited, 2) kochia has many strengths that align with soybean weaknesses (salinity and drought tolerance, for example), 3) lack of residue after soybean harvest leads to more kochia seed dispersal via wind. The easiest way to control kochia in soybeans is to use an effective pre-emergence herbicide program. However, in central and western North Dakota, the soybean planting season may not align with sufficient rainfall patterns to activate pre-emergence herbicides and light soil textures can lead to herbicide injury to the crop. Plus, in years like 2014, kochia emergence occurred in the spring before any field activity began, leaving no-till producers with few options if glyphosate-resistant kochia was present. A fall application could theoretically solve these issues provided the weed control was sufficient.

In the fall of 2013 a study was initiated to evaluate the effectiveness of fall-applied herbicides when compared to spring-applied herbicide programs. The main objective was to identify if there were any fall applications that would provide kochia control similar to a typical spring application. Fall applications were made on Oct 30, 2013 while spring applications were made on May 7, 2014. It should be noted that kochia had already emerged on May 1, so the weed control ratings for the spring treatments are considered post-emergence whereas the fall treatments would be pre-emergence control of kochia. Herbicide efficacy evaluations were taken on two dates, as well as a late-season assessment of kochia regrowth (and hence a snapshot of the duration of herbicide residual activity). During the first evaluation on May 28, two ratings were taken based on the size of kochia plants, one for kochia with four leaves or less, and one for kochia larger than that. Glyphosate was applied after the June 19 evaluation to better elicit the regrowth of new kochia (no GR kochia was present in this study). Soybean seed yield and test weight were also taken to determine if herbicide injury occurred to the crop.

During the first rating session, most of the products used as spring treatments provided excellent control of small kochia, meaning less than four leaf or 0.5" (Table 1). With the larger kochia plants, most of the other products (fall and spring) would be considered poor to good control. During the second evaluation, the small dead kochia were not considered and only ratings of the remaining kochia were taken. This control was generally the same or slightly greater than the earlier evaluation. Across herbicide treatments, there was no significant effect of fall vs spring treatments. Some herbicides, however, were better as a fall-applied product, and some were better spring-applied. Anthem, Spartan, Valor, and Fierce were equal or better when fall-applied, although it should be noted that the fall rate of Spartan was 8 oz/a vs. the spring application which was 5 oz/a. Metribuzin and BroadAxe were better as a spring treatment. The big difference between the fall and spring applications was the length of residual. Fall-applied products (in general) did not suppress kochia through canopy closure as well as spring treatments. There were some soybean yield differences based on the applied herbicide. However, this was not due to herbicide injury but due to poor weed control. The plots with poor weed control (i.e. the non-treated plots and fall metribuzin) had the lowest yields. Products that have been known to cause soybean injury in some cases, were generally among the yield leaders, simply due to better weed suppression.

Both BroadAxe and metribuzin were pleasant surprises in this study. BroadAxe is a mixture of Spartan + Dual II. Dual II is not known for kochia control but did seem to provide a boost to the Spartan component of the mix, plus it will also provide grass control. Metribuzin (Group 5) is one of the few products in the list that isn't a PPO inhibitor (Group 14). Group 14 herbicide resistance is likely the next thing that will emerge in kochia populations as this mode-of-action is currently the most effective (and in soybean, one of the only effective) chemistries that will still control all kochia populations, and therefore should see heavy use. Metribuzin is also inexpensive, more closely compared to application costs of glyphosate than many other pre-emergence herbicides available. With this in mind, it should be easy to incorporate 2 to 3 modes-of-action in a pre-emergence herbicide program to combat kochia populations.

Effective fall-applied herbicides are available. Once the soil temperatures in the fall limit the amount of microbial degradation, using Spartan, Valor, or Fierce in the fall could be an attractive option for those who have had issues with product activation or who would rather spend time on weed control in the fall, rather than the spring during planting.

From a weed resistance stand point, a combination of three modes-of-action could be achieved with several product combinations. At this time, the most effective such combination appears to be sulfentrazone (Group 14) + metribuzin (Group 5) + pyroxasulfone (Group 15) (these weren't applied together in this study). This could be followed up with bentazon (Group 6) as an early post-emergence treatment, and if needed, with a third application of something like fomesafen (Flexstar or Marvel).

Table 1. Comparison of fall vs spring treatments to control kochia prior to soybean establishment.

App Time[1]	Product	Rate	5/28 kochia > 4 leaf	5/28 kochia ≤ 4 leaf	6/19 kochia control	8/6 regrowth[2]	Test Weight	Yield
		oz/a	0-99	0-99	0-99	% of plots	lb/bu	bu/a
	non treated		0		0	100	55.4	31.3
fall	Anthem	12	28		45	100	56.4	50
fall	Broadax	25	59		56	75	56.3	44.4
fall	Fierce	3	55		67	50	56.4	45.5
fall	metribuzin	0.5 lb/a	24		18	25	55.8	36.7
fall	Spartan	8	89		84	100	56.5	46.3
fall	Valor	3	40		60	100	56.2	47.8
spring	Anthem	12	45	99	42	50	56.4	42.2
spring	Broadax	25	86	97	83	25	56.3	47.4
spring	Fierce	3	41	95	55	25	56.3	49.8
spring	metribuzin	0.5 lb/a	75	99	84	75	56.6	45.2
spring	Spartan	5	68	99	72	100	56.7	48.7
spring	Valor	3	51	90	60	70	56.4	44.4
LSD (α=0.05)			13	3	14	50	0.6	7.7

[1]fall applications made on Oct 30, spring applications on May 7

[2]soybeans were at 80% canopy closure

*trial was planted on 6/3; glyphosate sprayed after the 6/19 evaluations

Control of emerged kochia in a spring burndown. (Jenks, Walter, and Willoughby). The objective of the study was to evaluate alternative methods for controlling emerged kochia in a spring burndown that may be glyphosate-resistant. There was no crop planted in the field. Herbicide treatments were applied June 5 to 0.5- to 4-inch kochia with about 12 plants/ft^2. All treatments were applied with recommended adjuvants to enhance foliar control.

Glyphosate provided poor kochia control indicating it may be glyphosate-resistant. Sharpen and any Spartan or Authority product provided good to excellent kochia control through mid-July. Gramoxone provided good kochia control as well. Herbicides with longer residual such as Spartan/Authority provided better long-term control.

Table. Control of emerged kochia in a spring burndown. (1407)

Treatment[a]	Rate/A	Kochia contol			
		Jun-12	Jun-19	Jul-02	Jul-17
		----------%----------			
Untreated		0	0	0	0
Glyphosate[b] + AMS	32 fl oz + 2.5 gal	62	72	59	30
Sharpen + MSO + AMS	2 fl oz + 1% + 2.5 gal	98	98	95	89
Gramoxone + NIS	2 pt + 0.25%	98	97	93	85
Liberty 280 + AMS	29 fl oz + 8.82 gal	83	79	62	33
Spartan + MSO	4 fl oz + 1%	95	91	90	92
Spartan Charge + MSO	5 fl oz + 1%	99	99	97	97
Spartan + Sharpen + MSO	4 fl oz + 1 fl oz + 1%	99	98	97	97
Authority MTZ + MSO	10 oz + 1%	97	97	97	94
Authority MTZ + MSO	12 oz + 1%	97	98	98	95
Authority MTZ + MSO	14 oz + 1%	98	98	98	97
LSD (0.05)		5.9	5.3	4.8	4.2
CV		4.1	3.7	3.5	3.3

[a] *All treatments applied June 5 to 0.5-4 inch kochia (no crop)*

[b] *Glyphosate = 3 lb ae formulation*

Control of emerged kochia using soybean herbicides. (Jenks, Walter, and Willoughby). The objective of the study was to evaluate alternative methods for controlling emerged glyphosate-resistant kochia in a spring burndown using soybean herbicides. There was no crop planted in the field. Herbicide treatments were applied June 5 to 0.5- to 4-inch kochia with about 12 plants/ft^2. All treatments were applied with recommended adjuvants to enhance foliar control.

