Spray volume effects on herbicide efficacy, Fargo. (Ramsdale and Messersmith) Proso millet, foxtail millet, and oat were planted as 6-ft-wide strips side-by-side on May 31, 2001. Plots 12 ft wide were laid out perpendicular to the strips so that each plot contained all three assay species. Treatments were applied on July 2 with an all-terrain vehicle equipped with a four-nozzle boom (20-inch spacing) offset to one side. Conditions at treatment were 75 F, 65% RH, wind 8 mph, and sky cloudy. Proso millet was 6- to 8-inch (tillering), foxtail millet 8- to 10-inch (tillering), and oat 10- to 12-inch (tillering). Experimental design was a randomized complete block with four replicates. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of assay species.

			July 16			July 25			
Treatment[a]	Rate	Volume[b]	Prmi	Fomi	Oat	Prmi	Fomi	Oat	Ave
	oz ai/A	gpa	% control						
Immx + Scoil	0.25 + 1.5 pt	2.5	66	68	50	73	79	75	69
Immx + Scoil	0.25 + 1.5 pt	5	74	71	61	85	85	83	77
Immx + Scoil	0.25 + 1.5 pt	10	54	50	49	69	63	70	59
Immx + Scoil	0.25 + 1.5 pt	20	65	68	50	60	85	63	65
Seth + Scoil	1 + 1.5 pt	2.5	75	69	61	89	82	68	74
Seth + Scoil	1 + 1.5 pt	5	71	59	55	85	76	60	68
Seth + Scoil	1 + 1.5 pt	10	71	65	60	88	83	55	70
Seth + Scoil	1 + 1.5 pt	20	70	63	54	84	80	36	65
Flcz + Quad 7	0.2 + 1%	2.5	39	49	48	23	63	60	47
Flcz + Quad 7	0.2 + 1%	5	46	55	50	33	69	68	54
Flcz + Quad 7	0.2 + 1%	10	36	49	44	23	60	61	46
Flcz + Quad 7	0.2 + 1%	20	46	60	49	35	69	70	55
Glyt - Ultra	1	2.5	98	98	95	98	98	96	97
Glyt - Ultra	1	5	94	95	93	94	94	92	94
Glyt - Ultra	1	10	84	88	83	86	92	83	86
Glyt - Ultra	1	20	74	75	61	76	84	59	72
Glyt - TD	1	2.5	96	96	95	96	97	96	96
Glyt - TD	1	5	96	96	91	94	96	93	94
Glyt - TD	1	10	80	83	72	81	90	70	79
Glyt - TD	1	20	78	80	69	79	88	63	76
LSD (5%)			8	11	12	8	10	12	10

[a] Immx = imazamox; Seth = sethoxydim, Flcz = flucarbazone; Glyt - Ultra = glyphosate as Roundup Ultra; Glyt - TD = glyphosate as Touchdown Pro; Scoil = methylated seed oil; Quad 7 = basic blend adjuvant.
[b] All treatments were applied at 20 psi. Spray volumes at 2.5 and 5 gpa were applied with Turbo TeeJet 11001 nozzles, and spray volumes at 10 and 20 gpa were applied with Turbo TeeJet 11004 nozzles.

Grass species control by imazamox, sethoxydim, and flucarbazone was generally not influenced by changes in spray volume. Glyphosate as Roundup Ultra or Touchdown Pro were most effective when applied in 2.5 or 5 gpa spray volume. Roundup Ultra was more effective in 10 gpa spray volume than 20 gpa. Conversely, grass control by Touchdown Pro was similar whether applied in 10 or 20 gpa spray volume. The concentration of herbicide and adjuvant from formulated glyphosate would decrease as spray volume increased which likely contributed to reduced glyphosate efficacy.

Brown ?

Spray volume effects on herbicide efficacy, Hettinger. (Ramsdale, Messersmith, and Eriksmoen) Proso millet, foxtail millet, barley, and oat were planted as 6-ft-wide strips side-by-side on May 17, 2001. Plots 12 ft wide were laid out perpendicular to the strips so that each plot contained all three assay species. Treatments were applied on July 5 with an all-terrain vehicle equipped with a four-nozzle boom (20-inch spacing) offset to one side. Conditions at treatment were 81 F, 35% RH, wind 15 mph, and sky mostly sunny. Proso millet was 8- to 10-inch (tillering), foxtail millet 8- to 10-inch (tillering), barley 12- to 15-inch (tillering), and oat 12- to 15-inch (tillering). Experimental design was a randomized complete block with four replicates. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of assay species.

			July 19				July 30				
Treatment[a]	Rate	Volume[b]	Prmi	Fomi	Bar	Oat	Prmi	Fomi	Bar	Oat	Ave
	oz ai/A	gpa	% control								
Immx + Scoil	0.25 + 1.5 pt	2.5	63	58	60	60	43	88	75	86	67
Immx + Scoil	0.25 + 1.5 pt	5	70	60	70	64	63	93	83	86	74
Immx + Scoil	0.25 + 1.5 pt	10	60	63	60	63	63	91	75	88	70
Immx + Scoil	0.25 + 1.5 pt	20	63	60	61	58	56	93	85	90	71
Seth + Scoil	1 + 1.5 pt	2.5	76	58	38	43	93	80	48	48	61
Seth + Scoil	1 + 1.5 pt	5	70	55	39	48	95	95	45	45	62
Seth + Scoil	1 + 1.5 pt	10	66	58	35	26	93	93	43	13	53
Seth + Scoil	1 + 1.5 pt	20	73	65	34	29	94	94	50	14	57
Flcz + Quad 7	0.2 + 1%	2.5	45	63	49	48	53	91	45	88	60
Flcz + Quad 7	0.2 + 1%	5	50	58	49	53	53	93	35	88	60
Flcz + Quad 7	0.2 + 1%	10	53	63	48	55	38	93	48	86	61
Flcz + Quad 7	0.2 + 1%	20	45	65	43	53	53	94	43	86	60
Glyt - Ultra	1	2.5	45	53	45	39	64	81	70	55	57
Glyt - Ultra	1	5	23	30	30	40	20	30	48	40	33
Glyt - Ultra	1	10	9	9	4	10	8	40	18	18	15
Glyt - Ultra	1	20	4	4	9	11	0	0	13	23	8
Glyt - TD	1	2.5	30	40	34	33	36	40	55	55	40
Glyt - TD	1	5	33	45	21	16	33	48	45	38	35
Glyt - TD	1	10	9	11	8	8	6	19	19	9	11
Glyt - TD	1	20	3	4	1	1	0	6	6	3	3
LSD (5%)			15	12	13	14	29	18	20	21	18

[a] Immx = imazamox; Seth = sethoxydim, Flcz = flucarbazone; Glyt - Ultra = glyphosate as Roundup Ultra; Glyt - TD = glyphosate as Touchdown Pro; Scoil = methylated seed oil; Quad 7 = basic blend adjuvant.
[b] All treatments were applied at 20 psi. Spray volumes at 2.5 and 5 gpa were applied with Turbo TeeJet 11001 nozzles, and spray volumes at 10 and 20 gpa were applied with Turbo TeeJet 11004 nozzles.

Grass species control by imazamox, sethoxydim, and flucarbazone was generally not influenced by changes in spray volume. Glyphosate as Roundup Ultra was most effective when applied in 2.5 gpa spray volume. Similarly, glyphosate as Touchdown Pro was more effective in 2.5 or 5 gpa spray volume than 10 or 20 gpa. The concentration of herbicide and adjuvant from formulated glyphosate would decrease as spray volume increased which likely contributed to reduced glyphosate efficacy.

Spray volume effects on herbicide efficacy, Carrington. (Ramsdale, Messersmith, and Henson) Proso millet, foxtail millet, barley, and oat were planted as 6-ft-wide strips side-by-side on May 16, 2001. Plots 12 ft wide were laid out perpendicular to the strips so that each plot contained all three assay species. Treatments were applied on June 27 with an all-terrain vehicle equipped with a four-nozzle boom (20-inch spacing) offset to one side. Conditions at treatment were 80 F, 45% RH, wind 10-12 mph, and sky cloudy. Proso millet was 8- to 10-inch (tillering), foxtail millet 10- to 12-inch (tillering), barley 18- to 20-inch (jointing), and oat 10- to 12-inch (jointing). Experimental design was a randomized complete block with four replicates. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of assay species.

			July 11				July 26				
Treatment[a]	Rate	Volume[b]	Prmi	Fomi	Bar	Oat	Prmi	Fomi	Bar	Oat	Ave
	oz ai/A	gpa	% control								
Immx + Scoil	0.25 + 1.5 pt	2.5	80	70	64	33	78	80	93	64	70
Immx + Scoil	0.25 + 1.5 pt	5	73	70	63	35	66	78	90	60	67
Immx + Scoil	0.25 + 1.5 pt	10	71	69	49	30	54	68	83	50	59
Immx + Scoil	0.25 + 1.5 pt	20	36	51	40	25	38	59	61	41	44
Seth + Scoil	1 + 1.5 pt	2.5	79	71	51	33	89	79	51	38	61
Seth + Scoil	1 + 1.5 pt	5	85	75	46	36	90	84	49	26	61
Seth + Scoil	1 + 1.5 pt	10	81	74	36	34	89	85	39	25	58
Seth + Scoil	1 + 1.5 pt	20	86	83	44	30	89	80	31	26	59
Flcz + Quad 7	0.2 + 1%	2.5	49	55	43	24	26	64	63	15	42
Flcz + Quad 7	0.2 + 1%	5	50	51	43	28	40	64	63	10	43
Flcz + Quad 7	0.2 + 1%	10	51	51	39	28	36	66	63	10	43
Flcz + Quad 7	0.2 + 1%	20	36	44	38	25	30	64	61	18	40
Glyt - Ultra	1	2.5	83	90	92	79	79	84	86	86	85
Glyt - Ultra	1	5	83	90	90	68	71	84	80	78	81
Glyt - Ultra	1	10	41	59	58	28	28	55	46	40	44
Glyt - Ultra	1	20	13	41	33	9	11	44	34	15	25
Glyt - TD	1	2.5	79	83	93	82	81	86	90	91	86
Glyt - TD	1	5	74	80	84	63	69	81	74	81	85
Glyt - TD	1	10	51	66	56	40	48	61	44	44	51
Glyt - TD	1	20	39	59	45	20	23	54	35	30	38
LSD (5%)			17	14	12	10	14	10	11	9	12

[a] Immx = imazamox; Seth = sethoxydim, Flcz = flucarbazone; Glyt - Ultra = glyphosate as Roundup Ultra; Glyt - TD = glyphosate as Touchdown Pro; Scoil = methylated seed oil; Quad 7 = basic blend adjuvant.
[b] All treatments were applied at 20 psi. Spray volumes at 2.5 and 5 gpa were applied with Turbo TeeJet 11001 nozzles, and spray volumes at 10 and 20 gpa were applied with Turbo TeeJet 11004 nozzles.

Imazamox efficacy generally decreased as spray volume increased with the greatest decrease from 10 to 20 gpa. Grass species control by sethoxydim and flucarbazone was generally not influenced by changes in spray volume. Glyphosate as Roundup Ultra or Touchdown Pro were most effective when applied in 2.5 or 5 gpa spray volume. Additionally, glyphosate usually was more effective in 10 gpa spray volume than 20 gpa, regardless of formulation. The concentration of herbicide and adjuvant from formulated glyphosate would decrease as spray volume increased which likely contributed to reduced glyphosate efficacy.

Spray volume effects on herbicide efficacy, Minot. (Ramsdale, Messersmith, and Jenks) Proso millet, foxtail millet, barley, and oat were planted as 6-ft-wide strips side-by-side on May 22, 2001. Plots 12 ft wide were laid out perpendicular to the strips so that each plot contained all three assay species. Treatments were applied on June 27 with an all-terrain vehicle equipped with a four-nozzle boom (20-inch spacing) offset to one side. Conditions at treatment were 72 F, 55% RH, wind 10-15 mph, and sky cloudy. Proso millet was 4- to 8-inch (tillering), foxtail millet 4- to 8-inch (tillering), barley 12- to 15-inch (jointing), and oat 12- to 15-inch (jointing). Experimental design was a randomized complete block with four replicates. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of assay species.

			July 11				July 26				
Treatment[a]	Rate	Volume[b]	Prmi	Fomi	Bar	Oat	Prmi	Fomi	Bar	Oat	Ave
	oz ai/A	gpa	% control								
Immx + Scoil	0.25 + 1.5 pt	2.5	81	84	53	69	84	86	74	93	78
Immx + Scoil	0.25 + 1.5 pt	5	76	85	48	66	74	90	71	90	75
Immx + Scoil	0.25 + 1.5 pt	10	70	73	43	58	50	78	59	79	64
Immx + Scoil	0.25 + 1.5 pt	20	61	78	39	56	29	76	53	75	58
Seth + Scoil	1 + 1.5 pt	2.5	88	86	55	73	95	94	39	84	77
Seth + Scoil	1 + 1.5 pt	5	88	84	41	71	98	97	41	91	76
Seth + Scoil	1 + 1.5 pt	10	91	90	43	69	98	98	33	79	75
Seth + Scoil	1 + 1.5 pt	20	90	87	40	61	93	90	21	39	65
Flcz + Quad 7	0.2 + 1%	2.5	45	76	35	48	21	89	25	85	53
Flcz + Quad 7	0.2 + 1%	5	63	79	34	46	35	83	20	71	54
Flcz + Quad 7	0.2 + 1%	10	59	76	36	46	36	87	23	66	54
Flcz + Quad 7	0.2 + 1%	20	33	78	33	50	23	80	23	54	47
Glyt - Ultra	1	2.5	98	98	99	93	94	99	96	88	96
Glyt - Ultra	1	5	96	97	95	91	92	98	90	84	93
Glyt - Ultra	1	10	81	92	90	70	61	87	82	51	77
Glyt - Ultra	1	20	82	82	64	55	66	85	54	36	66
Glyt - TD	1	2.5	92	97	97	89	89	99	94	86	93
Glyt - TD	1	5	93	96	95	88	91	97	91	80	92
Glyt - TD	1	10	86	92	88	71	65	83	81	46	77
Glyt - TD	1	20	70	83	74	56	53	88	73	40	67
LSD (5%)			12	14	14	13	14	9	10	12	12

[a] Immx = imazamox; Seth = sethoxydim, Flcz = flucarbazone; Glyt - Ultra = glyphosate as Roundup Ultra; Glyt - TD = glyphosate as Touchdown Pro; Scoil = methylated seed oil; Quad 7 = basic blend adjuvant.
[b] All treatments were applied at 20 psi. Spray volumes at 2.5 and 5 gpa were applied with Turbo TeeJet 11001 nozzles, and spray volumes at 10 and 20 gpa were applied with Turbo TeeJet 11004 nozzles.

Imazamox efficacy was generally best when spray volume was 2.5 or 5 gpa. Grass species control by sethoxydim and flucarbazone was generally not influenced by changes in spray volume. Glyphosate as Roundup Ultra or Touchdown Pro were most effective when applied in 2.5 or 5 gpa spray volume. Additionally, glyphosate efficacy was generally similar whether applied in 10 or 20 gpa spray volume, regardless of formulation. The concentration of herbicide and adjuvant from formulated glyphosate would decrease as spray volume increased which likely contributed to reduced glyphosate efficacy.