Glyphosate + Zidua provided poor kochia control. Kochia control was greater where Metribuzin was applied at 0.5 lb compared to 0.25 lb/A. Verdict tended to provide slightly better kochia control than Sharpen treatments. Treatments containing Spartan/Authority provided excellent kochia control. Fierce was not as effective as the Spartan/Authority treatments. Cadet provided poor kochia control.

Table. Control of emerged kochia in the spring burndown using soybean herbicides. (1437)

Treatment[ab]	Rate	Kochia control			
		Jun-12	Jun-19	Jul-02	Jul-17
(All treatments applied w ith glyphosate + AMS)		----------%----------			
Zidua	2.5 oz	65	72	66	50
Zidua + Sharpen + MSO	2.5 oz + 1 oz + 1%	93	92	87	81
Zidua + Verdict + MSO	2.5 oz + 5 oz + 1%	99	97	95	90
Zidua + Metribuzin	2.5 oz + 0.5 lb	82	83	83	83
Metribuzin + Sharpen + MSO	0.5 lb + 1 oz + 1%	97	96	95	91
Metribuzin + Verdict + MSO	0.5 lb + 5 oz + 1%	98	98	98	98
Metribuzin + Zidua + Sharpen + MSO	0.5 lb + 2.5 oz + 1 oz + 1%	97	98	97	97
Zidua + Metribuzin	2.5 oz + 0.25 lb	75	74	69	49
Metribuzin + Sharpen + MSO	0.25 lb + 1 oz + 1%	96	95	90	83
Metribuzin + Verdict + MSO	0.25 lb + 5 oz + 1%	97	95	93	84
Metribuzin + Zidua + Sharpen + MSO	0.25 lb + 2.5 oz + 1 oz + 1%	98	97	95	90
Sharpen + Spartan + MSO	1 oz + 4 oz + 1%	99	99	99	99
Authority MTZ + MSO	12 oz + 1%	98	98	99	99
Fierce + MSO	3 oz + 1%	89	94	91	81
Zidua + Cadet + MSO	1.8 oz + 0.42 oz + 1%	79	78	70	48
Untreated		0	0	0	0
LSD (0.05)		2.8	5.0	6.1	6.8
CV		2.0	3.5	4.4	5.3

[a] All treatments applied with Glyphosate + AMS (22 oz + 2.5 gal/100 gal); Glyphosate = 4.5 lb ae formulation

[b] All treatments applied June 5 to 0.5-4 inch kochia (no crop)

Weed control with Zidua herbicide in soybean, Carrington, 2014. Greg Endres and Mike Ostlie. The trial was conducted at the NDSU Carrington Research Extension Center in cooperation with BASF to evaluate soybean weed control with PRE Zidua and other soil-applied herbicides. Experimental design was a randomized complete block with three replicates. The field trial was established on a conventionally-tilled Heimdal-Emrick loam soil with 3.2% organic matter and 6.1 pH. 'DSR0404-2YR' soybean seed was inoculated and planted at 200,000 seeds/A on May 21 in 15-inch rows. Herbicide treatments were applied with a hand-held boom sprayer delivering 14 gal/A at 35 psi through 8001 flat fan nozzles to the center 6.7 ft of 10- by 25-ft plots. PRE treatments were applied on May 22 with 70 F, 37% RH, and 2 MPH wind. Rainfall totaled 0.4 inches during 12 days following application of PRE herbicides. POST Roundup PowerMax at 22 fl oz/A plus Class Act NG at 2.5% v/v were applied to all plots except the untreated check on June 3 with 72 F, 46% RH, and 4 mph wind to VC-stage soybean.

Lack of timely rain reduced the impact of PRE herbicides. Following POST glyphosate application, foxtail control on June 20 ranged from 88-95% with all treatments except Authority First and MTZ (Table). On July 2, foxtail control at 88% or greater continued with all treatments containing Zidua and Authority Assist. On July 2, common lambsquarters and volunteer flax control ranged from 73 to 89%. Redroot and prostrate pigweed control was good to excellent (83 to 98%) with all treatments except Authority MTZ.

Table.

Herbicide			Weed control (%)[1]						
Treatment[2]		Rate	20-Jun			2-Jul			
No.		fl oz product/A	fota	colq	vofl	fota	colq	vofl	pigw
1	Zidua + Sharpen	2.5 oz wt + 1	89	93	81	88	76	75	92
2	Zidua + Sharpen	2.5 oz wt + 1	90	96	87	88	86	81	94
3	Verdict + Outlook	5 + 8	88	95	76	79	82	74	83
4	Zidua + Verdict	2.5 oz wt + 5	92	96	83	89	89	79	90
5	Zidua + Verdict	2.5 oz wt + 5	95	95	82	92	81	82	89
6	Zidua + Verdict	3 oz wt + 5	91	95	80	90	82	76	93
7	Fierce	3 oz wt	90	93	82	82	79	75	96
8	Authority First	6.45 oz wt	83	96	80	76	82	75	86
9	Authority MTZ	12 oz wt	83	79	95	74	73	80	76
10	Authority Assist	6	90	80	96	88	82	86	98
11	untreated check	x	0	0	0	0	0	0	0
C.V. (%)			4.8	9.7	1.9	4.9	7.8	7.8	8.9
LSD (0.05)			7	12	3	6	9	10	12

[1]fota=green and yellow foxtail; colq=common lambsquarters; vofl=volunteer flax; and pigw= redroot and prostrate pigweed.

[2]All treatments except untreated check include June 3 POST Roundup PowerMax at 22 fl oz/A plus Class Act NG at 2.5% v/v.

Canola control using pre-emergent herbicides. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Casselton, ND to evaluate volunteer RR canola control using PRE herbicides. RR canola was planted on July 7, 2014. PRE treatments were applied on July 7, 2014 at 3:00 pm with 80.5 F air, 77.1 F soil at a four inch depth, 56% RH, 100% cloud cover, 4-6 mph NW wind, and adequate soil moisture. Soil characteristics were: 9.1% sand, 51.9% silt, 39% clay, Silty Clay Loam, 5.1% OM, and 7.8 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through 11002 TT nozzles for the PRE applications. The experiment had a randomized complete block design with three replicates per treatment.

There was little rain after PRE herbicide application. At time of planting soil was wet, which helped to activate PRE herbicides. Sharpen at 2oz and 3oz gave excellent control of volunteer Roundup Ready canola.

Table. Canola control using pre-emergent herbicides. (Zollinger, Wirth, Adams)

		14 & 28 DAA
Treatments	Rate	Canola
	(Product/A)	(% Control)
PRE		
Zidua	3.5 oz	27
Valor	3 oz	30
Fierce	3 oz	42
Sharpen	1 fl oz	72
Sharpen	2 fl oz	93
Sharpen	3 fl oz	95
SureStart II	1.5 pt	70
SureStart II	2 pt	68
Boundary	1.6 pt	28
Authority Elite	20 fl oz	73
Authority Elite	26 fl oz	83
Metribuzin	0.25 lb	25
Metribuzin	0.33 lb	23
Metribuzin	0.5 lb	40
LSD (0.05)		8

PRE generic programs in soybean (Study 1). Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Prosper, ND to evaluate weed control in soybean. Roundup ready soybean was planted on May 27, 2014. PRE treatments were applied on May 28, 2014 at 8:00 with 76.0 F air, 70.0 F soil temp at a four inch depth, 35% RH, 0% cloud cover, 2-5 mph SSE wind, and adequate soil moisture. POST treatments were applied on June 24, 2014 at 8:50 am with 63.5 F air, 65.8 F soil at a four inch depth, 90% RH, 100% cloud cover, 3-5 mph NW wind, adequate soil moisture, good crop vigor, and no dew present at a V2.5 soybean crop stage. Weed species present at the time of the POST treatments were: 2-3" (6-8/ft^2) yellow foxtail, 2-3" (2-3/yd^2) common ragweed, 1-3" (1-2/yd^2) common lambsquarters, and 3-4" (1-2/yd^2) cocklebur. Soil characteristics were: 27% sand, 47% silt, 27% clay, loam, 4.5% OM, and 6.6 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through TT11002 nozzles for the PRE applications and delivering 8.5 gpa at 40 psi TT11001 nozzles for the POST applications. The experiment had a randomized complete block design with three replicates per treatment.

Blanket application of glyphosate at 3-5" weed height resulted in 99% weed control at 14, 28, and 42 days after post. At the time of PRE application there was already emerged common cocklebur which effected efficacy. PRE herbicides were adequately activated by spring moisture.

Table. PRE MANA programs in soybean (Study 1) (Zollinger, Wirth, Adams).

		All Timings	28 DA PRE							14, 28, & 42 DA POST						
Treatment[1]	Rate	Soy	Yeft	Wimu	Rrpw	Colq	Hans	Corw	Cocb	Yeft	Wimu	Rrpw	Colq	Hans	Corw	Cocb
	(Product/A)	-%inj-	----------% control----------							----------% control----------						
PRE																
(PRE) Pummel	2pt	0	90	99	99	99	99	47	18	93	99	99	99	99	99	99
(PRE) Pummel+Glory	2pt+5.3oz	0	99	99	99	99	99	52	32	99	99	99	99	99	99	99
(PRE) Pummel+Rumble	2pt+1pt	0	95	99	99	99	99	78	30	99	99	99	99	99	99	99
(PRE) Torment	1pt	0	99	83	87	87	85	77	10	99	99	99	99	99	99	99
(PRE) MANA 25337	4.25oz	0	99	98	99	96	99	58	13	99	99	99	99	99	99	99
(PRE) Authority First	8oz	0	68	99	99	99	99	71	62	99	99	99	99	99	99	99
(PRE) Authority Assist	9floz	0	73	99	99	99	99	58	28	99	99	99	99	99	99	99
(PRE) Authority MTZ	15oz	0	63	99	99	99	99	40	25	99	99	99	99	99	99	99
(PRE) Warrant	2qt	0	35	38	67	67	38	17	0	99	99	99	99	99	99	99
(PRE) Fierce	3.75oz	0	87	99	99	99	99	85	48	99	99	99	99	99	99	99
(PRE) Prefix	2pt	0	72	99	99	99	99	82	50	99	99	99	99	99	99	99
LSD (0.05)		0	8	4	3	4	3	14	11	3	ns	ns	ns	ns	ns	ns

PRE herbicides in soybean. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Prosper, ND to evaluate various tankmixed herbicides in soybean. Roundup ready soybean was planted on May 27, 2014. PRE treatments were applied on May 28, 2014 at 8:00 am with 76.0 F air, 70.0 F soil at a four inch depth, 35%% RH, 0% cloud cover, 2-5 mph SSE wind, and adequate soil moisture. Soil characteristics were: 27% sand, 47% silt, 27% clay, loam, 4.5% OM, and 6.6 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi TT11002 nozzles for the POST applications. The experiment had a randomized complete block design with three replicates per treatment.

At the time of PRE application there was already emerged common cocklebur which effected efficacy. PRE herbicides were adequately activated by spring moisture. At 28 and 42 days after PRE, soybean PPO injury symptoms appeared when using Valor at 3oz and 2oz, Warrant + Valor at 1.5qt + 2oz and 1.5qt + 3oz, and Fierce at 3.75oz.

Table. PRE herbicides in soybean (Zollinger, Wirth, Adams).

		14 DA PRE	28 and 42 DA PRE						
Treatment[1]	Rate	Soy	Soy	Yeft	Rrpw	Colq	Hans	Corw	Cocb
	(Product/A)	-%inj-	-%inj-	----------% control----------					
PRE									
(PRE) Warrant	1.5qt	0	0	70	63	63	63	0	0
(PRE) Valor	2oz	0	13	70	99	99	99	70	20
(PRE) Valor	3oz	0	30	73	99	94	99	84	25
(PRE) Sencor DF	0.25lb	0	0	63	68	68	68	42	20
(PRE) Sencor DF	0.33lb	0	0	65	75	75	73	65	22
(PRE) Sencor DF	0.5lb	0	0	75	88	83	85	75	52
(PRE) Warrant+Valor	1.5qt+2oz	0	35	96	99	99	99	63	45
(PRE) Warrant+Valor	1.5qt+3oz	0	40	99	99	99	99	99	40
(PRE) Warrant+Sencor DF	1.5qt+0.25lb	0	0	85	99	85	94	70	30
(PRE) Warrant+Sencor DF	1.5qt+0.33lb	0	0	72	93	83	85	70	23
(PRE) Warrant+Sencor DF	1.5qt+0.5lb	0	0	95	99	99	93	88	52
(PRE) Fierce	3.75oz	0	23	96	99	93	99	87	52
(PRE) Prefix	1qt	0	0	87	99	57	99	91	98
(PRE) Warrant+Sharpen	1.5qt+1floz	0	0	68	99	99	99	99	96
(PRE) Warrant+Sharpen	1.5qt+1.5floz	0	0	68	99	99	99	99	99
(PRE) Authority MTZ	15oz	0	0	73	96	99	96	63	20
(PRE) Authority MTZ	18oz	0	0	73	99	99	99	60	30
LSD (0.05)		0	5	9	4	9	8	8	8

PRE control of glyphosate resistant kochia. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Barney, ND to evaluate kochia control in soybean. Roundup ready soybean was planted on May 28, 2014. PRE treatments were applied on May 28, 2014 at 3:15 pm with 89.0 F air, 72.0 F soil at a four inch depth, 18% RH, 0% cloud cover, 3-8 mph S wind, and adequate soil moisture. Soil characteristics were: 38% sand, 39% silt, 23% clay, loam, 4.9% OM, and 7.7 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through TT11002 nozzles for the PRE applications. The experiment had a randomized complete block design with three replicates per treatment.

Spring tillage and wet soils resulted in low kochia emergence and a lack of multiple flushes throughout the growing season.

Table. PRE control of glyphosate resistant kochia (Zollinger, Wirth, Adams).