Fluroxypyr plus thifensulfuron: spray volume and adjuvants, Fargo. (Ramsdale and Messersmith) Oilseed sunflower, 'Omega' flax, and 'Mancan' tame buckwheat were planted as 6-ft-wide strips side-by-side on May 31, 2001. Plots 12 ft wide were laid out perpendicular to the strips so that each plot contained all three assay species. Treatments were applied on July 4 with an all-terrain vehicle equipped with a four-nozzle boom (20-inch spacing) offset to one side. Conditions at treatment were 70 F, 50% RH, wind calm, and sky clear. Sunflower was 6- to 10-inch, flax 4- to 6-inch, and buckwheat 6- to 10-inch. Experimental design was a randomized complete block with four replicates. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of assay species.

Treatment[a]	Rate	Volume[b]	July 23		
			Sunf	Bwht	Flax
	oz ai/A	gpa	% control		
Fluroxypyr	1.5	2.5	49	59	71
Flox + Thif + Activator 90	1.5 + 0.23 + 0.25%	2.5	90	85	76
Flox + Thif + Quad 7	1.5 + 0.23 + 1%	2.5	91	90	79
Fluroxypyr	1.5	5	58	73	69
Flox + Thif + Activator 90	1.5 + 0.23 + 0.25%	5	91	92	80
Flox + Thif + Quad 7	1.5 + 0.23 + 1%	5	96	95	78
Fluroxypyr	1.5	10	56	66	71
Flox + Thif + Activator 90	1.5 + 0.23 + 0.25%	10	92	88	73
Flox + Thif + Quad 7	1.5 + 0.23 + 1%	10	96	94	80
LSD (5%)			7	8	7

[a] Quad 7 = basic blend adjuvant; Activator 90 = nonionic surfactant.
[b] All treatments were applied at 20 psi. Spray volumes at 2.5 and 5 gpa were applied with Turbo TeeJet 11001 nozzles, and spray volumes at 10 and 20 gpa were applied with Turbo TeeJet 11004 nozzles.

Fluroxypyr applied alone provided better control of sunflower and tame buckwheat when applied in 5 gpa spray volume compared to 2.5 gpa. Fluroxypyr control of sunflower and tame buckwheat was similar whether applied in 5 or 10 gpa spray volume. Flax control by fluroxypyr was not influenced by spray volume. Fluroxypyr plus thifensulfuron provided similar broadleaf species control whether applied in 2.5, 5, or 10 gpa spray volume. Additionally, fluroxypyr plus thifensulfuron control of flax, sunflower, and tame buckwheat was similar whether applied with Activator 90 or Quad 7 adjuvant, regardless of spray volume.

Fluroxypyr: spray volume and adjuvants, Grand Forks. (Ramsdale and Messersmith) The experiment was established on fallow ground that was heavily infested with kochia. Plots were 12 ft wide by 30 ft long. Treatments were applied on June 21 with an all-terrain vehicle equipped with a four-nozzle boom (20-inch spacing) offset to one side. Conditions at treatment were 72 F, 50% RH, wind N at 5 mph, and sky clear. The kochia was up to 20 inches tall at time of treatment. Experimental design was a randomized complete block with four replicates. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of kochia.

Treatment[a]	Rate	Volume[b]	Kochia control	
			July 6	July 17
	oz ai/A	gpa	%	
Fluroxypyr	1.5	2.5	43	55
Fluroxypyr + Activator 90	1.5 + 0.25%	2.5	40	50
Fluroxypyr + Quad 7	1.5 + 1%	2.5	35	58
Fluroxypyr	1.5	5	41	59
Fluroxypyr + Activator 90	1.5 + 0.25%	5	41	53
Fluroxypyr + Quad 7	1.5 + 1%	5	45	54
Fluroxypyr	1.5	10	43	53
Fluroxypyr + Activator 90	1.5 + 0.25%	10	43	59
Fluroxypyr + Quad 7	1.5 + 1%	10	39	63
LSD (5%)			NS	7

[a] Quad 7 = basic blend adjuvant; Activator 90 = nonionic surfactant.
[b] All treatments were applied at 20 psi. Spray volumes at 2.5 and 5 gpa were applied with Turbo TeeJet 11001 nozzles, and spray volumes at 10 and 20 gpa were applied with Turbo TeeJet 11004 nozzles.

Kochia at time of treatment was very large (up to 20 inch), which led to low levels of control. Overall, fluroxypyr control of kochia generally was not influenced by changes in spray volume. Kochia control was also generally similar for fluroxypyr applied alone or in combination with Quad 7 or Activator 90. These results are similar to the Fargo experiment in which flax control by fluroxypyr was not influenced by spray volume. Flax and kochia are similar species morphologically.

Fomesafen (Reflex): spray volume and adjuvants, Fargo. (Ramsdale and Messersmith) Oilseed sunflower, 'Omega' flax, and 'Mancan' tame buckwheat were planted as 6-ft-wide strips side-by-side on May 31, 2001. Plots 12 ft wide were laid out perpendicular to the strips so that each plot contained all three assay species. Treatments were applied on July 2 with an all-terrain vehicle equipped with a four-nozzle boom (20-inch spacing) offset to one side. Conditions at treatment were 60 F, 75% RH, wind 6-8 mph, and sky cloudy. Sunflower was 6- to 10-inch, flax 4- to 6-inch, and buckwheat 6- to 10-inch. Experimental design was a randomized complete block with four replicates. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of assay species.

			July 9			July 23	
Treatment[a]	Rate	Volume[b]	Sunf	Bwht	Flax	Sunf	Ave
	oz ai/A	gpa	% control				
Reflex + Scoil	1.5 + 1.5 pt	2.5	58	81	82	39	65
Reflex + Quad 7	1.5 + 1%	2.5	46	58	70	29	51
Reflex + Activator 90	1.5 + 0.25%	2.5	14	21	28	9	18
Reflex + Herbimax	1.5 + 1.5 pt	2.5	34	36	52	18	35
Reflex + Scoil	1.5 + 1.5 pt	5	58	78	78	41	64
Reflex + Quad 7	1.5 + 1%	5	53	70	83	33	60
Reflex + Activator 90	1.5 + 0.25%	5	36	43	54	21	39
Reflex + Herbimax	1.5 + 1.5 pt	5	36	48	60	20	41
Reflex + Scoil	1.5 + 1.5 pt	10	61	81	78	53	68
Reflex + Quad 7	1.5 + 1%	10	49	59	78	31	54
Reflex + Activator 90	1.5 + 0.25%	10	29	39	53	15	34
Reflex + Herbimax	1.5 + 1.5 pt	10	34	45	50	20	37
Reflex + Scoil	1.5 + 1.5 pt	20	65	81	81	46	68
Reflex + Quad 7	1.5 + 1%	20	68	83	85	48	71
Reflex + Activator 90	1.5 + 0.25%	20	46	66	65	31	52
Reflex + Herbimax	1.5 + 1.5 pt	20	41	43	48	23	39
LSD (5%)			12	15	15	12	14

[a] Scoil = methylated seed oil; Quad 7 = basic blend adjuvant; Activator 90 = nonionic surfactant; Herbimax = petroleum oil concentrate.

[b] All treatments were applied at 20 psi. Spray volumes at 2.5 and 5 gpa were applied with Turbo TeeJet 11001 nozzles, and spray volumes at 10 and 20 gpa were applied with Turbo TeeJet 11004 nozzles.

The Reflex formulation of fomesafen does not include an adjuvant. Overall, Reflex was most effective when applied with Scoil methylated seed oil adjuvant. Reflex plus Scoil provided similar broadleaf control whether applied in 2.5, 5, 10, or 20 gpa spray volume. Broadleaf control by Reflex plus Herbimax crop oil concentrate also was not influenced by changes in spray volume, but was 23 to 31% less than Reflex plus Scoil when averaged across species. Reflex plus Activator 90 nonionic surfactant was most effective when applied in 20 gpa spray volume. Likewise, Reflex plus Quad 7 basic blend adjuvant was generally most effective in 20 gpa spray volume, providing broadleaf control that was similar to Reflex plus Scoil. Activator 90 and Quad 7 were applied at a percentage-of-spray-volume rate (% v/v). Thus, the amount of adjuvant applied per acre increased as spray volume increased which likely contributed to increased herbicide efficacy as spray volume increased. Scoil and Herbimax were applied on a per acre basis, so Reflex efficacy was not influenced by spray volume as sufficient adjuvant was present to maximize herbicide efficacy.

Fomesafen (Flexstar): spray volume and adjuvants, Fargo. (Ramsdale and Messersmith) Oilseed sunflower, 'Omega' flax, and 'Mancan' tame buckwheat were planted as 6-ft-wide strips side-by-side on May 31, 2001. Plots 12 ft wide were laid out perpendicular to the strips so that each plot contained all three assay species. Treatments were applied on July 2 with an all-terrain vehicle equipped with a four-nozzle boom (20-inch spacing) offset to one side. Conditions at treatment were 60 F, 75% RH, wind 6-8 mph, and sky cloudy. Sunflower was 6- to 10-inch, flax 4- to 6-inch, and buckwheat 6- to 10-inch. Experimental design was a randomized complete block with four replicates. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of assay species.

			July 9			July 23			
Treatment[a]	Rate	Volume[b]	Sunf	Bwht	Flax	Sunf	Bwht	Flax	Ave
	oz ai/A	gpa	% control						
Flexstar + Scoil	1.5 + 1.5 pt	2.5	58	76	83	46	66	78	68
Flexstar + Quad 7	1.5 + 1%	2.5	58	65	77	43	58	74	63
Flexstar + Activator 90	1.5 + 0.25%	2.5	48	61	80	34	51	71	58
Flexstar + Herbimax	1.5 + 1.5 pt	2.5	54	75	84	46	68	80	69
Flexstar + Scoil	1.5 + 1.5 pt	5	64	82	88	44	70	81	72
Flexstar + Quad 7	1.5 + 1%	5	63	76	89	38	51	75	65
Flexstar + Activator 90	1.5 + 0.25%	5	55	66	85	36	56	70	61
Flexstar + Herbimax	1.5 + 1.5 pt	5	56	78	85	40	59	78	66
Flexstar + Scoil	1.5 + 1.5 pt	10	63	78	86	45	61	78	69
Flexstar + Quad 7	1.5 + 1%	10	73	75	82	55	61	79	71
Flexstar + Activator 90	1.5 + 0.25%	10	53	64	82	36	49	73	60
Flexstar + Herbimax	1.5 + 1.5 pt	10	53	74	86	39	54	76	64
Flexstar + Scoil	1.5 + 1.5 pt	20	76	88	89	55	81	83	79
Flexstar + Quad 7	1.5 + 1%	20	76	85	88	54	75	80	76
Flexstar + Activator 90	1.5 + 0.25%	20	55	64	80	35	49	71	59
Flexstar + Herbimax	1.5 + 1.5 pt	20	55	63	78	34	51	70	59
LSD (5%)			10	11	8	11	16	NS	11

[a] Scoil = methylated seed oil; Quad 7 = basic blend adjuvant; Activator 90 = nonionic surfactant; Herbimax = petroleum oil concentrate.

[b] All treatments were applied at 20 psi. Spray volumes at 2.5 and 5 gpa were applied with Turbo TeeJet 11001 nozzles, and spray volumes at 10 and 20 gpa were applied with Turbo TeeJet 11004 nozzles.

The Flexstar formulation of fomesafen contains a partial adjuvant load, as it still requires the addition of a nonionic surfactant or oil based adjuvant. Flexstar control of broadleaf species was similar among adjuvant types at 2.5, 5, or 10 gpa spray volume. However, Flexstar plus Scoil or Quad 7 was more effective than Flexstar plus Activator 90 or Herbimax when applied in 20 gpa spray volume. Flexstar efficacy was generally not influenced by changes in spray volume, regardless of spray adjuvant. The adjuvant in the Flexstar formulation was likely important for herbicide efficacy when applied at low spray volumes with Activator 90 or Quad 7, which were applied at a % v/v rate.

Fomesafen formulation, spray volume and adjuvants, Grand Forks. (Ramsdale and Messersmith) The experiment was established on fallow ground that was heavily infested with kochia. Plots were 12 ft wide by 30 ft long. Treatments were applied on June 21 with an all-terrain vehicle equipped with a four-nozzle boom (20-inch spacing) offset to one side. Conditions at treatment were 72 F, 50% RH, wind N at 5 mph, and sky clear. The kochia was up to 20 inches tall at time of treatment. Experimental design was a randomized complete block with four replicates. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of kochia.

Treatment[a]	Rate	Volume[b]	July 6	
			Reflex	Flexstar
	oz ai/A	gpa	% kochia control	
Fomesafen + Scoil	2.8 + 1.5 pt	2.5	39	43
Fomesafen + Quad 7	2.8 + 1%	2.5	9	30
Fomesafen + Activator 90	2.8 + 0.25%	2.5	19	31
Fomesafen + Herbimax	2.8 + 1.5 pt	2.5	25	33
Fomesafen + Scoil	2.8 + 1.5 pt	5	46	43
Fomesafen + Quad 7	2.8 + 1%	5	23	31
Fomesafen + Activator 90	2.8 + 0.25%	5	25	29
Fomesafen + Herbimax	2.8 + 1.5 pt	5	29	33
Fomesafen + Scoil	2.8 + 1.5 pt	10	43	49
Fomesafen + Quad 7	2.8 + 1%	10	18	44
Fomesafen + Activator 90	2.8 + 0.25%	10	30	34
Fomesafen + Herbimax	2.8 + 1.5 pt	10	39	44
Fomesafen + Scoil	2.8 + 1.5 pt	20	48	51
Fomesafen + Quad 7	2.8 + 1%	20	55	46
Fomesafen + Activator 90	2.8 + 0.25%	20	39	41
Fomesafen + Herbimax	2.8 + 1.5 pt	20	51	41
LSD (5%)			15	14

[a] Scoil = methylated seed oil; Quad 7 = basic blend adjuvant; Activator 90 = nonionic surfactant; Herbimax = petroleum oil concentrate.
[b] All treatments were applied at 20 psi. Spray volumes at 2.5 and 5 gpa were applied with Turbo TeeJet 11001 nozzles, and spray volumes at 10 and 20 gpa were applied with Turbo TeeJet 11004 nozzles.

The kochia at time of treatment were very large (up to 20 inch), which led to low levels of control. Fomesafen as the Reflex formulation was generally most effective with Scoil whether applied in 2.5, 5, 10, or 20 gpa spray volume. Reflex plus Activator 90, Herbimax, or Quad 7 was more effective in 20 gpa than 2.5 gpa and provided similar kochia control to Reflex plus Scoil. Fomesafen as the Flexstar formulation was generally not influenced by adjuvant type when comparing adjuvants at the same spray volume. Overall, these results were similar to the Fargo studies.