		28 DA PRE				42 DA PRE				56 DA PRE			
Treatment[1]	Rate	Soy	Rrpw	Colq	Koch	Soy	Rrpw	Colq	Koch	Soy	Rrpw	Colq	Koch
	(Product/A)	-%inj-	-------%control-------			-%inj-	-------%control-------			-%inj-	-------%control-------		
PRE													
(PRE) Valor	2oz	0	87	87	80	0	87	87	77	0	83	83	75
(PRE) Fierce	3oz	0	99	99	98	0	99	99	98	0	99	99	93
(PRE) Valor+Sencor DF	2oz+4oz	0	99	98	98	0	99	98	98	0	99	98	97
(PRE) Valor+Sencor DF	3oz+4oz	0	99	99	99	0	99	99	99	0	99	99	99
(PRE) Fierce+Sencor DF	3oz+4oz	0	99	99	99	0	99	99	99	0	99	99	99
(PRE) Classic+Harmony SG+Valor SX	0.32oz+0.5oz+1.98oz	0	99	99	99	0	99	99	99	0	99	99	98
(PRE) Authority MTZ	11oz	0	99	99	99	0	99	99	99	0	99	99	99
(PRE) Authority MTZ	16 oz	0	99	99	99	0	99	99	99	0	99	99	99
(PRE) Warrant+Valor	1.25qt+2oz	0	99	99	99	0	99	99	99	0	99	99	97
(PRE) Gangster V+Gangster FR	2oz+0.4oz	0	87	87	88	0	87	87	88	0	80	87	87
(PRE) Gangster V+Gangster FR+Sencor DF	2oz+0.4oz+4oz	0	98	98	98	0	98	98	98	0	98	96	96
LSD (0.05)		ns	3	3	3	ns	3	3	2	ns	2	4	2

Resistant common ragweed control using PRE herbicides. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Mayville, ND to evaluate glyphosate resistant common ragweed control using Fierce MTZ. Roundup ready soybean was planted on May 21, 2014. PRE treatments were applied on May 22, 2014 at 9:45 am with 68.0 F air, 55.0 F soil at a four inch depth, 28% RH, 0% cloud cover, 1-3 mph SSE wind, and adequate soil moisture. Soil characteristics were: 70.6% sand, 20.6% silt, 8.8% clay, Sandy Loam, 2.8% OM, and 6.8 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through TT11002 nozzles for the PRE applications. The experiment had a randomized complete block design with three replicates per treatment.

PRE herbicides were activated by adequate spring moisture. Common ragweed at this location had some level of ALS resistance in addition to glyphosate resistance.

Table. Resistant common ragweed control using PRE herbicides (Zollinger, Wirth, Adams).

		28 DAA				42 DAA				56 DAA			
Treatment[1]	Rate	Soy	Rrpw	Colq	Corw	Soy	Rrpw	Colq	Corw	Soy	Rrpw	Colq	Corw
	(Product/A)	-%inj-	---% control---			-%inj-	---% control---			-%inj-	---%control---		
PRE													
(PRE) Valor	2oz	13	99	99	77	2	99	99	78	2	99	99	77
(PRE) Fierce	3oz	17	99	99	89	15	99	99	90	18	99	99	90
(PRE) Valor+Sencor DF	2oz+4oz	12	99	99	86	7	99	99	88	10	99	99	83
(PRE) Valor+Sencor DF	3oz+4oz	17	99	99	98	10	99	99	98	10	99	99	98
(PRE) Fierce+Sencor DF	3oz+4oz	18	99	99	93	8	99	99	93	12	99	99	90
(PRE) Classic+Harmony SG+Valor	0.32oz+0.5oz+1.98oz	8	99	99	76	2	99	99	72	2	99	99	72
(PRE) Authority MTZ	11oz	0	99	99	67	0	99	99	65	0	99	99	65
(PRE) Authority MTZ	16oz	0	99	99	72	0	99	99	68	0	99	99	68
(PRE) Warrant+Valor	1.25qt+2oz	25	99	99	82	10	99	99	82	10	99	99	78
(PRE) Gangster V+Gangster FR	2oz+0.4oz	5	99	80	98	0	99	98	99	0	99	99	99
(PRE) Gangster V+Gangster FR+Sencor DF	2oz+0.4oz+4oz	13	99	99	98	8	99	99	98	12	99	99	98
LSD (0.05)		7	ns	4	7	4	ns	1	5	3	ns	ns	5

PRE/POST programs in soybean. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Prosper, ND to evaluate weed control in soybean. Roundup ready soybean was planted on May 27, 2014. PRE treatments were applied on May 29, 2014 at 11:20 am with 88.0 F air, 61.2 F soil at a four inch depth, 33% RH, 0% cloud cover, 8-10 mph SE wind, and adequate soil moisture. POST treatments were applied on June 24, 2014 at 7:30 am with 63.5 F air, 65.8 F soil at a four inch depth, 90% RH, 100% cloud cover, 3-5 mph NW wind, adequate soil moisture, good crop vigor, and dew present at a V2.5 soybean crop stage. Weed species present at the time of the POST treatments WITH A PRE were: 0.5-1" (1-2/yd^2) common ragweed, and 0.5-1" (1-2/yd^2) common lambsquarters. Weed species present at the time of the POST treatments WITHOUT A PRE were: 1-3" (3-4/yd^2) common ragweed, 1-2" (3-4/yd^2) common lambsquarters, 0.5-1" (3-4/yd^2) yellow foxtail, 1-2" (1-2/yd^2) redroot pigweed, and 1-3" (1/yd^2) hairy nightshade. Soil characteristics were: 27% sand, 47% silt, 27% clay, loam, 4.5% OM, and 6.6 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through TT11002 nozzles for the PRE applications and delivering 8.5 gpa at 40 psi through TT11001 nozzles for the POST applications. The experiment had a randomized complete block design with three replicates per treatment.

PRE herbicides were adequately activated by spring moisture.

Table. PRE/POST programs in soybean (Zollinger, Wirth, Adams).

		14 DAE							14, 28, and 42 DA POST						
Treatment[1]	Rate	Soy	Yeft	Rrpw	Colq	Hans	Corw	Cocb	Soy	Yeft	Rrpw	Colq	Hans	Corw	Cocb
	(Product/A)	-%inj-	----------% control----------						-%inj-	----------% control----------					
PRE															
(PRE) Authority MTZ+Accolade	6.4oz+10floz+1qt	0	99	99	99	99	99	99	0	99	99	99	99	99	99
PRE/POST															
(PRE) Authority	6.4oz														
(POST) Select+PO	10floz+1qt	0	99	99	99	99	99	99	0	99	99	99	99	99	99
(PRE) Authority First+Anthem	6.4oz+8floz														
(POST) Select+PO	10floz+1qt	0	99	99	99	99	99	99	0	99	99	99	99	99	99
(PRE) Authority Assist	9floz														
(POST) Select+PO	10floz+1qt	0	99	99	99	99	99	99	0	99	99	99	99	99	99
(PRE) Fierce	3.75oz														
(POST) Select+PO	10floz+1qt	33	99	99	99	99	99	99	23	99	99	99	99	99	99
(PRE) Optill	2floz														
(POST) Select+PO	10floz+1qt	0	99	99	99	99	99	99	0	99	99	99	99	99	99
(PRE) Authority First+Anthem	6.4oz+8floz														
(POST) RUPM+AMS	22floz+8.5lb/100gal	0	57	99	99	99	99	99	0	99	99	99	99	99	99
POST															
(POST) Warrant+RUPM+AMS	1.5pt+22floz+8.5lb/100gal	0	0	0	0	0	0	0	0	99	99	99	99	99	99
(POST) Anthem+RUPM+AMS	8floz+22floz+8.5lb/100gal	0	0	0	0	0	0	0	22	99	99	99	99	99	99
(POST) Marvel+RUPM+AMS	6floz+22floz+8.5lb/100gal	0	0	0	0	0	0	0	20	99	99	99	99	99	99
(POST) Flexstar+Destiny HC	2.68pt+1pt	0	0	0	0	0	0	0	15	99	99	99	99	99	99
(POST) Fomesafen+TD Total +Destiny HC	0.75pt+23floz +1pt	0	0	0	0	0	0	0	28	99	99	99	99	99	99
(POST) Flexstar+TD Total +Destiny HC	0.75pt+23floz +1pt	0	0	0	0	0	0	0	28	99	99	99	99	99	99
LSD (0.05)		1	3	3	3	3	3	3	2	3	ns	ns	ns	ns	ns