Acifluorfen: spray volume and adjuvants, Fargo. (Ramsdale and Messersmith) Oilseed sunflower, 'Omega' flax, and 'Mancan' tame buckwheat were planted as 6-ft-wide strips side-by-side on May 31, 2001. Plots 12 ft wide were laid out perpendicular to the strips so that each plot contained all three assay species. Treatments were applied on July 2 with an all-terrain vehicle equipped with a four-nozzle boom (20-inch spacing) offset to one side. Conditions at treatment were 60 F, 75% RH, wind 6-8 mph, and sky cloudy. Sunflower was 6- to 10-inch, flax 4- to 6-inch, and buckwheat 6- to 10-inch. Experimental design was a randomized complete block with four replicates. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of assay species.

			July 9			July 23			
Treatment[a]	Rate	Volume[b]	Sunf	Bwht	Flax	Sunf	Bwht	Flax	Ave
	oz ai/A	gpa	% control						
Acifluorfen + Scoil	2 + 1.5 pt	2.5	56	87	78	46	83	92	74
Acifluorfen + Quad 7	2 + 1%	2.5	36	75	70	26	66	74	58
Acifluorfen + Activator 90	2 + 0.25%	2.5	35	75	74	30	65	74	59
Acifluorfen + Herbimax	2 + 1.5 pt	2.5	58	84	80	46	81	88	73
Acifluorfen + Scoil	2 + 1.5 pt	5	59	89	83	55	88	89	77
Acifluorfen + Quad 7	2 + 1%	5	56	86	83	38	75	86	71
Acifluorfen + Activator 90	2 + 0.25%	5	41	78	77	33	60	75	61
Acifluorfen + Herbimax	2 + 1.5 pt	5	49	79	73	39	70	80	65
Acifluorfen + Scoil	2 + 1.5 pt	10	73	94	89	60	92	97	84
Acifluorfen + Quad 7	2 + 1%	10	73	93	91	54	90	93	82
Acifluorfen + Activator 90	2 + 0.25%	10	48	80	72	30	65	75	62
Acifluorfen + Herbimax	2 + 1.5 pt	10	60	78	69	38	66	73	64
Acifluorfen + Scoil	2 + 1.5 pt	20	71	90	86	49	83	92	79
Acifluorfen + Quad 7	2 + 1%	20	85	98	92	60	92	99	88
Acifluorfen + Activator 90	2 + 0.25%	20	64	90	90	36	75	93	75
Acifluorfen + Herbimax	2 + 1.5 pt	20	54	85	73	31	68	79	65
LSD (5%)			10	11	13	10	13	14	12

[a] Scoil = methylated seed oil; Quad 7 = basic blend adjuvant; Activator 90 = nonionic surfactant; Herbimax = petroleum oil concentrate.

[b] All treatments were applied at 20 psi. Spray volumes at 2.5 and 5 gpa were applied with Turbo TeeJet 11001 nozzles, and spray volumes at 10 and 20 gpa were applied with Turbo TeeJet 11004 nozzles.

Acifluorfen (Ultra Blazer) plus Scoil methylated seed oil adjuvant provided similar broadleaf species control at 2.5, 5, 10, or 20 gpa spray volume. Likewise, broadleaf species control by acifluorfen plus Herbimax petroleum oil was not influenced by spray volume. Scoil and Herbimax were each applied at 1.5 pt/A, so an equivalent amount of adjuvant was applied per acre regardless of spray volume. Broadleaf species control by acifluorfen plus Quad 7 basic blend adjuvant generally increased as spray volume increased from 2.5 to 20 gpa. Acifluorfen plus Activator 90 nonionic surfactant also was much more effective in 20 than 2.5 gpa. Quad 7 and Activator 90 were each applied on a % v/v basis, so the amount of adjuvant applied per acre increased as spray volume increased which was likely important for acifluorfen efficacy with these two adjuvants.

Bentazon: spray volume and adjuvants, Fargo. (Ramsdale and Messersmith) Oilseed sunflower, 'Omega' flax, and 'Mancan' tame buckwheat were planted as 6-ft-wide strips side-by-side on May 31, 2001. Plots 12 ft wide were laid out perpendicular to the strips so that each plot contained all three assay species. Treatments were applied on July 2 with an all-terrain vehicle equipped with a four-nozzle boom (20-inch spacing) offset to one side. Conditions at treatment were 65 F, 70% RH, wind 6-8 mph, and sky cloudy. Sunflower was 6- to 10-inch, flax 4- to 6-inch, and buckwheat 6- to 10-inch. Experimental design was a randomized complete block with four replicates. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of assay species.

Treatment[a]	Rate	Volume[b]	July 9		July 23		
			Sunf	Bwht	Sunf	Bwht	Ave
	oz ai/A	gpa	% control				
Bentazon + Scoil	8 + 1.5 pt	2.5	51	63	39	56	52
Bentazon + Quad 7	8 + 1%	2.5	60	73	46	68	62
Bentazon + Herbimax	8 + 1.5 pt	2.5	73	74	54	71	68
Bentazon + Scoil	8 + 1.5 pt	5	70	73	51	63	64
Bentazon + Quad 7	8 + 1%	5	71	75	55	63	66
Bentazon + Herbimax	8 + 1.5 pt	5	64	71	49	63	62
Bentazon + Scoil	8 + 1.5 pt	10	64	68	46	58	59
Bentazon + Quad 7	8 + 1%	10	64	75	54	61	64
Bentazon + Herbimax	8 + 1.5 pt	10	73	72	50	56	63
Bentazon + Scoil	8 + 1.5 pt	20	64	71	44	60	60
Bentazon + Quad 7	8 + 1%	20	68	76	46	55	61
Bentazon + Herbimax	8 + 1.5 pt	20	69	78	46	59	63
LSD (5%)			NS	NS	NS	NS	NS

[a] Scoil = methylated seed oil; Quad 7 = basic blend adjuvant; Herbimax = petroleum oil concentrate.
[b] All treatments were applied at 20 psi. Spray volumes at 2.5 and 5 gpa were applied with Turbo TeeJet 11001 nozzles, and spray volumes at 10 and 20 gpa were applied with Turbo TeeJet 11004 nozzles.

Bentazon efficacy was not influenced by adjuvant type or spray volume. These results agree with research in 1999 that bentazon efficacy was similar at 2.5 or 10 gpa spray volume. However, in 1998, bentazon controlled sunflower better in 10 than 2.5 gpa spray volume.

Lactofen: spray volume and adjuvants, Fargo. (Ramsdale and Messersmith) Oilseed sunflower, 'Omega' flax, and 'Mancan' tame buckwheat were planted as 6-ft-wide strips side-by-side on May 31, 2001. Plots 12 ft wide were laid out perpendicular to the strips so that each plot contained all three assay species. Treatments were applied on July 2 with an all-terrain vehicle equipped with a four-nozzle boom (20-inch spacing) offset to one side. Conditions at treatment were 60 F, 75% RH, wind 6-8 mph, and sky cloudy. Sunflower was 6- to 10-inch, flax 4- to 6-inch, and buckwheat 6- to 10-inch. Experimental design was a randomized complete block with four replicates. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of assay species.

			July 9			July 23			
Treatment[a]	Rate	Volume[b]	Sunf	Bwht	Flax	Sunf	Bwht	Flax	Ave
	oz ai/A	gpa	% control						
Lactofen + Scoil	1.5 + 1.5 pt	2.5	23	43	54	13	28	63	37
Lactofen + Herbimax	1.5 + 1%	2.5	30	45	67	16	30	60	41
Lactofen + Herbimax	1.5 + 1.5 pt	2.5	35	55	71	18	35	64	46
Lactofen + Scoil	1.5 + 1.5 pt	5	28	43	64	13	25	56	38
Lactofen + Herbimax	1.5 + 1%	5	39	65	85	18	36	71	52
Lactofen + Herbimax	1.5 + 1.5 pt	5	50	73	88	25	49	81	61
Lactofen + Scoil	1.5 + 1.5 pt	10	41	65	80	19	36	75	53
Lactofen + Herbimax	1.5 + 1%	10	53	71	89	30	43	78	61
Lactofen + Herbimax	1.5 + 1.5 pt	10	63	80	94	33	60	87	70
Lactofen + Scoil	1.5 + 1.5 pt	20	59	75	88	29	50	84	64
Lactofen + Herbimax	1.5 + 1%	20	66	80	95	44	59	88	72
Lactofen + Herbimax	1.5 + 1.5 pt	20	75	86	97	45	73	95	79
LSD (5%)			10	11	12	9	13	14	12

[a] Scoil = methylated seed oil; Herbimax = petroleum oil concentrate.
[b] All treatments were applied at 20 psi. Spray volumes at 2.5 and 5 gpa were applied with Turbo TeeJet 11001 nozzles, and spray volumes at 10 and 20 gpa were applied with Turbo TeeJet 11004 nozzles.

Overall, lactofen was most effective with Herbimax petroleum oil and when applied in 20 gpa spray volume. Broadleaf species control with lactofen increased as spray volume increased, regardless of the spray adjuvant. The rate of Herbimax was not critical in determining lactofen efficacy, as control was generally similar whether the rate of Herbimax was 1% v/v or 1.5 pt/A. The increased plant coverage by high spray volumes was important for maximizing the efficacy of lactofen.

Dicamba plus diflufenzopyr (Distinct): spray volume and adjuvants, Fargo. (Ramsdale and Messersmith) Oilseed sunflower, 'Omega' flax, and 'Mancan' tame buckwheat were planted as 6-ft-wide strips side-by-side on May 31, 2001. Plots 12 ft wide were laid out perpendicular to the strips so that each plot contained all three assay species. Treatments were applied on July 2 with an all-terrain vehicle equipped with a four-nozzle boom (20-inch spacing) offset to one side. Conditions at treatment were 60 F, 75% RH, wind 6-8 mph, and sky cloudy. Sunflower was 6- to 10-inch, flax 4- to 6-inch, and buckwheat 6- to 10-inch. Experimental design was a randomized complete block with four replicates. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of assay species.

			July 16			July 24			
Treatment[a]	Rate	Volume[b]	Sunf	Bwht	Flax	Sunf	Bwht	Flax	Ave
	oz ai/A	gpa	% control						
Distinct + NIS + UAN	2.1 + 0.25% + 1.25%	2.5	79	83	73	82	92	60	78
Distinct + Quad 7	2.1 + 1%	2.5	79	81	76	83	92	69	80
Distinct + Quad 7	2.1 + 2%	2.5	77	85	74	83	94	66	80
Distinct + NIS + UAN	2.1 + 0.25% + 1.25%	5	83	86	74	87	91	65	81
Distinct + Quad 7	2.1 + 1%	5	81	88	80	84	94	70	83
Distinct + Quad 7	2.1 + 2%	5	84	87	82	89	94	75	85
Distinct + NIS + UAN	2.1 + 0.25% + 1.25%	10	81	86	71	86	95	60	80
Distinct + Quad 7	2.1 + 1%	10	81	90	79	85	96	71	84
Distinct + Quad 7	2.1 + 2%	10	80	88	78	86	95	76	84
Distinct + NIS + UAN	2.1 + 0.25% + 1.25%	20	84	86	78	88	95	69	83
Distinct + Quad 7	2.1 + 1%	20	81	89	78	88	96	77	85
Distinct + Quad 7	2.1 + 2%	20	80	84	79	89	96	76	84
LSD (5%)			NS	NS	NS	NS	NS	9	NS

[a] NIS = Activator 90 nonionic surfactant; Quad 7 = basic blend; UAN = urea ammonium nitrate fertilizer (28-0-0).
[b] All treatments were applied at 20 psi. Spray volumes at 2.5 and 5 gpa were applied with Turbo TeeJet 11001 nozzles, and spray volumes at 10 and 20 gpa were applied with Turbo TeeJet 11004 nozzles.

Overall, Distinct efficacy was not influenced by spray volume or adjuvant type. Distinct plus Quad 7 basic-blend adjuvant (nonionic surfactant, nitrogen fertilizer, and pH buffers) controlled broadleaf species similarly to Distinct plus Activator 90 plus UAN. The rate of Quad 7 adjuvant also was not important for determining Distinct efficacy, regardless of spray volume.

Foramsulfuron: spray volume and adjuvants, Casselton. (Ramsdale and Messersmith) 'Jerry' oat, 'Ember' hard red spring wheat, 'Omega' flax, and oilseed sunflower were planted as 6-ft-wide strips side-by-side on May 30, 2001. Plots 12 ft wide were laid out perpendicular to the strips so that each plot contained all three assay species. Treatments were applied on July 10 with an all-terrain vehicle equipped with a four-nozzle boom (20-inch spacing) offset to one side. Conditions at treatment were 85 F, 40% RH, wind N at 5 mph, and sky clear. Oat was 12- to 20-inch, wheat 12- to 20-inch, flax 6- to 10-inch, and sunflower 6- to 10-inch. Experimental design was a randomized complete block with four replicates. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of assay species.

Treatment[a]	Rate	Volume[b]	July 25				
			Flax	Wht	Oat	Sunf	Ave
	oz ai/A	gpa	% control				
Foramsulfuron + Scoil	0.35 + 1%	2.5	10	58	59	36	41
Foramsulfuron + Scoil	0.35 + 1.5 pt	2.5	11	64	69	54	50
Foramsulfuron + Scoil + UAN	0.35 + 1.5 pt + 2 pt	2.5	38	68	81	70	64
Foramsulfuron + Quad 7	0.35 + 1%	2.5	4	44	53	28	32
Foramsulfuron + Quad 7	0.35 + 2%	2.5	5	56	63	44	42
Foramsulfuron + Scoil	0.35 + 1%	5	10	54	56	39	40
Foramsulfuron + Scoil	0.35 + 1.5 pt	5	26	66	70	50	53
Foramsulfuron + Scoil + UAN	0.35 + 1.5 pt + 2 pt	5	35	64	76	71	62
Foramsulfuron + Quad 7	0.35 + 1%	5	24	60	63	40	47
Foramsulfuron + Quad 7	0.35 + 2%	5	38	58	69	48	53
Foramsulfuron + Scoil	0.35 + 1%	10	10	56	63	49	45
Foramsulfuron + Scoil	0.35 + 1.5 pt	10	28	65	80	65	60
Foramsulfuron + Scoil + UAN	0.35 + 1.5 pt + 2 pt	10	35	68	74	71	62
Foramsulfuron + Quad 7	0.35 + 1%	10	19	68	69	54	53
Foramsulfuron + Scoil	0.35 + 1%	20	3	61	69	54	47
Foramsulfuron + Scoil	0.35 + 1.5 pt	20	31	66	71	60	57
Foramsulfuron + Scoil + UAN	0.35 + 1.5 pt + 2 pt	20	45	60	76	74	64
Foramsulfuron + Quad 7	0.35 + 1%	20	34	66	69	64	58
LSD (5%)			17	12	9	13	13

[a] Scoil = methylated seed oil; Quad 7 = basic blend adjuvant; UAN = urea ammonium nitrate fertilizer (28-0-0).

[b] All treatments were applied at 20 psi. Spray volumes at 2.5 and 5 gpa were applied with Turbo TeeJet 11001 nozzles, and spray volumes at 10 and 20 gpa were applied with Turbo TeeJet 11004 nozzles.

Foramsulfuron was generally most effective when applied with Scoil methylated seed oil plus UAN fertilizer. Additionally, foramsulfuron plus Scoil plus UAN provided similar species control at 2.5. 5, 10, or 20 gpa spray volume. Foramsulfuron applied with Scoil alone was generally more effective when Scoil was applied at 1.5 pt/A than 1% v/v. Foramsulfuron plus Quad 7 basic blend adjuvant at 1% v/v provided better species in 20 than 2.5 gpa. Foramsulfuron plus Quad 7 applied in 20 gpa spray volume provided similar control to foramsulfuron plus Scoil plus UAN. However, foramsulfuron plus Quad 7 in 2.5 gpa was much less effective than foramsulfuron plus Scoil plus UAN.

Clethodim: spray volume-herbicide rate study, Fargo. (Ramsdale and Messersmith) 'Jerry' oat, 'Red Siberian' foxtail millet, and 'Sunrise' white proso millet were planted as 6-ft-wide strips side-by-side on May 31, 2001. Plots 12 ft wide were laid out perpendicular to the strips so that each plot contained all three assay species. Treatments were applied on July 2 with an all-terrain vehicle equipped with a four-nozzle boom (20-inch spacing) offset to one side. Conditions at treatment were 70 F, 65% RH, wind calm, and sky partly cloudy. Oat was 12- to 15-inch (tillering), foxtail millet 10- to 12-inch (tillering), and proso millet 10- to 12-inch (tillering). Experimental design was a randomized complete block with four replicates. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of assay species.

			July 23			August 7			
Treatment[a]	Rate	Volume[b]	Oat	Prmi	Fomi	Oat	Prmi	Fomi	Ave
	oz ai/A	gpa	% control						
Clethodim + Herbimax	0.2 + 1.5 pt	2.5	87	79	65	91	81	60	77
Clethodim + Herbimax	0.2 + 1.5 pt	5	78	81	65	78	80	65	75
Clethodim + Herbimax	0.2 + 1.5 pt	10	51	74	60	50	63	50	58
Clethodim + Scoil	0.2 + 1.5 pt	2.5	93	85	73	98	83	70	84
Clethodim + Scoil	0.2 + 1.5 pt	5	86	80	64	89	82	64	78
Clethodim + Scoil	0.2 + 1.5 pt	10	81	79	63	85	81	65	76
Clethodim + Herbimax	0.4 + 1.5 pt	2.5	97	92	75	99	95	79	90
Clethodim + Herbimax	0.4 + 1.5 pt	5	95	90	74	99	97	81	89
Clethodim + Herbimax	0.4 + 1.5 pt	10	93	87	75	94	88	75	85
Clethodim + Scoil	0.4 + 1.5 pt	2.5	98	92	76	99	96	87	91
Clethodim + Scoil	0.4 + 1.5 pt	5	96	91	71	99	98	78	89
Clethodim + Scoil	0.4 + 1.5 pt	10	95	85	69	99	93	77	86
Clethodim + Herbimax	0.8 + 1.5 pt	2.5	99	99	85	99	99	93	96
Clethodim + Herbimax	0.8 + 1.5 pt	5	99	98	81	99	99	93	95
Clethodim + Herbimax	0.8 + 1.5 pt	10	99	96	81	99	97	88	93
Clethodim + Scoil	0.8 + 1.5 pt	2.5	99	98	80	99	99	88	94
Clethodim + Scoil	0.8 + 1.5 pt	5	99	99	88	99	99	94	96
Clethodim + Scoil	0.8 + 1.5 pt	10	99	96	86	99	98	92	95
LSD (5%)			4	6	9	4	7	10	6

[a] Herbimax = petroleum oil concentrate; Scoil = methylated vegetable oil.
[b] All treatments were applied with XR8001 tips at 28 psi, and volume was change by application speed.

Clethodim at 0.4 or 0.8 oz/A plus Scoil or Herbimax provided similar grass species control whether applied in 2.5, 5 or 10 gpa spray volume. However, clethodim 0.2 oz/A plus Scoil or Herbimax was generally more effective when applied in 2.5 or 5 gpa than 10 gpa spray volume. Overall, grass control by clethodim within the same rate was not influenced by adjuvant.

Glyphosate: ammonium sulfate concentration, Fargo. (Ramsdale and Messersmith) 'Jerry' oat, 'Ember' hard red spring wheat, and 'Sunrise' white proso millet were planted as 6-ft-wide strips side-by-side on May 31, 2001. Plots 10 ft wide were laid out perpendicular to the strips so that each plot contained all three assay species. Treatments were applied on June 29 with a bicycle-wheel-type sprayer equipped with four XR8001 flat-fan nozzles (20-inch spacing). Spray volume was 8.5 gpa and pressure 40 psi. Conditions at treatment were 80 F, 73% RH, wind 5 mph, and sky partly cloudy. Oat was 10- to 12-inch (tillering), wheat 8- to 10-inch (tillering), and proso millet 6- to 8-inch (4- to 6-leaf). Experimental design was a randomized complete block with four replicates. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of assay species.

			July 8			July 16			
Treatment[a]	Rate	AMS rate	Oat	Prmi	Wht	Oat	Prmi	Wht	Ave
	oz ae/A	w/v	% control						
Glyt + Tween 20	0.5	None	84	83	98	85	84	93	88
Glyt + Tween 20	0.5	0.5%	83	92	99	93	91	99	94
Glyt + Tween 20	0.5	1%	89	89	99	90	88	98	92
Glyt + Tween 20	0.5	2%	91	90	99	92	90	98	93
Glyt + Tween 20	1	None	98	93	99	98	93	99	97
Glyt + Tween 20	1	0.5%	99	97	99	99	98	99	99
Glyt + Tween 20	1	1%	98	96	99	99	98	99	98
Glyt + Tween 20	1	2%	98	94	99	99	97	99	98
Glyt + Tween 20	1.5	None	98	94	99	99	98	99	98
Glyt + Tween 20	1.5	0.5%	99	99	99	99	99	99	99
Glyt + Tween 20	1.5	1%	99	98	99	99	99	99	99
Glyt + Tween 20	1.5	2%	99	93	99	99	98	99	98
Glyt + Tween 20	2	None	99	95	99	99	99	99	98
Glyt + Tween 20	2	0.5%	99	98	99	99	99	99	99
Glyt + Tween 20	2	1%	99	98	99	99	99	99	99
Glyt + Tween 20	2	2%	99	97	99	99	99	99	99
Glyt Ultra	1	None	88	86	99	99	85	97	92
Glyt Ultra	1	0.5%	97	95	99	99	98	99	94
Glyt Ultra	1	1%	98	95	99	99	98	99	98
Glyt Ultra	1	2%	97	93	99	99	96	99	97
LSD (5%)			3	5	NS	5	7	4	5

[a] Glyphosate = Rodeo® formulation; Glyt-Ultra = Roundup Ultra® forumulation; AMS = spray-grade ammonium sulfate; Tween 20 = nonionic surfactant from Uniqema, applied at 0.5% v/v.

Control levels were very high which minimized differences between treatments. Overall, glyphosate efficacy was greater with 0.5% w/v AMS than with glyphosate alone. However, glyphosate plus 0.5% w/v AMS was equally effective as glyphosate plus 1% or 2% w/v AMS. Treatments were applied with Fargo city water, which likely contained very low levels of antagonistic salts. Thus, 0.5% w/v AMS was sufficient to maximize glyphosate efficacy.

Glyphosate: ammonium sulfate concentration with hard water, Fargo. (Ramsdale and Messersmith) The spray water used for herbicide treatments contained 1556 mg/L $CaCO_3$. 'Jerry' oat, 'Ember' hard red spring wheat, and 'Foster' barley were planted as 10-ft-wide strips side-by-side on August 8, 2001. Plots 12 ft wide were laid out perpendicular to the strips so that each plot contained all three assay species. Treatments were applied on September 5 with an all-terrain vehicle equipped with a four-nozzle boom (20-inch spacing) offset to one side. Conditions at treatment were 80 F, 55% RH, wind S at 12-15 mph, and sky clear. Oat, wheat and barley were 6- to 8-inch and tillering. Experimental design was a randomized complete block with four replicates. Glyphosate was applied at a reduced rate to better detect treatment effects on glyphosate efficacy. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of assay species.

			September 19			October 3			
Treatment[a]	Rate	AMS rate	Barley	Oat	Wheat	Barley	Oat	Wheat	Ave
	oz ae/A	w/v	% control						
Glyt + Tween 20	0.5	None	33	31	45	39	43	43	39
Glyt + Tween 20	0.5	0.5%	73	64	80	77	78	84	76
Glyt + Tween 20	0.5	1%	76	60	79	84	82	85	78
Glyt + Tween 20	0.5	2%	85	71	88	86	84	90	84
Glyt + Tween 20	1	None	46	46	54	64	61	61	55
Glyt + Tween 20	1	0.5%	90	80	89	92	91	94	89
Glyt + Tween 20	1	1%	94	84	93	95	92	96	92
Glyt + Tween 20	1	2%	93	86	95	96	95	96	94
Glyt + Tween 20	1.5	None	67	63	75	75	78	80	73
Glyt + Tween 20	1.5	0.5%	89	85	94	91	93	96	91
Glyt + Tween 20	1.5	1%	95	89	96	97	96	98	95
Glyt + Tween 20	1.5	2%	99	96	99	99	99	99	99
Glyt + Tween 20	2	None	81	76	85	83	83	87	83
Glyt + Tween 20	2	0.5%	98	94	97	98	98	99	98
Glyt + Tween 20	2	1%	96	94	98	98	99	99	97
Glyt + Tween 20	2	2%	99	97	99	99	99	99	99
Glyt Ultra	1	None	39	36	50	45	48	44	44
Glyt Ultra	1	0.5%	84	76	87	86	85	92	85
Glyt Ultra	1	1%	89	75	92	90	87	95	88
Glyt Ultra	1	2%	87	79	92	88	91	96	89
LSD (5%)			7	7	5	7	6	7	7

[a] Glyphosate = Rodeo® formulation; Glyt-Ultra = Roundup Ultra® forumulation; AMS = spray-grade ammonium sulfate; Tween 20 = nonionic surfactant from Uniqema, applied at 0.5% v/v.

Glyphosate applied with antagonistic well water occasionally became more effective as AMS concentration increased. However, the response was not consistent and did not relate to glyphosate rate. Glyphosate as Roundup Ultra responded similarly to ammonium sulfate concentration as Rodeo plus nonionic surfactant.

Glyphosate: formulation, spray volume, and AMS, Prosper. (Ramsdale and Messersmith) 'Jerry' oat, 'Ember' hard red spring wheat, and 'Sunrise' white proso millet were planted as 6-ft-wide strips side-by-side on May 30, 2001. Plots 12 ft wide were laid out perpendicular to the strips so that each plot contained all three assay species. Treatments were applied on June 29 with an all-terrain vehicle equipped with a four-nozzle boom (20-inch spacing) offset to one side. Conditions at treatment were 85 F, 60% RH, wind NW at 8-10 mph, and sky partly cloudy. Oat was 10- to 12-inch (tillering), wheat 10- to 12-inch (tillering), and proso millet 6- to 8-inch (tillering). Experimental design was a randomized complete block with four replicates. Glyphosate was applied at a reduced rate to better detect treatment effects on glyphosate efficacy. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of assay species.

			July 8			July 16			
Treatment[a]	Rate	Volume[b]	Prmi	Wht	Oat	Prmi	Wht	Oat	Ave
	oz ae/A	gpa	% control						
Roundup Custom + NIS	1 + 0.5%	2.5	98	99	96	99	99	93	98
Roundup Ultra	1	2.5	99	98	98	99	97	95	98
Glyphomax Plus	1	2.5	97	97	91	97	99	88	95
Glyfos X-tra	1	2.5	96	97	94	98	99	89	96
Touchdown Pro	1	2.5	97	98	98	97	97	96	97
Roundup UltraDry	1	2.5	99	98	96	99	98	94	97
Roundup Custom + NIS + AMS	1 + 0.5% + 1%	2.5	99	99	98	99	99	97	99
Roundup Ultra + AMS	1 + 1%	2.5	99	98	99	98	99	98	99
Glyphomax Plus + AMS	1 + 1%	2.5	98	99	97	98	99	95	98
Glyfos X-tra + AMS	1 + 1%	2.5	97	98	97	97	99	94	97
Touchdown Pro + AMS	1 + 1%	2.5	95	99	99	97	99	98	98
Roundup UltraDry + AMS	1 + 1%	2.5	99	99	98	98	99	97	98
Roundup Custom + NIS	1 + 0.5%	10	95	94	90	97	99	86	95
Roundup Ultra	1	10	79	84	74	61	89	67	76
Glyphomax Plus	1	10	82	83	74	70	89	66	77
Glyfos X-tra	1	10	78	81	68	65	85	55	72
Touchdown Pro	1	10	85	85	75	68	92	66	79
Roundup UltraDry	1	10	73	73	76	55	84	56	70
Roundup Custom + NIS + AMS	1 + 0.5% + 1%	10	99	98	92	99	99	97	97
Roundup Ultra + AMS	1 + 1%	10	98	98	98	98	99	96	98
Glyphomax Plus + AMS	1 + 1%	10	96	95	90	96	97	82	93
Glyfos X-tra + AMS	1 + 1%	10	98	96	95	98	99	91	96
Touchdown Pro + AMS	1 + 1%	10	94	90	87	90	98	72	89
Roundup UltraDry + AMS	1 + 1%	10	93	96	92	90	99	88	93
LSD (5%)			6	9	11	9	7	17	10

[a] Roundup Ultra, Glyphomax Plus, Glyfos X-tra, Roundup Custom = glyphosate isopropylamine salt; Roundup UltraDry = glyphosate ammonium salt; Touchdown Pro = glyphosate diammonium salt; NIS = Atplus GTM-10 nonionic surfactant by Uniqema; AMS = spray-grade ammonium sulfate (% w/v).
[b] Treatments were applied at 2.5 and 10 gpa with Turbo TeeJet 11001 and 11004 tips at 20 psi, respectively.

The objective of this experiment was to compare the formulations of glyphosate that do not require additional adjuvant. The Roundup Custom formulation does not contain any adjuvant and represented a standard reference. All glyphosate formulations provided similar grass control when applied in 2.5 gpa spray volume, with or without AMS. Grass control by glyphosate as Roundup Custom plus NIS was not influenced by spray volume. Roundup Ultra, Glyphomax Plus, Glyfos X-tra, Touchdown Pro, and Roundup UltraDry applied alone all were more effective in 2.5 than 10 gpa spray volume. However, these formulations plus AMS provided similar grass control whether applied in 2.5 or 10 gpa spray volume. The amount of adjuvant in the formulation at 10 gpa may have been insufficient to maximize efficacy of glyphosate applied at the reduced rate of 1 oz ae/A.

Glyphosate: formulation, spray volume, and AMS, Fargo. (Ramsdale and Messersmith) 'Jerry' oat, 'Ember' hard red spring wheat, and 'Foster' barley were planted as 6-ft-wide strips side-by-side on August 8, 2001. Plots 12 ft wide were laid out perpendicular to the strips so that each plot contained all three assay species. Treatments were applied on September 6 with an all-terrain vehicle equipped with a four-nozzle boom (20-inch spacing) offset to one side. Conditions at treatment were 85 F, 48% RH, wind S at 15-20 mph, and sky clear. Oat was 6- to 8-inch (tillering), wheat 6- to 8-inch (tillering), and barley 6- to 8-inch (tillering). Experimental design was a randomized complete block with four replicates. Glyphosate was applied at a reduced rate to better detect treatment effects on glyphosate efficacy. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of assay species.