[1]RUPM=Roundup Powermax; TD Total=Touchdown Total; PO=WCS Crop Oil

Soybean herbicide programs. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Prosper, ND to evaluate weed control in soybean. Roundup ready soybean was planted on May 27, 2014. PRE treatments were applied on May 28, 2014 at 8:00 am with 76.0 F air, 70.0 F soil at a four inch depth, 35% RH, 0% cloud cover, 2-5 mph SSE wind, and adequate soil moisture. POST treatments were applied on June 24, 2014 at 7:30 am with 63.5 F air, 65.8 F soil at a four inch depth, 90% RH, 100% cloud cover, 3-5 mph NW wind, adequate soil moisture, good crop vigor, and dew present at a V2.5 soybean crop stage. Weed species present at the time of the POST treatments **WITH** a PRE were: 1-2" (8-10/ft^2) yellow foxtail, 1-1.5" (2-3/yd^2) common lambsquarters, 3-4" (1-3/yd^2) cocklebur, 1-2" (1/yd^2) common ragweed. Weed species present at the time of the POST treatments **WITHOUT** a PRE were: 2-4" (6-10/ft^2) yellow foxtail, 1-3" (2-4/yd^2) common lambsquarters, and 3-6" (1-4/yd^2) cocklebur. Soil characteristics were: 27% sand, 47% silt, 27% clay, loam, 4.5% OM, and 6.6 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through TT11002 nozzles for the PRE applications and delivering 8.5 gpa at 40 psi through TT11001 nozzles for the POST applications. The experiment had a randomized complete block design with three replicates per treatment.

At the time of PRE application there was already emerged common cocklebur which effected efficacy. PRE herbicides were adequately activated by spring moisture. After POST application was made, all treatments gave 99% control of most weeds.

Table. Soybean herbicide programs (Zollinger, Wirth, Adams).

		Prior to POST							14, 28, and 42 DA POST						
Treatment[1]	Rate	Soy	Yeft	Rrpw	Colq	Hans	Corw	Cocb	Soy	Yeft	Rrpw	Colq	Hans	Corw	Cocb
	(Product/A)	-%inj-	----------% control----------						-%inj-	----------% control----------					
PRE															
(PRE) Statement	1qt	0	67	99	42	43	73	33	0	67	99	42	43	73	32
(PRE) Prefix	1qt	0	73	99	43	88	65	36	0	73	99	43	88	65	34
PRE/POST															
(PRE) Sonic	3oz														
(POST) Durango+AMS	24floz+8.5lb/100gal	0	53	99	99	99	87	60	0	77	99	99	99	99	99
(PRE) Sonic	4.5oz														
(POST) Durango+AMS	24floz+8.5lb/100gal	0	50	99	99	99	83	38	0	99	99	99	99	99	99
(PRE) Sonic	3oz														
(POST) Durango+FirstRate+AMS	24floz+0.3oz+8.5lb/100gal	0	60	99	99	99	99	40	0	99	99	99	99	99	99
(PRE) Surveil FR+Surveil V	0.4oz+2oz														
(POST) Durango+AMS	24floz+8.5lb/100gal	0	65	99	99	99	99	45	0	99	99	99	99	99	99
(PRE) Surveil FR+Surveil V	0.6oz+3oz														
(POST) Durango+AMS	24floz+8.5lb/100gal	8	77	99	99	99	97	58	4	99	99	99	99	99	99
(PRE) Prefix	1qt														
(POST) Glyfos X-tra+AMS	1qt+8.5lb/100gal	0	72	99	38	99	67	40	0	99	99	99	99	99	99
POST															
(POST) Statement	1qt														
+Glyfos X-tra+AMS	+1qt+8.5lb/100gal	0	0	0	0	0	0	0	13	99	99	99	99	99	99
(POST) Rhythm	25.5floz														
+Glyfos X-tra+AMS	+1qt+8.5lb/100gal	0	0	0	0	0	0	0	0	99	99	99	99	99	99
LSD (0.05)		2	10	2	5	6	9	14	5	3	ns	2	6	5	4

Glyphosate resistant common ragweed control using Cobra. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Mayville, ND to evaluate glyphosate resistant common ragweed control using cobra. Roundup ready soybean was planted on May 21, 2014. PRE treatments were applied on May 21, 2014 at 1:10 pm with 65.0 F air, 59.0 F soil at a four inch depth, 45% RH, 80% cloud cover, 8-10 mph NW wind, adequate soil moisture. EPOST treatments were applied on June 13, 2014 at 6:30 pm with 56.0 F air, 58.0 F soil at a four inch depth, 74% RH, 0% cloud cover, 1-3 mph W wind, adequate soil moisture, good crop vigor, and no dew present at a 1-2 trifoliate soybean crop stage. Weed species present at the time of the EPOST treatments were: emerging-1" (3-5/yd^2) common lambsquarters, and emerging-1" (5-10/ft^2) common ragweed. POST treatments were applied on June 25, 2014 at 12:30 pm with 70.0 F air, 68.0 F soil at a four inch depth, 70% RH, 100% cloud cover, 5-8 mph S wind, moist soil moisture, good crop vigor, and no dew present at a 3-4 trifoliate soybean crop stage. Weed species present at the time of the POST treatments were: 0-2" (3/yd^2) common lambsquarters, 1-4" (20/yd^2) common ragweed, 0-2" (sparse) green foxtail, and 2-4" (3/yd^2) redroot pigweed. Soil characteristics were: 70.6% sand, 20.6% silt, 8.8% clay, Sandy Loam, 2.8% OM, and 6.8 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through TT11002 nozzles for the PRE applications, and delivering 8.5 gpa at 40 psi through TT11001 nozzles for the EPOST and POST applications. The experiment had a randomized complete block design with three replicates per treatment.

This study represents the importance of the use of a PRE herbicide and utilizing different effective modes of action to control glyphosate resistant weeds (common ragweed). EPOST and POST treatments of glyphosate resulted in poor control on most weeds at 28 and 42 days after POST. The use of flumioxazin (Gangster V) and cloransulam (Gangster FR) as a PRE helped give excellent control of all weeds at 28 and 42 days after POST.

Table. Glyphosate resistant common ragweed control using Cobra. (Zollinger, Wirth, Adams).

		14 DA POST				28 & 42 DA POST			
Treatment[1]	Rate	Soy	Rrpw	Colq	Corw	Soy	Rrpw	Colq	Corw
	(Product/A)	-inj-	------% control-------			-inj-	------% control-------		
EPOST/POST									
(EPOST) RUPM+NIS+AMS	32fl oz+0.25% v/v+2.5lb	0	99	99	47	0	47	74	50
(POST) RUPM+NIS+AMS	32fl oz+0.25% v/v+2.5lb								
PRE/POST									
(PRE) Gangster V+Gangster FR	2oz+0.4oz	3	99	99	99	3	99	99	93
(POST) RUPM+NIS+AMS	32fl oz+0.25% v/v+2.5lb								
(PRE) Gangster V+Gangster FR	2oz+0.4oz	15	99	99	99	17	99	99	99
(POST) RUPM+Cobra+PO+AMS	32fl oz+12.5fl oz+1.5pt+2.5lb								
(PRE) Gangster V+Gangster FR	2oz+0.4oz	25	99	99	99	0	99	99	99
(POST) TD Total+Flexstar GT+NIS+AMS	12fl oz+2.7pt+0.25% v/v+2.5lb								
LSD (0.05)		6	n/s	n/s	6	7	6	2	11

[1]RUPM=Roundup Powermax; TD Total=Touchdown Total

Weed control in DEB. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Thompson, ND to evaluate Marvel in dry edible beans. Navy dry bean was planted on June 4, 2014. PRE treatments were applied on June 6, 2014 at 11:00 am with 61.0 F air, 57.0 F soil at a four inch depth, 40% RH, 80% cloud cover, 8-10 mph NW wind, and moist soil moisture. EPOST treatments were applied on July 7, 2014 at 11:40 am with 81.0 F air, 76.0 F soil at a four inch depth, 39% RH, 50% cloud cover, 5-8 mph NW wind, dry soil moisture, fair crop vigor, and no dew present at a V1-V2 dry bean crop stage. Soil characteristics were: 13% sand, 53% silt, 34% clay, silty clay loam, 4.7% OM, and 7.6 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through TT11002 nozzles for the PRE applications and 8.5 gpa at 40 psi through TT11001 nozzles for the EPOST applications. The experiment had a randomized complete block design with three replicates per treatment.

A late, wet spring resulted in poor germination and poor vegetative growth of dry bean. There was minimal weed growth throughout the growing season. The addition of an NIS resulted in less dry bean injury when compared to the addition of a PO or MSO. There were no significant differences in dry bean injury when comparing the addition of a PO to the addition of an MSO.

Table. Weed control in DEB (Zollinger, Wirth, Adams).

		3 DA EPOST				7 DA EPOST				14 DA EPOST				28 & 42 DA EPOST			
Treatment[1]	Rate	Deb	Rrpw	Colq	Prkw	Deb	Rrpw	Colq	Prkw	Deb	Rrpw	Colq	Prkw	Deb	Rrpw	Colq	Prkw
	(Product/A)	-%inj-	------%control------			-%inj-	------%control------			-%inj-	------%control------			-%inj-	------%control------		
PRE/POST																	
(PRE) BroadAxe	26floz																
(POST) F9140+NIS	0.35floz+0.25%v/v	27	99	99	99	27	99	99	99	23	99	99	99	11	99	99	99
EPOST																	
(EPOST) Marvel+NIS	6floz+0.25%v/v	8	99	99	99	8	99	99	99	2	99	99	99	0	99	99	99
(EPOST) Marvel+PO	6floz+1%v/v	32	99	99	99	32	99	99	99	10	99	99	99	6	99	99	99
(EPOST) F9140+NIS	0.35floz+0.25%v/v	18	99	99	99	18	99	99	99	5	99	99	99	0	99	99	99
(EPOST) F9140+PO	0.35floz+1%v/v	38	99	99	99	38	99	99	99	18	99	99	99	8	99	99	99
(EPOST) F9140+MSO	0.35floz+1%v/v	35	99	99	99	35	99	99	99	23	99	99	99	11	99	99	99
(EPOST) Reflex+PO	1pt+1%v/v	13	99	99	99	13	99	99	99	5	99	99	99	0	99	99	99
(EPOST) Rezult B+PO	1pt+1%v/v	13	99	99	99	13	99	99	99	0	70	63	20	0	52	48	99
(EPOST) Raptor+NIS	3floz+0.25%v/v	0	99	99	99	0	99	99	99	0	99	82	99	0	99	70	99
(EPOST) F9140+Raptor +NIS+28%N	0.35floz+3floz +0.25%v/v+0.25%v/v	30	99	99	99	30	99	99	99	5	99	99	99	0	99	99	99
(EPOST) F9410+Basagran+NIS	0.35floz+1pt+0.25%v/v	10	99	99	99	10	99	99	99	0	99	99	99	0	99	99	99
EPOST/POST																	
(EPOST) F9140+NIS	0.35floz+0.25%v/v																
(POST) F9140+NIS	0.35floz+0.25%v/v	23	99	99	99	23	99	99	99	2	99	99	99	0	99	99	99
(EPOST) F9140+PO	0.35floz+1%v/v																
(POST) F9140+PO	0.35floz+1%v/v	37	99	99	99	37	99	99	99	12	99	99	99	10	99	99	99
LSD (0.05)		4	ns	ns	ns	4	ns	ns	ns	4	2	2	5	4	1	1	ns

[1]PO=WCS Crop Oil; MSO=Upland; NIS=R-11

POST generic programs in soybean (Study 2). Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Prosper, ND to evaluate weed control in soybean. Roundup ready soybean was planted on May 27, 2014. POST treatments were applied on June 24, 2014 at 7:30 am with 63.5 F air, 65.8 F soil at a four inch depth, 90% RH, 100% cloud cover, 3-5 mph NW wind, adequate soil moisture, good crop vigor, and no dew present at a V2.5 soybean crop stage. Weed species present at the time of the POST treatments were: emerging-6" (5/yd^2) cocklebur, emerging-3" (5/yd^2) common ragweed, emerging-2" (5/ft^2) redroot pigweed, emerging-3" (10/ft^2) common lambsquarters, emerging-3" (10/ft^2) hairy nightshade, and emerging-5" (10/yd^2) yellow foxtail. Soil characteristics were: 27% sand, 47% silt, 27% clay, loam, 4.5% OM, and 6.6 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 8.5 gpa at 40 psi TT11001 nozzles for the POST applications. The experiment had a randomized complete block design with three replicates per treatment.

Most treatments resulted in visual soybean injury. All weed species at all timings were 99% controlled.

Table. POST MANA programs in soybean (Study 2) (Zollinger, Wirth, Adams).

		7 DA POST	14 DA POST							28, & 42 DA POST							
Treatment[1]	Rate	Soy	Yeft	Wimu	Rrpw	Colq	Hans	Corw	Cocb	Soy	Yeft	Wimu	Rrpw	Colq	Hans	Corw	Cocb
	(Product/A)	-%inj-	----------% control----------							-%inj-	----------% control----------						
POST																	
(POST) Pummel+RUPM+AMS	2pt+22floz+8.7lb/100gal	17	99	99	99	99	99	99	99	20	99	99	99	99	99	99	99
(POST) Rumble+RUPM	1pt+22floz																
+Destiny HC+AMS	+1%v/v+8.7lb/100gal	22	99	99	99	99	99	99	99	10	99	99	99	99	99	99	99
(POST) Pummel+Rumble+RUPM	2pt+1pt+22floz																
+Destiny HC+AMS	+1%v/v+8.7lb/100gal	28	99	99	99	99	99	99	99	13	99	99	99	99	99	99	99
(POST) Warrant+RUPM+AMS	2qt+22floz+8.7lb/100gal	0	99	99	99	99	99	99	99	0	99	99	99	99	99	99	99
(POST) Torment+RUPM	1pt+22floz																
+Destiny HC+AMS	+1%v/v+8.7lb/100gal	3	99	99	99	99	99	99	99	0	99	99	99	99	99	99	99
(POST) Cobra+RUPM+AMS	12.5floz+22floz+8.7lb/100gal	32	99	99	99	99	99	99	99	3	99	99	99	99	99	99	99
LSD (0.05)		8	ns	ns	ns	ns	ns	ns	ns	3	ns	ns	ns	ns	ns	ns	ns