			September 24			October 1			
Treatment[a]	Rate	Volume[b]	Barley	Oat	Wht	Barley	Oat	Wht	Ave
	oz ae/A	gpa	% control						
Roundup Custom + NIS	1 + 0.5%	2.5	73	70	80	83	81	86	79
Roundup Ultra	1	2.5	69	70	82	75	75	85	76
Glyphomax Plus	1	2.5	70	66	77	78	73	80	74
Glyfos X-tra	1	2.5	66	64	73	73	69	76	70
Touchdown Pro	1	2.5	64	64	76	69	70	78	70
Roundup UltraDry	1	2.5	73	70	80	79	78	83	77
Roundup Custom + NIS + AMS	1 + 0.5% + 1%	2.5	88	82	91	94	92	96	91
Roundup Ultra + AMS	1 + 1%	2.5	81	78	88	88	87	92	86
Glyphomax Plus + AMS	1 + 1%	2.5	79	73	83	86	82	88	82
Glyfos X-tra + AMS	1 + 1%	2.5	79	74	83	85	79	86	81
Touchdown Pro + AMS	1 + 1%	2.5	70	70	84	78	80	86	78
Roundup UltraDry + AMS	1 + 1%	2.5	71	61	80	79	78	83	75
Roundup Custom + NIS	1 + 0.5%	10	58	59	70	68	65	76	66
Roundup Ultra	1	10	43	43	46	49	51	49	47
Glyphomax Plus	1	10	45	45	46	49	50	48	47
Glyfos X-tra	1	10	38	31	38	41	40	43	39
Touchdown Pro	1	10	38	36	44	48	45	46	43
Roundup UltraDry	1	10	39	43	49	50	50	53	47
Roundup Custom + NIS + AMS	1 + 0.5% + 1%	10	71	68	80	74	75	86	76
Roundup Ultra + AMS	1 + 1%	10	63	63	73	73	66	76	69
Glyphomax Plus + AMS	1 + 1%	10	55	53	61	64	60	64	60
Glyfos X-tra + AMS	1 + 1%	10	54	54	60	66	60	65	60
Touchdown Pro + AMS	1 + 1%	10	56	53	61	65	61	66	60
Roundup UltraDry + AMS	1 + 1%	10	55	51	61	63	63	64	60
LSD (5%)			8	8	7	8	6	7	7

[a] Roundup Ultra, Glyphomax Plus, Glyfos X-tra, Roundup Custom = glyphosate isopropylamine salt; Roundup UltraDry = glyphosate ammonium salt; Touchdown Pro = glyphosate diammonium salt; NIS = Atplus GTM-10 nonionic surfactant by Uniqema; AMS = spray-grade ammonium sulfate (% w/v).
[b] Treatments were applied at 2.5 and 10 gpa with Turbo TeeJet 11001 and 11004 tips at 20 psi, respectively.

The study was conducted in the fall, so control was generally less than the summer experiments. All glyphosate formulations were more effective with AMS except for Roundup UltraDry which was equally effective with or without AMS when applied in 2.5 gpa spray volume. Additionally, all glyphosate formulations were more effective in 2.5 than 10 gpa spray volume whether applied with or without AMS. Roundup Custom plus NIS was generally more effective than all other formulations when treatments were applied in 10 gpa spray volume. Roundup Ultra was also more effective than the other formulations of glyphosate that do not require additional adjuvant when treatments were applied at 10 gpa spray volume with AMS.

Glyphosate: formulation, spray volume, and AMS, Casselton. (Ramsdale and Messersmith) 'Jerry' oat, 'Ember' hard red spring wheat, oilseed sunflower, and 'Omega' flax were planted as 6-ft-wide strips side-by-side on May 30, 2001. Plots 12 ft wide were laid out perpendicular to the strips so that each plot contained all three assay species. Treatments were applied on July 10 with an all-terrain vehicle equipped with a four-nozzle boom (20-inch spacing) offset to one side. Conditions at treatment were 85 F, 40% RH, wind N at 5 mph, and sky clear. Oat was 12- to 20-inch, wheat 12- to 20-inch, flax 6- to 10-inch, and sunflower 6- to 10-inch. Experimental design was a randomized complete block with four replicates. Glyphosate was applied at a reduced rate to better detect treatment effects on glyphosate efficacy. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of assay species.

			July 25				
Treatment[a]	Rate	Volume[b]	Flax	Wheat	Oat	Sunflower	Ave
	oz ae/A	gpa	% control				
Roundup Custom + NIS	1 + 0.5%	2.5	50	70	61	76	64
Roundup Ultra	1	2.5	41	66	56	75	60
Glyphomax Plus	1	2.5	56	75	53	79	66
Glyfos X-tra	1	2.5	56	70	45	75	62
Touchdown Pro	1	2.5	54	78	58	79	67
Roundup UltraDry	1	2.5	56	81	60	83	70
Roundup Custom + NIS + AMS	1 + 0.5% + 1%	2.5	69	88	70	85	78
Roundup Ultra + AMS	1 + 1%	2.5	68	93	73	88	81
Glyphomax Plus + AMS	1 + 1%	2.5	59	86	58	88	73
Glyfos X-tra + AMS	1 + 1%	2.5	66	88	63	88	76
Touchdown Pro + AMS	1 + 1%	2.5	65	91	68	86	78
Roundup UltraDry + AMS	1 + 1%	2.5	64	84	64	86	75
Roundup Custom + NIS	1 + 0.5%	10	51	61	36	76	56
Roundup Ultra	1	10	30	31	15	71	37
Glyphomax Plus	1	10	33	30	11	68	36
Glyfos X-tra	1	10	34	36	11	75	39
Touchdown Pro	1	10	33	38	15	81	42
Roundup UltraDry	1	10	24	33	13	78	37
Roundup Custom + NIS + AMS	1 + 0.5% + 1%	10	61	80	65	86	73
Roundup Ultra + AMS	1 + 1%	10	39	74	40	86	60
Glyphomax Plus + AMS	1 + 1%	10	39	70	31	85	56
Glyfos X-tra + AMS	1 + 1%	10	41	66	31	84	56
Touchdown Pro + AMS	1 + 1%	10	20	73	38	90	55
Roundup UltraDry + AMS	1 + 1%	10	40	71	31	85	57
LSD (5%)			14	8	9	7	10

[a] Roundup Ultra, Glyphomax Plus, Glyfos X-tra, Roundup Custom = glyphosate isopropylamine salt; Roundup UltraDry = glyphosate ammonium salt; Touchdown Pro = glyphosate diammonium salt; NIS = Atplus GTM-10 nonionic surfactant by Uniqema; AMS = spray-grade ammonium sulfate (% w/v).
[b] Treatments were applied at 2.5 and 10 gpa with Turbo TeeJet 11001 and 11004 tips at 20 psi, respectively.

The objective of this experiment was to compare the formulations of glyphosate that do not require additional adjuvant. The Roundup Custom formulation does not contain any adjuvant and represented a standard reference. Species control at Casselton was generally lower than at Prosper due to water stress from excessive rains. Glyphosate formulations that do not require additional adjuvant were generally similar with no consistent differences across the two spray volumes and with or without AMS (Table 2). Ammonium sulfate usually enhanced glyphosate efficacy regardless of spray volume or formulation. Species control by glyphosate as Roundup Custom plus NIS was not influenced by spray volume. Roundup Ultra, Glyphomax Plus, Glyfos X-tra, Touchdown Pro, and Roundup UltraDry all were more effective for flax, wheat, and oat control when applied in 2.5 than 10 gpa spray volume, with or without AMS.

Glyphosate: spray volume-herbicide rate study, Prosper. (Ramsdale and Messersmith) 'Jerry' oat, 'Ember' hard red spring wheat, and 'Sunrise' white proso millet were planted as 6-ft-wide strips side-by-side on May 30, 2001. Plots 12 ft wide were laid out perpendicular to the strips so that each plot contained all three assay species. Treatments were applied on June 29 with an all-terrain vehicle equipped with a four-nozzle boom (20-inch spacing) offset to one side. Conditions at treatment were 85 F, 60% RH, wind NW at 8-10 mph, and sky partly cloudy. Oat was 10- to 12-inch (tillering), wheat 10- to 12-inch (tillering), and proso millet 6- to 8-inch (tillering). Experimental design was a randomized complete block with four replicates. Glyphosate was applied at reduced rates to better detect treatment effects on glyphosate efficacy. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of assay species.

			July 8			July 16			
Treatment[a]	Rate	Volume[b]	Prmi	Wht	Oat	Prmi	Wht	Oat	Ave
	oz ae/A	gpa	% control						
Glyphosate	0.5	2.5	81	87	78	82	88	80	83
Glyphosate	0.5	5	66	82	64	62	85	58	70
Glyphosate	0.5	10	35	68	49	24	79	39	49
Glyphosate	0.5	20	25	54	34	5	65	26	35
Glyphosate + NIS	0.5 + 0.5%	2.5	74	87	73	75	88	76	79
Glyphosate + NIS	0.5 + 0.5%	5	73	81	73	73	80	65	74
Glyphosate + NIS	0.5 + 0.5%	10	61	65	48	54	75	46	58
Glyphosate + NIS	0.5 + 0.5%	20	64	78	60	65	84	53	67
Glyphosate	1	2.5	95	99	94	99	99	96	97
Glyphosate	1	5	96	99	97	99	99	97	98
Glyphosate	1	10	81	92	82	80	93	85	86
Glyphosate	1	20	69	89	71	67	91	68	76
Glyphosate + NIS	1 + 0.5%	2.5	98	99	97	98	98	96	98
Glyphosate + NIS	1 + 0.5%	5	92	97	94	94	98	94	95
Glyphosate + NIS	1 + 0.5%	10	91	98	95	92	98	97	95
Glyphosate + NIS	1 + 0.5%	20	87	97	92	93	98	92	93
Glyphosate	2	2.5	99	99	99	99	99	99	99
Glyphosate	2	5	99	99	99	99	99	99	99
Glyphosate	2	10	98	99	99	99	99	99	99
Glyphosate	2	20	97	99	99	98	99	99	99
Glyphosate + NIS	2 + 0.5%	2.5	99	99	99	99	99	99	99
Glyphosate + NIS	2 + 0.5%	5	99	99	99	99	99	99	99
Glyphosate + NIS	2 + 0.5%	10	99	99	99	99	99	99	99
Glyphosate + NIS	2 + 0.5%	20	99	99	99	99	99	99	99
LSD (5%)			9	5	7	12	6	7	8

[a] Glyphosate = Roundup Ultra; NIS = Atplus GTM-10 nonionic surfactant by Uniqema.
[b] All treatments were applied at 20 psi. Spray volumes at 2.5 and 5 gpa were applied with Turbo TeeJet 11001 nozzles, and spray volumes at 10 and 20 gpa were applied with Turbo TeeJet 11004 nozzles.

All glyphosate treatments at 2 oz/A provided greater than 95% control. Glyphosate at 1 oz/A in 2.5 or 5 gpa spray volume also provided 95% or greater grass control. Increasing spray volume to 10 and 20 gpa with glyphosate alone at 1 oz/A decreased grass control by an average of 10 and 20%, respectively. However, glyphosate plus 0.5% NIS applied in 10 or 20 gpa spray volume was equally effective to glyphosate applied in 2.5 or 5 gpa. Grass control by glyphosate at 0.5 oz/A decreased by an average of 48% as spray volume increased from 2.5 to 20 gpa. Grass control by glyphosate at 0.5 oz/A applied in 2.5 or 5 gpa spray volume was similar to grass control by glyphosate at 1 oz/A in 20 gpa. These data suggest that glyphosate rate can be reduced by applying in 2.5 or 5 gpa spray volume.

Glyphosate: spray volume-herbicide rate study, Fargo. (Ramsdale and Messersmith) 'Jerry' oat, 'Ember' hard red spring wheat, and 'Foster' barley were planted as 10-ft-wide strips side-by-side on August 8, 2001. Plots 12 ft wide were laid out perpendicular to the strips so that each plot contained all three assay species. Treatments were applied on September 4 with an all-terrain vehicle equipped with a four-nozzle boom (20-inch spacing) offset to one side. Conditions at treatment were 75 F, 50% RH, wind SE at 8-12 mph, and sky partly cloudy. Oat, wheat and barley were 6- to 8-inch and tillering. Experimental design was a randomized complete block with four replicates. Glyphosate was applied at a reduced rate to better detect treatment effects on glyphosate efficacy. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of assay species.

			September 18			October 2			
Treatment[a]	Rate	Volume[b]	Barley	Oat	Wheat	Barley	Oat	Wheat	Ave
	oz ae/A	gpa	% control						
Glyphosate	0.5	2.5	40	34	48	59	54	56	49
Glyphosate	0.5	5	23	30	38	31	34	33	32
Glyphosate	0.5	10	11	11	25	13	14	16	15
Glyphosate	0.5	20	11	13	19	9	18	16	14
Glyphosate + NIS	0.5 + 0.5%	2.5	55	44	66	70	63	73	62
Glyphosate + NIS	0.5 + 0.5%	5	38	33	55	58	55	58	50
Glyphosate + NIS	0.5 + 0.5%	10	26	28	41	43	41	40	37
Glyphosate + NIS	0.5 + 0.5%	20	16	19	31	24	30	31	25
Glyphosate	1	2.5	66	58	71	74	70	78	70
Glyphosate	1	5	56	38	63	69	63	68	60
Glyphosate	1	10	28	26	40	43	39	41	36
Glyphosate	1	20	10	15	23	11	19	16	16
Glyphosate + NIS	1 + 0.5%	2.5	76	63	83	81	79	86	78
Glyphosate + NIS	1 + 0.5%	5	66	60	75	75	74	82	72
Glyphosate + NIS	1 + 0.5%	10	53	40	69	70	66	73	62
Glyphosate + NIS	1 + 0.5%	20	40	35	59	56	58	59	51
Glyphosate	2	2.5	89	81	94	89	89	91	89
Glyphosate	2	5	91	79	93	90	87	93	89
Glyphosate	2	10	66	55	69	71	66	76	67
Glyphosate	2	20	51	40	54	66	63	63	56
Glyphosate + NIS	2 + 0.5%	2.5	90	83	95	91	92	97	91
Glyphosate + NIS	2 + 0.5%	5	94	86	98	94	93	97	94
Glyphosate + NIS	2 + 0.5%	10	80	70	85	82	80	88	81
Glyphosate + NIS	2 + 0.5%	20	79	66	81	81	79	86	79
LSD (5%)			13	11	11	10	10	10	11

[a] Glyphosate = Roundup Ultra; NIS = Atplus GTM-10 nonionic surfactant by Uniqema.
[b] All treatments were applied at 20 psi. Spray volumes at 2.5 and 5 gpa were applied with Turbo TeeJet 11001 nozzles, and spray volumes at 10 and 20 gpa were applied with Turbo TeeJet 11004 nozzles.

Glyphosate at all rates was more effective as spray volume decreased from 20 to 2.5 gpa. Glyphosate at 1 oz/A applied in 2.5 or 5 gpa provided equal or greater grass control than glyphosate at 2 oz/A applied in 10 or 20 gpa spray volume. Similarly, glyphosate at 0.5 oz/A applied in 2.5 or 5 gpa provided equal or greater grass control than glyphosate at 1 oz/A applied in 10 or 20 gpa spray volume. The addition of NIS enhanced glyphosate efficacy regardless of spray volume, although the greatest enhancement was when glyphosate was applied in 10 to 20 gpa.

Glyphosate: spray volume-herbicide rate study, Grand Forks. (Ramsdale and Messersmith) The experiment was established on fallow ground with a heavy infestation of quackgrass. Plots were 10 ft wide by 30 ft long. Treatments were applied on June 21 with a CO_2-pressurized backpack sprayer equipped with a four-nozzle boom (20-inch spacing). Conditions at treatment were 65 F, 50% RH, wind calm, and sky partly cloudy. The quackgrass was 12 to 24 inches tall and in the boot to heading stage at time of treatment. Experimental design was a randomized complete block with four replicates. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of quackgrass.

Treatment[a]	Rate	Volume	Tip[b]	Quackgrass control	
				July 6	July 24
	oz ae/A	gpa		%	
Glyphosate	1.5	5	TT 11001	21	34
Glyphosate	1.5	10	TT 11002	13	20
Glyphosate	1.5	20	TT 11004	8	11
Glyphosate + NIS	1.5 + 0.5%	5	TT 11001	25	30
Glyphosate + NIS	1.5 + 0.5%	10	TT 11002	19	18
Glyphosate + NIS	1.5 + 0.5%	20	TT 11004	13	18
Glyphosate	3	5	TT 11001	69	66
Glyphosate	3	10	TT 11002	39	50
Glyphosate	3	20	TT 11004	24	31
Glyphosate + NIS	3 + 0.5%	5	TT 11001	60	66
Glyphosate + NIS	3 + 0.5%	10	TT 11002	51	45
Glyphosate + NIS	3 + 0.5%	20	TT 11004	39	39
Glyphosate	6	5	TT 11001	89	90
Glyphosate	6	10	TT 11002	80	84
Glyphosate	6	20	TT 11004	77	75
Glyphosate + NIS	6 + 0.5%	5	TT 11001	85	89
Glyphosate + NIS	6 + 0.5%	10	TT 11002	78	83
Glyphosate + NIS	6 + 0.5%	20	TT 11004	74	80
LSD (5%)				10	10

[a] Glyphosate = Roundup UltraMax; NIS = Atplus GTM-10 nonionic surfactant by Uniqema.
[b] TT = Turbo TeeJet nozzles by Spraying Systems Co. All treatments were applied 20 psi.

Overall, glyphosate control of quackgrass increased as spray volume decreased from 20 to 5 gpa. Glyphosate at 3 oz/A applied in 5 gpa spray volume increased quackgrass control by up to 45% compared to application in 20 gpa. Glyphosate at 3 oz/A applied in 5 gpa provided similar quackgrass control to glyphosate at 6 oz/A applied in 20 gpa spray volume. Likewise, glyphosate at 1.5 oz/A applied in 5 gpa spray volume provided similar control to glyphosate at 3 oz/A applied in 20 gpa. The addition of 0.5% NIS generally did not enhance glyphosate efficacy, regardless of spray volume.

Sethoxydim: spray volume-herbicide rate study, Fargo. (Ramsdale and Messersmith) 'Jerry' oat, 'Red Siberian' foxtail millet, and 'Sunrise' white proso millet were planted as 6-ft-wide strips side-by-side on May 31, 2001. Plots 12 ft wide were laid out perpendicular to the strips so that each plot contained all three assay species. Treatments were applied on July 2 with an all-terrain vehicle equipped with a four-nozzle boom (20-inch spacing) offset to one side. Conditions at treatment were 70 F, 65% RH, wind calm, and sky partly cloudy. Oat was 12- to 15-inch (tillering), foxtail millet 10- to 12-inch (tillering), and proso millet 10- to 12-inch (tillering). Experimental design was a randomized complete block with four replicates. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of assay species.

			July 23			August 7			
Treatment[a]	Rate	Volume[b]	Oat	Prmi	Fomi	Oat	Prmi	Fomi	Ave
	oz ai/A	gpa	% control						
Sethoxydim + Herbimax	0.5 + 1.5 pt	2.5	38	81	73	30	81	71	62
Sethoxydim + Herbimax	0.5 + 1.5 pt	5	36	80	74	30	83	76	63
Sethoxydim + Herbimax	0.5 + 1.5 pt	10	29	75	60	20	70	59	52
Sethoxydim + Scoil	0.5 + 1.5 pt	2.5	53	89	70	44	84	73	69
Sethoxydim + Scoil	0.5 + 1.5 pt	5	36	83	71	31	84	80	64
Sethoxydim + Scoil	0.5 + 1.5 pt	10	25	71	56	15	74	68	52
Sethoxydim + Herbimax	1 + 1.5 pt	2.5	65	84	76	70	93	87	79
Sethoxydim + Herbimax	1 + 1.5 pt	5	68	84	78	72	92	87	80
Sethoxydim + Herbimax	1 + 1.5 pt	10	51	82	74	40	84	78	68
Sethoxydim + Scoil	1 + 1.5 pt	2.5	71	86	76	74	90	83	80
Sethoxydim + Scoil	1 + 1.5 pt	5	73	87	81	73	94	90	83
Sethoxydim + Scoil	1 + 1.5 pt	10	63	81	78	64	88	86	77
Sethoxydim + Herbimax	1.5 + 1.5 pt	2.5	85	94	83	90	99	88	90
Sethoxydim + Herbimax	1.5 + 1.5 pt	5	84	94	86	87	95	91	90
Sethoxydim + Herbimax	1.5 + 1.5 pt	10	77	88	80	76	93	90	84
Sethoxydim + Scoil	1.5 + 1.5 pt	2.5	92	98	90	94	98	93	94
Sethoxydim + Scoil	1.5 + 1.5 pt	5	90	93	87	93	98	90	92
Sethoxydim + Scoil	1.5 + 1.5 pt	10	79	84	80	86	93	88	85
LSD (5%)			12	10	12	15	9	10	11

[a] Herbimax = petroleum oil concentrate; Scoil = methylated vegetable oil.
[b] All treatments were applied with XR8001 tips at 28 psi, and volume was change by application speed.

Sethoxydim at 1 or 1.5 oz/A plus Scoil or Herbimax provided similar grass species control whether applied in 2.5, 5 or 10 gpa spray volume. However, sethoxydim at 0.5 oz/A plus Scoil or Herbimax was generally more effective when applied in 2.5 or 5 gpa than 10 gpa spray volume. Overall, grass control by sethoxydim was not influenced by adjuvant when comparing the same herbicide rate.

Drift-reducing nozzles at low spray volume, Fargo. (Ramsdale and Messersmith) 'Jerry' oat, 'Ember' hard red spring wheat, and 'Sunrise' white proso millet were planted as 6-ft-wide strips side-by-side on May 31, 2001. Plots 12 ft wide were laid out perpendicular to the strips so that each plot contained all three assay species. Treatments were applied on July 1 with an all-terrain vehicle equipped with a four-nozzle boom (20-inch spacing) offset to one side. Conditions at treatment were 64 F, 45% RH, wind E at 5 mph, and sky partly cloudy. Oat was 10- to 12-inch (tillering), wheat 8- to 10-inch (tillering), proso millet 6- to 8-inch (tillering) and foxtail millet 8- to 10-inch (tillering). Experimental design was a randomized complete block with four replicates. Treatments included glyphosate (Roundup Ultra) at 1 oz ae/A, quizalofop-P at 3 oz ai/A with 1.5 pt/A Herbimax, imazethapyr at 0.37 oz ai/A with 1.5 pt/A Scoil, and sethoxydim at 1 oz ai/A with 1 pt/A Scoil. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of assay species.

July 16 evaluation

				Glyphosate			Quizalofop-P			Imazethapyr			Sethoxydim		
Nozzle[a]	Volume	Speed	Pressure	Proso millet	Oat	Wheat	Proso millet	Oat	Wheat	Proso millet	Oat	Wheat	Proso millet	Oat	Foxtail millet
	(gpa)	(mph)	(psi)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
XR 11001	2.5	10	28	68	64	71	75	68	71	64	50	44	73	60	64
LM 11002	2.5	14	15	64	63	71	65	65	66	64	49	45	76	61	66
TD 11002	2.5	14	15	71	60	74	64	63	70	66	53	44	80	59	74
TT 11001	2.5	7	15	69	59	70	66	60	71	66	53	46	83	59	74
TT 11002	2.5	14	15	74	60	76	83	63	73	60	47	40	75	58	69
XR 11001	10	2.5	28	43	30	26	73	60	64	54	41	35	70	51	69
LM 11002	10	3.5	15	33	25	28	78	55	64	59	44	36	73	51	69
TD 11002	10	3.5	15	33	25	25	79	53	65	61	40	35	74	50	70
TT 11002	10	3.5	15	40	31	34	79	54	65	51	41	31	70	51	59
LSD (5%)				11	11	6	NS	8	6	NS	6	6	NS	4	NS

July 23 evaluation

				Glyphosate			Quizalofop-P			Imazethapyr			Sethoxydim		
Nozzle[a]	Volume	Speed	Pressure	Proso millet	Oat	Wheat	Proso millet	Oat	Wheat	Proso millet	Oat	Wheat	Proso millet	Oat	Foxtail millet
	(gpa)	(mph)	(psi)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
XR 11001	2.5	10	28	65	68	81	78	89	86	46	48	41	81	65	79
LM 11002	2.5	14	15	70	68	81	65	85	86	50	50	45	86	74	80
TD 11002	2.5	14	15	74	65	83	69	78	88	48	50	41	88	73	86
TT 11001	2.5	7	15	70	59	83	69	79	86	48	50	41	93	70	90
TT 11002	2.5	14	15	70	59	85	86	89	90	41	47	34	89	75	84
XR 11001	10	2.5	28	28	18	29	86	87	86	33	35	28	84	40	83
LM 11002	10	3.5	15	30	15	30	88	78	89	38	40	33	84	55	83
TD 11002	10	3.5	15	29	14	29	80	70	84	34	35	29	84	49	81
TT 11002	10	3.5	15	30	21	34	85	78	86	30	38	25	83	58	76
LSD (5%)				10	14	7	16	11	NS	6	6	5	NS	12	NS

[a] TD = TurboDrop XL low pressure air-induction nozzle by Greenleaf Technologies Inc., Covington, LA; LM = Lurmark Ultra-Lo-Drift air-induction nozzle by Precision Fluid Control Products, Farmington, MN; TT = Turbo TeeJet flooding flat-fan nozzle and XR = Extended Range nozzle by Spraying Systems Co., Wheaton, IL.

Overall, herbicides applied through drift-reducing nozzles provided similar grass species control compared to application through standard extended-range (XR) sprayer nozzles, whether applied at 2.5 or 10 gpa spray volume. However, the Turbo Drop XL nozzle at 15 psi left streaks in the plots, suggesting that higher pressures are needed to maintain an acceptable spray pattern with this nozzle. The results also support previous North Dakota State University research that many translocated herbicides applied in 2.5 gpa spray volume provide equal or greater control than when applied in 10 gpa spray volume. Standard low-output nozzles produce fine spray droplets that are susceptible to spray drift. However, drift-reducing nozzles that produce large spray droplets can be used to apply herbicides in low spray volumes. These data suggest that herbicides applied in 2.5 gpa spray volume with drift-reducing nozzles can provide similar control to application with standard XR flat-fan nozzles.

Low-rate split application of herbicides for weed control in soybean, Casselton. (Ramsdale and Messersmith) Experiments were conducted to examine the potential of reducing herbicide rates in soybean by split application. 'AG0801' soybean was planted in 30-inch rows on June 4, 2001, near Casselton, ND. All treatments were applied with a bicycle-wheel-type plot sprayer equipped with four 8001 flat-fan nozzles at 20-inch spacing. Plots were 10 by 30 ft and arranged in a randomized complete block design with four replicates. All herbicide rates were lower than labeled rates and either were applied in one single application or two applications each at half the single rate. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete weed death. Soybean were harvested on October 18, 2001.

Date Treatment	June 26 1st Split	July 3 Single	July 10 2nd Split
Sprayer			
gpa	8.5	8.5	8.5
psi	35	35	35
Air temperature (F)	81	80	75
Relative humidity (%)	45	50	40
Wind (mph)	8	6-8	5
Sky	clear	clear	clear
Soybean	unifoliolate	2 trifoliolate	4-5 trifoliolate
Common cocklebur			
leaf no.	cotyledon-4	2-6	-
height (inch)	1-4	4-8	4-6
Yellow foxtail			
leaf no.	1-4	3-7	4-6
height (inch)	1-4	1-6	1-6

Imazethapyr as split-applied treatments at one-third to one-half rate provided greater yellow foxtail control compared to equivalent rates applied once and were similar to the full-rate applied once. Common cocklebur control by imazethapyr was generally similar among all treatments, although reduced-rate split-applied treatments provided more consistent control that was equal to or greater than the full-rate treatment. Imazamox as split-applied treatments at one-third or one-half rate provided greater yellow foxtail control and equal or greater common cocklebur control compared to the equivalent rates applied once. Additionally, imazamox as split-applied treatments generally required one-half rate (0.25x + 0.25x) to provide equal control as the full-rate of imazamox applied once. Soybean yield ranged from 27 to 42 bu/A following herbicide treatment compared to 12 bu/A for untreated plots and related closely to visual estimates of weed control. Soybean yields were generally best for reduced-rate split-applied treatments of imazethapyr and imazamox, and were equal to or greater than full-rate treatments applied once.

Treatment[a]	Rate	July 25 Yeft Single	July 25 Yeft Split	July 25 Cocb Single	July 25 Cocb Split	August 7 Yeft Single	August 7 Yeft Split	August 7 Cocb Single	August 7 Cocb Split	Yield Single	Yield Split
	oz ai/A	% control								bu/A	
Imazethapyr experiment											
Imazethapyr + Act90 + 28%N	0.75 + 0.25% + 4.0%	82	-	88	-	75	-	91	-	39	-
Imazethapyr + Quad 7	0.75 + 1.0%	79	-	86	-	83	-	90	-	37	-
Imazethapyr + Scoil	0.75 + 2.0%	88	-	92	-	91	-	92	-	39	-
Imazethapyr + Act90 + 28%N	0.38 + 0.25% + 4.0%	64	87	83	92	75	95	87	97	38	40
Imazethapyr + Quad 7	0.38 + 1.0%	66	92	84	94	63	96	85	96	35	42
Imazethapyr + Scoil	0.38 + 2.0%	59	88	84	91	73	92	90	93	38	41
Imazethapyr + Act90 + 28%N	0.25 + 0.25% + 4.0%	44	78	84	91	54	88	89	94	36	42
Imazethapyr + Quad 7	0.25 + 1.0%	49	79	79	86	61	90	85	93	37	41
Imazethapyr + Scoil	0.25 + 2.0%	44	83	80	90	63	89	88	93	36	39
Untreated										12	
LSD (5%)		12		7		17		6		4	
Imazamox experiment											
Imazamox + Act90 + 28%N	0.5 + 0.25% + 4.0%	89	-	89	-	86	-	90	-	32	-
Imazamox + Quad 7	0.5 + 1.0%	89	-	89	-	90	-	90	-	32	-
Imazamox + Scoil	0.5 + 2.0%	92	-	91	-	90	-	94	-	33	-
Imazamox + Act90 + 28%N	0.25 + 0.25% + 4.0%	80	89	86	90	76	91	88	96	33	38
Imazamox + Quad 7	0.25 + 1.0%	79	94	83	86	71	86	80	87	34	37
Imazamox + Scoil	0.25 + 2.0%	81	90	86	90	80	92	88	92	34	36
Imazamox + Act90 + 28%N	0.15 + 0.25% + 4.0%	60	76	68	76	58	74	74	78	29	36
Imazamox + Quad 7	0.15 + 1.0%	63	75	61	71	53	79	60	80	27	34
Imazamox + Scoil	0.15 + 2.0%	64	83	69	80	58	83	70	82	27	37
Untreated										11	
LSD (5%)		8		7		10		8		4	

[a] Act90 = Activator 90 nonionic surfactant; 28%N = 28% N as urea-ammonium nitrate fertilizer; Quad 7 = basic blend adjuvant, Scoil = methylated vegetable oil.