[1]RUPM=Roundup Powermax

Soybean variety tolerance to PPO herbicides. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Valley City, ND to evaluate soybean tolerance to PPO herbicides. 14 Days Prior to Planting treatments were applied on May 16, 2014 at 1:20 pm with 54.2 F air, 55.6 F soil at a four inch depth, 30% RH, 50% cloud cover, 8-10 mph NW wind, dry soil moisture, and no dew present at a pre planting crop stage. PRE treatments were applied on May 30, 2014 at 9:30 am with 83.0 F air, 80.0 F soil at a four inch depth, 49% RH, 75% cloud cover, 2-4 mph SSE wind, adequate soil moisture, good crop vigor, and no dew present at pre-emergent crop stage. Soil characteristics were: 70% sand, 19% silt, 11% clay, sandy loam, 3.0% OM, and 4.8 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through TT11002 nozzles for the 14 Days Prior to Planting applications and delivering 17 gpa at 40 psi through TT11002 nozzles for the PRE applications. The experiment had a randomized complete block design with three replicates per treatment.

This study was conducted to test a variety of soybean that is potentially naturally tolerant (Tsoy) to PPO herbicides and a variety of soybean that is potentially naturally susceptible (SSoy) to PPO herbicides.

Table. Soybean variety tolerance to PPO herbicides (Zollinger, Wirth, Adams).

		7 DAA		14 DAA		28 DAA		42 DAA		56 DAA	
Treatment[1]	Rate	Ssoy	TSoy	Ssoy	TSoy	Ssoy	TSoy	Ssoy	TSoy	Ssoy	TSoy
	(Product/A)	-----%inj-----		-----%inj-----		-----%inj-----		-----%inj-----		-----%inj-----	
POST											
(POST) Sharpen	2floz	0	0	7	0	5	2	3	2	3	0
(POST) Sharpen+Authority Assist	2floz+6floz	0	0	5	3	7	5	15	3	12	3
(POST) Verdict	10floz	0	0	0	0	0	0	0	0	0	0
(POST) Authority Assist	6floz	0	0	7	8	7	5	12	3	7	5
(POST) Valor	4oz	0	0	12	0	7	15	7	0	3	0
(POST) Verdict+Authority Assist	10floz+6floz	0	0	13	0	15	0	15	0	12	0
(POST) Verdict+Valor	10floz+4oz	0	0	0	0	17	3	17	0	8	0
(POST) Sharpen	2floz	0	0	7	0	12	3	15	3	12	3
(POST) Sharpen+Authority Assist	2floz+6floz	0	0	7	0	12	0	15	0	13	0
(POST) Verdict	10floz	0	0	17	0	18	8	22	13	22	15
(POST) Authority Assist	6floz	0	0	7	0	5	0	7	0	3	0
(POST) Valor	4oz	0	0	5	0	13	12	10	2	7	0
(POST) Verdict+Authority Assist	10floz+6floz	0	0	27	20	27	15	27	15	20	15
(POST) Verdict+Valor	10floz+4oz	0	0	17	17	22	17	18	10	17	10
LSD (0.05)		0	0	9	7	9	8	8	5	8	5

Bentazon formulation comparison in DEB. Zollinger, Richard K., Devin A. Wirth, Jason W. Adams. An experiment was conducted near Thompson, ND to evaluate weed control in dry edible bean production. Navy dry bean was planted on June 4, 2014. POST treatments were applied on July 23, 2014 at 12:00 pm with 78.2 F air, 80.0 F soil at a four inch depth, 40% RH, 0% cloud cover, 2-4 mph N wind, dry soil moisture, good crop vigor, and no dew present at a V6-V10 dry bean crop stage. Weed species present at the time of the POST treatments were: 1-1.5 (5-10/yd^2) redroot pigweed, 1-3 (1-3/yd^2) prostrate pigweed, 1-3 (5-10/yd^2) yellow foxtail, 1-3 (1-2/yd^2) knotweed, 2-4 (3-5/yd^2) common lambsquarters, and 1-2 (1/yd^2) kochia. Soil characteristics were: 13% sand, 53% silt, 34% clay, silty clay loam, 4.7% OM, and 7.6 pH. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through TT11002 nozzles for the POST applications. The experiment had a randomized complete block design with three replicates per treatment.

This study compares Broadloom (bentazon) with other bentazon products. There were no significant differences between bentazon products when tankmixed with Raptor (imazamox). A late, wet spring resulted in poor germination and poor vegetative growth of dry bean. There was minimal weed growth throughout the growing season.

Table. Bentazon formulation comparison in DEB (Zollinger, Wirth, Adams).

		7 DAA	14 DAA					28 DAA				
Treatment[1]	Rate	Deb	Deb	Wimu	Rrpw	Colq	Biww	Deb	Wimu	Rrpw	Colq	Biww
	(Product/A)	-%inj-	-%inj-	---------% control---------				-%inj-	--------% control---------			
POST												
(POST) Basagran+PO	1pt+1%v/v	0	0	99	37	37	52	0	99	38	38	52
(POST) Broadloom+PO	1pt+1%v/v	0	0	99	47	47	60	0	99	48	48	62
(POST) Basagran+PO	1.5pt+1%v/v	0	0	99	45	45	55	0	99	47	47	57
(POST) Broadloom+PO	1.5pt+1%v/v	0	0	99	57	57	62	0	99	58	58	65
(POST) Basagran+PO	2pt+1%v/v	0	0	99	62	62	72	0	99	62	63	72
(POST) Broadloom+PO	2pt+1%v/v	0	0	99	62	62	73	0	99	62	62	73
(POST) Basagran+Raptor+PO	0.5pt+4floz+1%v/v	0	0	99	95	95	96	0	99	95	95	96
(POST) Broadloom+Raptor+PO	0.5pt+4floz+1%v/v	0	0	99	93	93	96	0	99	95	95	96
(POST) Basagran+Raptor+PO	1pt+4floz+1%v/v	0	0	99	96	96	98	0	99	96	96	98
(POST) Broadloom+Raptor+PO	1pt+4floz+1%v/v	0	0	99	93	93	96	0	99	93	95	96
LSD (0.05)		ns	ns	ns	8	8	6	ns	ns	6	6	5

[1]PO=WCS Crop Oil

Timing of initial weed control in soybean, Carrington, 2014. Greg Endres and Mike Ostlie. The study was being conducted to continue building a North Dakota database documenting response of soybean to initial timing of weed control. Experimental design was a randomized complete block with four replicates. The field trial was conducted at the NDSU Carrington Research Extension Center. 'DSR0404-2Y2' Roundup Ready inoculated soybean was planted in 15-inch rows on May 21 and plant emergence across the trial was on May 28. Herbicides were applied with a hand-held boom sprayer delivering 10 gal/A at 35 psi through 8001 flat fan nozzles to the center 6.7 ft of 10- by 25-ft plots. A tank mixture of Roundup Powermax at 32 fl oz/A plus Class Act NG at 2.5% plus Zidua at 4 oz wt/A plus metribuzin at 0.33 lb/A was PRE applied on May 22 with 66 F, 44% RH and 9 mph wind. Rain totaled 0.33 inches 10 days after application of PRE herbicides. Table 1 provides POST application details for glyphosate (Roundup Powermax at 32 fl oz/A plus Class Act NG at 2.5% v/v). This POST treatment was also applied on May 27 and June 24 to continue weed control following application of PRE herbicides. The trial was harvested for seed yield on October 6.