Split application of herbicides for wild oat control, Fargo. (Ramsdale and Messersmith) 'Alsen' hard red spring wheat was seeded on May 15, 2001. Treatments were a single application at standard timing and two applications at one-half the single rate. Experimental design was a randomized complete block with four replicates, and plot size was 10 by 30 ft. All treatments were applied at 8.5 gpa with a bicycle-wheel-type plot sprayer equipped with four 8001 flat-fan nozzles at 20-inch spacing. Weed control and wheat injury was evaluated visually where 0 equaled no visible injury and 100 equaled complete plant death.

Treatment Date	1st Split May 30	Single June 6	2nd Split June 12
Air temperature (F)	64	63	76
Relative humidity (%)	53	45	34
Wind (mph)	8-10	6-8	8-10
Sky	cloudy	cloudy	clear
Wheat	1.5 leaf	3-5 leaf and 1-2 tillers	5-6 leaf and 2-3 tillers
Height	2-3 inch	3-5 inch	5-7 inch
Wild oat	1-2 leaf	1-5 leaf and 1-2 tiller	variable
Height	2-3 inch	2-5 inch	variable

Table 1. Reduced-rate split-applied imazamethabenz treatments, Fargo.

Treatment[a]	Rate	Wild oat control		Yield
		June 28	July 16	
	oz ai/A	%		bu/A
Immb + Scoil	5 + 1.5 pt	88	96	37
Immb + brox&MCPA + Scoil	5 + 8 + 1.5 pt	69	82	36
Immb + thif + flur + Scoil	5 + 0.3 + 1 + 1.5 pt	77	80	29
Immb + Scoil / Immb + Scoil	1.25 + 1.5 pt / 1.25 + 1.5 pt	69	86	36
Immb + brox&MCPA + Scoil / Immb + Scoil	1.25 + 8 + 1.5 pt / 1.25 + 1.5 pt	63	64	36
Immb + thif + flur + Scoil / Immb + Scoil	1.25+0.3+1+1.5pt / 1.25+1.5pt	73	89	37
Immb + Scoil / Immb + brox&MCPA + Scoil	1.25 + 1.5 pt / 1.25 + 8 + 1.5 pt	68	84	34
Immb + Scoil / Immb + thif + flur + Scoil	1.25+1.5pt / 1.25+0.3+1+1.5pt	75	88	39
Untreated		-	-	19
LSD (5%)		9	12	9

[a] Brox&MCPA = Bronate; Scoil = methylated vegetable oil.

Table 2. Reduced-rate split-applied fenoxaprop-P treatments, Fargo.

Treatment	Rate	Wild oat control		Yield
		June 28	July 16	
	oz ai/A	%		bu/A
Fenoxaprop-P	1.24	97	99	29
Fenx + brox&MCPA	1.24 + 8	98	99	35
Fenx + thif + flur	1.24 + 0.3 + 1	99	99	31
Fenx / Fenx	1.24 / 1.24	94	99	32
Fenx + brox&MCPA / Fenx	1.24 + 8 / 1.24	91	97	38
Fenx + thif + flur / Fenx	1.24 + 0.3 + 1 / 1.24	92	99	37
Fenx / Fenx + brox&MCPA	1.24 / 1.24 + 8	84	98	36
Fenx / Fenx + thif + flur	1.24 / 1.24 + 0.3 + 1	93	99	36
Untreated		-	-	18
LSD (5%)		6	NS	9

[a] Brox&MCPA = Bronate.

Table 3. Reduced-rate split-applied flucarbazone treatments, Fargo.

Treatment[a]	Rate	Wild oat control		Yield
		June 28	July 16	
	oz ai/A	%		bu/A
Flucarbazone + Quad 7	0.42 + 1%	99	99	30
Flcz + brox&MCPA + Quad 7	0.42 + 8 + 1%	91	99	30
Flcz + thif + flur + Quad 7	0.42 + 0.3 + 1 + 1%	97	99	31
Flcz + Quad 7 / Flcz + Quad 7	0.42 + 1% / 0.42 + 1%	96	99	30
Flcz + brox&MCPA + Quad 7 / Flcz + Quad 7	0.42 + 8 + 1% / 0.42 + 1%	91	99	34
Flcz + thif + flur + Quad 7 / Flcz + Quad 7	0.42 + 0.3 + 1 + 1% / 0.42 + 1%	93	99	31
Flcz + Quad 7 / Flcz + brox&MCPA + Quad 7	0.42 + 1% / 0.42 + 8 + 1%	94	99	31
Flcz + Quad 7 / Flcz + thif + flur + Quad 7	0.42 + 1% / 0.42 + 0.3 + 1 + 1%	94	99	34
Untreated		-	-	26
LSD (5%)		NS	NS	NS

[a] Brox&MCPA = Bronate; Quad 7 = basic blend adjuvant.

Table 4. Reduced-rate split-applied tralkoxydim treatments, Fargo.

Treatment[a]	Rate	June 28		July 16		Yield
		Wht	Wioa	Wht	Wioa	
	oz ai/A	%				bu/A
Tralkoxydim + Scoil	2.9 + 1.5 pt	31	99	23	99	28
Tral + brox&MCPA + Scoil	2.9 + 8 + 1.5 pt	28	99	20	98	30
Tral + thif + flur + Scoil	2.9 + 0.3 + 1 + 1.5 pt	0	97	0	99	32
Tral + Scoil / Tral + Scoil	0.7 + 1.5 pt / 0.7 + 1.5 pt	0	95	0	98	40
Tral + brox&MCPA + Scoil / Tral + Scoil	0.7 + 8 + 1.5 pt / 0.7 + 1.5 pt	0	93	0	98	28
Tral + thif + flur + Scoil / Tral + Scoil	0.7+0.3+1+1.5pt / 0.7+1.5pt	0	92	0	95	22
Tral + Scoil / Tral + brox&MCPA + Scoil	0.7 + 1.5 pt / 0.7 + 8 + 1.5 pt	0	94	0	99	31
Tral + Scoil / Tral + thif + flur + Scoil	0.7+1.5pt / 0.7+0.3+1+1.5pt	0	98	0	99	30
Untreated		-	-	-	-	17
LSD (5%)		7	3	6	2	9

[a] Brox&MCPA = Bronate; Scoil = methylated vegetable oil.

Table 5. Reduced-rate split-applied clodinafop treatments, Fargo.

Treatment[a]	Rate	Wild oat control		Yield
		June 28	July 16	
	oz ai/A	——— % ———		bu/A
Clodinafop + PO	0.8 + 1.5 pt	98	99	38
Clfp + brox&MCPA + PO	0.8 + 8 + 1.5 pt	97	99	35
Clfp + thif + flur + PO	0.8 + 0.3 + 1 + 1.5 pt	95	99	42
Clfp + PO / Clfp + PO	0.2 + 1.5 pt / 0.2 + 1.5 pt	99	99	42
Clfp + brox&MCPA + PO / Clfp + PO	0.2 + 8 + 1.5 pt / 0.2 + 1.5 pt	98	99	41
Clfp + thif + flur + PO / Clfp + PO	0.2 + 0.3 + 1 + 1.5 pt / 0.2 + 1.5 pt	97	99	40
Clfp + PO / Clfp + brox&MCPA + PO	0.2 + 1.5 pt / 0.2 + 8 + 1.5 pt	95	99	37
Clfp + PO / Clfp + thif + flur + PO	0.2 + 1.5 pt / 0.2 + 0.3 + 1 + 1.5 pt	97	99	41
Untreated		-	-	17
LSD (5%)		2	NS	6

[a] Brox&MCPA = Bronate; PO = Herbimax petroleum oil concentrate

Fargo Summary

The discussion will focus on the July 16 evaluation taken after wild oat heading. Bromoxynil&MCPA or thifensulfuron plus fluroxypyr did not antagonize reduced-rate split-treatments of fenoxaprop-P, flucarbazone, tralkoxydim, and clodinafop. Imazamethabenz at 5 oz/A provided greater wild oat control than imazamethabenz at 5 oz/A with bromoxynil&MCPA or thifensulfuron plus fluroxypyr. Reduced-rate split-treatments of imazamethabenz were generally not antagonized by broadleaf herbicides with the exception of bromoxynil&MCPA in the first split-treatment of imazamethabenz. The full-labeled rate of tralkoxydim applied alone or plus bromoxynil&MCPA significantly injured wheat. However, the full-labeled rate of tralkoxydim plus thifensulfuron plus fluroxypyr did not injure wheat. The thifensulfuron and/or fluroxypyr likely antagonized tralkoxydim that no wheat injury occurred yet excellent wild oat control was maintained. Wheat yield was generally similar among all treatments of each herbicide.

Split application of herbicides for wild oat control, Cando. (Ramsdale and Messersmith) 'Gunner' hard red spring wheat was seeded on May 15, 2001. Treatments were a single application at standard timing and two applications at one-half the single rate. Experimental design was a randomized complete block with four replicates, and plot size was 10 by 30 ft. All treatments were applied at 8.5 gpa with a bicycle-wheel-type plot sprayer equipped with four 8001 flat-fan nozzles at 20-inch spacing. Weed control and wheat injury was evaluated visually where 0 equaled no visible injury and 100 equaled complete plant death.

Treatment	1st Split	Single	2nd Split
Date	June 7	June 7	June 22
Air temperature (F)	72	72	70
Relative humidity (%)	36	36	48
Wind (mph)	5	5	10-12
Sky	partly cloudy	partly cloudy	partly cloudy
Wheat	3-5 leaf, 1-2 tillers	3-5 leaf, 1-2 tillers	tillering
Height	3-6 inch	3-6 inch	6-10 inch
Wild oat	1-3 leaf	1-3 leaf	variable
Height	2-5 inch	2-5 inch	variable

Table 1. Reduced-rate split-applied imazamethabenz treatments, Cando.

Treatment[a]	Rate	July 11	
		Wheat	Wild oat
	oz ai/A	%	
Imazamethabenz + Scoil	5 + 1.5 pt	0	99
Immb + brox&MCPA + Scoil	5 + 8 + 1.5 pt	0	99
Immb + thif + flur + Scoil	5 + 0.3 + 1 + 1.5 pt	0	99
Immb + Scoil / Immb + Scoil	1.25 + 1.5 pt / 1.25 + 1.5 pt	0	99
Immb + brox&MCPA + Scoil / Immb + Scoil	1.25 + 8 + 1.5 pt / 1.25 + 1.5 pt	0	96
Immb + thif + flur + Scoil / Immb + Scoil	1.25 + 0.3 + 1 + 1.5pt / 1.25 + 1.5 pt	0	99
Immb + Scoil / Immb + brox&MCPA + Scoil	1.25 + 1.5 pt / 1.25 + 8 + 1.5 pt	0	99
Immb + Scoil / Immb + thif + flur + Scoil	1.25 + 1.5 pt / 1.25 + 0.3 + 1 + 1.5 pt	0	99
Untreated		-	-
LSD (5%)		NS	2

[a] Brox&MCPA = Bronate; Scoil = methylated vegetable oil.

Table 2. Reduced-rate split-applied fenoxaprop-P treatments, Cando.

Treatment[a]	Rate	July 11	
		Wheat	Wild oat
	oz ai/A	%	
Fenoxaprop-P	1.24	0	99
Fenx + brox&MCPA	1.24 + 8	0	99
Fenx + thif + flur	1.24 + 0.3 + 1	0	99
Fenx / Fenx	1.24 / 1.24	0	99
Fenx + brox&MCPA / Fenx	1.24 + 8 / 1.24	0	99
Fenx + thif + flur / Fenx	1.24 + 0.3 + 1 / 1.24	0	99
Fenx / Fenx + brox&MCPA	1.24 / 1.24 + 8	0	99
Fenx / Fenx + thif + flur	1.24 / 1.24 + 0.3 + 1	0	99
Untreated		-	-
LSD (5%)		NS	NS

[a] Fenoxaprop-P = Puma; Brox&MCPA = Bronate.

Table 3. Reduced-rate split-applied flucarbazone treatments, Cando.

Treatment[a]	Rate	July 11	
		Wheat	Wild oat
	oz ai/A	%	
Flucarbazone + Quad 7	0.42 + 1%	0	99
Flcz + brox&MCPA + Quad 7	0.42 + 8 + 1%	0	99
Flcz + thif + flur + Quad 7	0.42 + 0.3 + 1 + 1%	0	99
Flcz + Quad 7 / Flcz + Quad 7	0.42 + 1% / 0.42 + 1%	0	99
Flcz + brox&MCPA + Quad 7 / Flcz + Quad 7	0.42 + 8 + 1% / 0.42 + 1%	0	99
Flcz + thif + flur + Quad 7 / Flcz + Quad 7	0.42 + 0.3 + 1 + 1% / 0.42 + 1%	0	99
Flcz + Quad 7 / Flcz + brox&MCPA + Quad 7	0.42 + 1% / 0.42 + 8 + 1%	0	99
Flcz + Quad 7 / Flcz + thif + flur + Quad 7	0.42 + 1% / 0.42 + 0.3 + 1 + 1%	0	99
Untreated		-	-
LSD (5%)		NS	NS

[a] Brox&MCPA = Bronate; Quad 7 = basic blend adjuvant.

Table 4. Reduced-rate split-applied tralkoxydim treatments, Cando.

Treatment[a]	Rate	July 11	
		Wheat	Wild oat
	oz ai/A	%	
Tralkoxydim + Scoil	2.9 + 1.5 pt	35	99
Tral + brox&MCPA + Scoil	2.9 + 8 + 1.5 pt	16	99
Tral + thif + flur + Scoil	2.9 + 0.3 + 1 + 1.5 pt	0	99
Tral + Scoil / Tral + Scoil	0.7 + 1.5 pt / 0.7 + 1.5 pt	0	98
Tral + brox&MCPA + Scoil / Tral + Scoil	0.7 + 8 + 1.5 pt / 0.7 + 1.5 pt	0	99
Tral + thif + flur + Scoil / Tral + Scoil	0.7 + 0.3 + 1 + 1.5 pt / 0.7 + 1.5 pt	0	99
Tral + Scoil / Tral + brox&MCPA + Scoil	0.7 + 1.5 pt / 0.7 + 8 + 1.5 pt	0	99
Tral + Scoil / Tral + thif + flur + Scoil	0.7 + 1.5 pt / 0.7 + 0.3 + 1 + 1.5 pt	0	98
Untreated			-
LSD (5%)		3	NS

[a] Brox&MCPA = Bronate; Scoil = methylated vegetable oil.