Soybean plant development was similar among treatments measured from planting to first flower and maturity (Table 2). Canopy closure occurred first with PRE and POSTA treatments while the untreated check did not have canopy closure. Seed yield tended to be higher with initial weed control at planting compared to POST treatments and all herbicide treatments provided greater yield than the untreated check.

Table 1. POST glyphosate application details for soybean response to initial timing of weed control, Carrington, 2014.

Application date	POST treatment	Soybean[1]		Weed height		Weed density[2]		Environment			
		Growth stage	Average plant height	Average	Range	Grass	Broad-leaf	Air temp.	RH	Wind speed	Clouds
			inches	inches		square foot		F	%	MPH	%
13-Jun	A	VC-V1	3 to 4	3	1 to 9	34	15	60	64	0	10
24-Jun	B	V2	5 to 6	7	1 to 16	x	x	57	96	9	100
2-Jul	C	V3-V4	8	12	1 to 20	x	x	59	77	3	60

[1]Soybean density on June 13 averaged 179,460 plants/A.

[2]Grass weeds include green and yellow foxtail; Broadleaf weeds include common lambsquarters, redroot and prostrate pigweed, volunteer flax and wild buckwheat.

Table 2. Soybean response to initial timing of weed control, Carrington, 2014.

Treatment		Flower	Canopy closure[1]	Physiological maturity	Seed yield	Test weight	Seeds/lb	Oil	Protein
Number	Timing[2]	Jday			bu/A	lb/bu		%	
1	untreated	195	x	265	17.7	x	x	15.2	33.8
2	PRE/POST	195	208	264	53.4	56.7	2909	15.6	32.9
3	POSTA	195	209	264	47.2	56.5	2818	15.6	33.1
4	POSTB	195	222	264	50.5	56.3	2946	15.6	33.3
5	POSTC	195	226	265	51.6	56.5	2880	15.5	33.7
C.V. (%)		0.3	2.4	0.3	11.8	0.7	2.1	1.6	1.1
LSD (0.05)		NS	8	NS	8.0	NS	NS	NS	33.4

[1]≥75% of plot area covered by soybean canopy.

[2]PRE/POST=May 22/May 27 and June 24; POSTA=June 13; POSTB=June 24; POSTC=July 2.

Nozzle tip effect on weed control in soybean. Howatt, Roach, and Harrington. 'Asgrow AG0333' soybean was seeded near Fargo on June 6. Treatments were applied to flowering mustard, 4 to 6 inch pigweed, 5 leaf foxtail, and 4 to 6 leaf Venice mallow on July 9 with 79°F, 27% relative humidity, clear sky, 1 to 3 mph wind velocity at 350°, and dry soil. Treatments were applied with a sprayer mounted on a 4 wheel all-terrain vehicle delivering 10 gpa with various nozzle tips to a 7 foot wide area the length of 10 by 30 feet. The experiment was a randomized complete block design with four replicates.

Treatment	Rate	Tip	Yeft 7/21	Wimu 7/21	Corw 7/21	Answ 7/21	Colq 7/21	Rrpw 7/21	Cudo 7/21
	oz ai/A		%	%	%	%	%	%	%
Glyt+K_2P	18+2%	TJ60	99	99	99	99	99	99	99
Glyt+K_2P	18+2%	TTI	99	99	99	99	99	99	99
Glyt+Lact+K_2P+NIS	18+2.5+2%+0.25%	TJ60	99	99	99	99	99	99	99
Glyt+Lact+K_2P+NIS	18+2.5+2%+0.25%	TTI	99	99	99	99	99	99	99
Glyt+Lact+K_2P+NIS	18+2.5+2%+0.25%	XR	99	99	99	99	99	99	99
Glyt+Fmsf+K_2P+NIS	18+5.2+2%+0.25%	TJ60	99	99	99	99	99	99	99
Glyt+Fmsf+K_2P+NIS	18+5.2+2%+0.25%	TTI	99	99	99	99	99	99	99
Glyt+K_2P+Acet[a]	18+2%+18	TJ60	99	99	99	99	99	99	99
Glyt+K_2P+Acet	18+2%+18	TTI	99	99	99	99	99	99	99
Glyt+Acet+Lact+K_2P+NIS	18+18+2.5+2%+0.25%	TJ60	99	99	99	99	99	99	99
Glyt+Acet+Lact+K_2P+NIS	18+18+2.5+2%+0.25%	TTI	99	99	99	99	99	99	99
Glyt+Cleth+K_2P	18+0.73+2%	TJ60	99	99	99	99	99	99	99
Glyt+Cleth+K_2P	18+0.73+2%	TTI	99	99	99	99	99	99	99
CV			0	0	0	0	0	0	0
LSD (P=0.05)			0	0	0	0	0	0	0

Treatment	Rate	Tip	Injury 7/21	Injury 8/6	Corw 8/6	Rrpw 8/6	Colq 8/6	Yeft 8/6	Vema 8/6	Weeds 9/19
	oz ai/A		%	%	plants/m^2					%
Glyt+K_2P	18+2%	TJ60	9	2	5	6	3	5	1	86
Glyt+K_2P	18+2%	TTI	8	2	6	9	5	7	2	69
Glyt+Lact+K_2P+NIS	18+2.5+2%+0.25%	TJ60	27	11	2	5	2	9	3	75
Glyt+Lact+K_2P+NIS	18+2.5+2%+0.25%	TTI	22	9	0	7	4	13	2	82
Glyt+Lact+K_2P+NIS	18+2.5+2%+0.25%	XR	26	8	0	4	0	8	1	86
Glyt+Fmsf+K_2P+NIS	18+5.2+2%+0.25%	TJ60	25	9	2	4	2	1	0	84
Glyt+Fmsf+K_2P+NIS	18+5.2+2%+0.25%	TTI	22	8	6	4	2	1	1	84
Glyt+K_2P+Acet	18+2%+18	TJ60	1	2	4	3	2	2	1	90
Glyt+K_2P+Acet	18+2%+18	TTI	2	1	5	7	4	2	2	84
Glyt+Acet+Lact+K_2P+NIS	18+18+2.5+2%+0.25%	TJ60	29	11	2	5	2	1	1	84
Glyt+Acet+Lact+K_2P+NIS	18+18+2.5+2%+0.25%	TTI	25	8	1	5	4	3	1	89
Glyt+Cleth+K_2P	18+0.73+2%	TJ60	4	4	3	6	2	0	1	92
Glyt+Cleth+K_2P	18+0.73+2%	TTI	9	4	7	8	4	1	1	87
CV			23	39	92	76	85	118	74	6
LSD (P=0.05)			5	3	5	7	4	8	1	7

[a] Acet was Warrant

All treatments, including glyphosate alone, provided complete control of existing weeds at application. Control was not affected by nozzle tip. Soybean injury also was not affected by nozzle tip. Treatments that included lactofen or fomesafen resulted in 20 to 30% injury to soybean. Glyphosate alone caused 8 to 9% injury to soybean mainly as mottled chlorosis, but glyphosate with acetochlor only resulted in 1 to 2% injury. Addition of acetochlor did not reduce presence of late cohort weeds.