Table 5. Reduced-rate split-applied clodinafop treatments, Cando.

Treatment[a]	Rate	July 11	
		Wheat	Wild oat
	oz ai/A	%	
Clodinafop + PO	0.8 + 1.5 pt	0	99
Clfp + brox&MCPA + PO	0.8 + 8 + 1.5 pt	0	99
Clfp + thif + flur + PO	0.8 + 0.3 + 1 + 1.5 pt	0	99
Clfp + PO / Clfp + PO	0.2 + 1.5 pt / 0.2 + 1.5 pt	0	99
Clfp + brox&MCPA + PO / Clfp + PO	0.2 + 8 + 1.5 pt / 0.2 + 1.5 pt	0	99
Clfp + thif + flur + PO / Clfp + PO	0.2 + 0.3 + 1 + 1.5 pt / 0.2 + 1.5 pt	0	99
Clfp + PO / Clfp + brox&MCPA + PO	0.2 + 1.5 pt / 0.2 + 8 + 1.5 pt	0	99
Clfp + PO / Clfp + thif + flur + PO	0.2 + 1.5 pt / 0.2 + 0.3 + 1 + 1.5 pt	0	99
Untreated		-	-
LSD (5%)		NS	NS

[a] Brox&MCPA = Bronate; PO = Herbimax petroleum oil concentrate

Cando Summary

All herbicide treatments provided 96% or greater wild oat control. Bromoxynil&MCPA or thifensulfuron plus fluroxypyr did not antagonize reduced-rate split-treatments of imazamethabenz, fenoxaprop-P, flucarbazone, tralkoxydim, and clodinafop. The full-labeled rate of tralkoxydim applied alone or plus bromoxynil&MCPA significantly injured wheat. However, the full-labeled rate of tralkoxydim plus thifensulfuron plus fluroxypyr did not injure wheat. The thifensulfuron and/or fluroxypyr likely antagonized tralkoxydim that no wheat injury occurred yet wild oat control was maintained at 99%. The wheat was not harvested due to severe lodging. The wild oat population was generally light and likely did significantly impact yield regardless of herbicide treatment.

Weed control with glyphosate and adjuvants. (Howatt, Roach, Davidson-Harrington) An experiment was established on fallow area. Treatments were applied to headed volunteer hard red spring wheat, 5 to 6 leaf yellow foxtail, 2 to 10 inch redroot pigweed, 4 to 12 inch common lambsquarters, and 4 to 10 inch common purslane on July 5 with 82 F, 32% RH, 5% cloudcover, 0 to 2 mph wind and 67 F soil temperature. Treatments were applied with a bicycle-wheel-type plot sprayer delivering 8.5 gpa at 35 psi through 8001 flat fan nozzles to a 7 ft wide area the length of 10 by 30 ft plots. The experiment was a randomized complete block design with four replicates.

Treatment[a]	Rate	7/10					7/13			
		WHT	Yeft	Rrpw	Colq	Copu	Yeft	Rrpw	Colq	Copu
	oz/A	%								
Glyphosate-ipa	3	33	56	59	33	45	74	51	13	25
Glyphosate-ipa+Class Act NG	3+2.5%	91	82	98	58	45	93	97	35	35
Glyphosate-ipa+Propel AMS	3+2.5%	86	75	94	40	53	81	96	50	65
Glyphosate-ipa+PCC1196	3+0.6%	84	79	91	40	48	85	95	35	60
Glyphosatet&AMADS	3&22	96	87	98	61	65	95	98	71	88
Glyphosate&AMADS+Class Act NG	3&22+2.5%	96	87	98	79	73	94	98	85	88
Glyphosate&AMADS+Propel AMS	3&22+2.5%	94	86	94	61	64	89	95	65	80
Glyphosate&AMADS+PCC1196	3&22+0.6%	95	89	97	70	68	94	98	80	89
C.V. %		5	5	6	11	12	4	5	12	12
LSD 5%		6	6	8	9	10	5	7	10	12
# OF REPS		4	4	4	4	4	4	4	4	4

[a] Glyphosate-ipa was RoundUp Ultramax from Monsanto; Class Act NG was Class Act Next Generation, surfactant plus fertilizer, from Agriliance; Propel AMS was surfactant plus fertilizer from West Central; PCC1196, a proprietary adjuvant, was from Loveland Industries; and AMADS, aminomethanamide dihydrogen tetraoxosulfate, was a sulfuric acid based adjuvant system in Engame premix from Entek.

AMADS generally provided the greatest increase in speed and consistency of glyphosate weed control for adjuvants considered in this study. Redroot pigweed control was increased 44 to 47% with all adjuvants. For yellow foxtail and volunteer wheat, AMADS or Class Act Next Generation enhanced glyphosate activity the most. Propel AMS applied with glyphosate tended to provide better common lambsquarters and common purslane control than Class Act Next Generation or PCC1196, however, Propel AMS with glyphosate&AMADS provided less control than other adjuvants applied with glyphosate&AMADS. While AMADS tended to be the best adjuvant for glyphosate, common lambsquaters control was better when Class Act Next Generation was applied with glyphosate&AMADS.

Adjuvants with Accent and Steadfast in corn. Zollinger, Richard K. and Jerry L Ries. An experiment was conducted near Chaffee, ND, to evaluate weed control in corn using a combination of a adjuvants with Accent or Steadfast herbicides applied POST. Pioneer '38P06' corn was planted on May 4, 2001. POST treatments were applied June 4 at 4:40 pm with 71 F air, 71 F soil surface, 40% relative humidity, 85% clouds, 9 mph E wind, dry soil surface, moist subsoil, good crop vigor, and no dew present to 3 to 5 inch (3 collar) corn. Weed species present were: 1 to 4 inch (75-150/ft^2) foxtail; and 0.5 to 3 inch (1-3/yd^2) common lambsquarters. Treatments were applied to the center 6.67 feet of the 10 by 40 foot plots with a bicycle-wheel-type plot sprayer delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Table. Adjuvants with Accent and Steadfast in corn (Zollinger and Ries).

		June 18		July 2
Treatment[1]	Rate	Yeft	Colq	Yeft
	(product/A)	---------- % control ----------		
Accent+Hornet+PO+28-0-0	0.5oz+1.6oz	63	57	62
Accent+Hornet+WC00	0.5oz+1.6oz	63	47	73
Accent+Dicamba+PO+28-0-0	0.5oz+8fl oz	66	43	73
Accent+Dicamba+WC00	0.5oz+8fl oz	72	45	83
Steadfast+Hornet+PO+28-0-0	0.5oz+1.6oz	70	42	83
Steadfast+Hornet+WC00	0.5oz+1.6oz	70	47	87
Steadfast+Dicamba+PO+28-0-0	0.5oz+8fl oz	72	42	75
Steadfast+Dicamba+WC00	0.5oz+8fl oz	68	47	88
DPX 79406+Hornet+PO+28-0-0	0.5oz+2.4oz	72	45	88
DPX 79406+Hornet+ WC00	0.5oz+2.4oz	67	45	87
LSD (0.05)		NS	NS	NS

[1]PO = petroleum oil concentrate = Herbimax at 1% v/v; 28-0-0 = urea ammonium nitrate at 0.5% v/v; WC00 = proprietary adjuvant from West Central Inc. at 1% v/v.

No differences in yellow foxtail or common lambsquarters control were observed.

Callisto with adjuvants in corn. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Carrington, ND, to evaluate weed control in corn using a combination of a adjuvants with Callisto herbicide applied POST. Pioneer '39D81' corn was planted on May 10, 2001. POST treatments were applied June 11 at 4:00 pm with 70 F air, 78 F soil surface, 85% relative humidity, 0% clouds, 6 mph W wind, moist soil surface, wet subsoil, excellent crop vigor, and no dew present to 5 to 7 inch (2 collar) corn. Weed species present were: 2 to 4 inch (2-5/yd^2) foxtail; 4 to 6 inch rosette to bolting (1/yd^2) wild mustard; 1 to 5 inch diameter (5-10/ft^2) prostrate pigweed; 1 to 3 inch (1-5/ft^2) redroot pigweed; 1 to 6 inch (5-10/ft^2) common lambsquarters; 1 to 6 inch diameter (1-2/yd^2) wild buckwheat; 3 to 6 inch (4-8/yd^2) volunteer wheat; and 3 to 5 inch (1-2/yd^2) flax. Treatments were applied to the center 6.67 feet of the 10 by 40 foot plots with a bicycle-wheel-type plot sprayer delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Table. Callisto with adjuvants in corn (Zollinger and Ries).

		June 25				July 9			
Treatment[1]	Rate	Fxtl	Prpw	Colq	Wibw	Fxtl	Rrpw	Prpw	Wibw
	(product/A)	---------- % control ----------				---------- % control ----------			
Callisto+Destiny+AMS	3fl oz+1% v/v	62	68	95	65	50	99	99	50
Callisto+Destiny+AMS	2fl oz+1% v/v	65	68	92	58	50	57	47	23
Callisto+Advance ESO+AMS	3fl oz+1% v/v	55	92	88	47	53	73	63	30
Callisto+Prime Oil+AMS	3fl oz+1% v/v	52	53	82	52	50	33	23	0
Callisto+Hi-Per-Oil+AMS	3fl oz+0.5% v/v	40	57	83	35	50	53	43	20
Callisto+Class Act NG	3fl oz+2.5% v/v	47	60	80	52	47	40	30	7
Callisto+AG 01023+AMS	3fl oz+0.5% v/v	45	60	88	58	53	70	70	43
Callisto+AG 01019+AMS	3fl oz+0.5% v/v	47	73	88	71	43	70	70	50
Callisto+L-64	3fl oz+1% v/v	53	63	90	62	60	77	77	50
Callisto+L-177	3fl oz+0.5% v/v	57	57	88	52	37	20	20	0
Callisto+Sub 4 MSO	3 fl oz+1% v/v	50	62	87	48	37	20	20	0
LSD (0.05)		12	12	6	12	6	10	10	7

[1]AMS = ammonium sulfate at 1 lb/A; Advance ESO = ethylated seed oil; Prime Oil = petroleum oil concentrate; Hi-Per-Oil = petroleum oil concentrate; Class Act NG = Class Act Next Generation = surfactants + fertilizer; AG 01023 and AG 01019 = proprietary adjuvants from Agriliance; L-64 and L-177 = proprietary experimental adjuvants from North Dakota State University; Sub 4 MSO = methylated seed oil.

Callisto at 3 fl oz/A is the labeled POST rate. No crop injury occurred. Redroot pigweed population was not evaluated on June 25. Common lambsquarters was controlled by all herbicide treatments at July 9. Reducing Callisto rate from 3 to 2 fl oz/A reduced weed control. Callisto does not control wild buckwheat. Methylated seed oils (except Sub 4 MSO) and AG 01023 and AG 01019 enhanced weed control from Callisto more than other adjuvants. L-177and Sub 4 MSO gave less weed control than other adjuvants.

Raptor with adjuvants in soybean. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Colfax and Wahpeton, ND, to evaluate weed control in soybean using a combination of a adjuvants with Raptor herbicide applied POST. At Colfax, Pioneer '91B33' corn was planted on May 24, 2001. POST treatments were applied June 27 at 3:00 pm with 89 F air, 90 F soil surface, 53% relative humidity, 50% clouds, 8 mph S wind, dry soil surface, moist subsoil, good crop vigor, and no dew present to V-2 soybean. Weed species present were: 1 to 6 inch tillering (10-30/ft^2) foxtail; 2 inch to vining (1-5/yd^2) wild buckwheat; 3 to 5 inch (1-3/ft^2) redroot pigweed; 1 to 6 inch (2-10/ft^2) common lambsquarters; 1 to 5 inch (1/yd^2) eastern black nightshade; and 2 to 5 inch (3-5/yd^2) marshelder.

At Wahpeton, Pioneer '90B93' corn was planted on May 17, 2001. POST treatments were applied June 29 at 9:30 am with 78 F air, 87 F soil surface, 62% relative humidity, 10% clouds, 3 mph SW wind, dry soil surface, moist subsoil, good crop vigor, and no dew present to V-2 soybean. Weed species present were: 1 to 6 inch (5-15/ft^2) foxtail; 1 to 3 inch (1-2/yd^2) redroot pigweed; 1 to 3 inch (1-3/yd^2) common lambsquarters; 1 to 5 inch (1-10/ft^2) common cocklebur; and 1 to 4 inch (5-20/ft^2) common ragweed.

Treatments were applied to the center 6.67 feet of the 10 by 40 foot plots with a bicycle-wheel-type plot sprayer delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Table. Raptor with adjuvants in soybean, Colfax (Zollinger and Ries).

		Soybean		July 11			Soybean	July 25		
Treatments[1]	Rate	July 5	July 11	Fxtl	Colq	Wibw	July 25	Fxtl	Colq	Wibw
	(product/A)	– % injury --		----- % control -----			% injury	------ % control ------		
Raptor+Soy-Stik+28-0-0	5fl oz+1% v/v+1qt	23	15	92	77	53	15	82	83	63
Raptor+WC00	5fl oz+1% v/v	20	13	67	73	50	12	77	70	47
Raptor+WC013	5fl oz+1% v/v	20	22	77	80	53	10	82	83	60
Raptor+Premium COC+28-0-0	5fl oz+1% v/v+1qt	27	17	78	77	53	16	77	77	57
Raptor+Linkage	5fl oz+1% v/v	23	23	83	73	57	8	75	80	53
Raptor+Premier 90+28-0-0	5fl oz+0.25% v/v+1qt	20	10	78	67	57	10	82	73	63
Raptor+WC007+28-0-0	5fl oz+0.5% v/v+1qt	20	10	68	67	40	7	74	67	53
Raptor+L-64	5fl oz+1% v/v	22	13	82	63	50	8	77	73	57
Raptor+L-177	5fl oz+0.5% v/v	5	7	57	53	30	8	57	47	33
Raptor+Sub 4+3	5fl oz+1% v/v	8	7	70	67	50	10	73	63	53
Raptor+Sub 4 MSO	5fl oz+1% v/v	13	13	73	67	53	10	68	57	47
Raptor+Dispatch 111	5fl oz+1% v/v	20	13	77	70	60	8	77	77	60
Raptor+LI-222	5fl oz+1% v/v	22	10	68	67	47	12	73	67	53
Raptor+LI-227	5fl oz+1% v/v	20	15	77	80	57	18	80	73	57
LSD (0.05)		7	14	9	11	14	12	10	16	20

[1]Soy-Stik = methylated seed oil; 28-0-0 = urea ammonium nitrate; WC00 = proprietary adjuvant from West Central Inc.; WC013 = methylated seed oil based basic blend adjuvant; Premium COC = petroleum oil concentrate; Linkage = basic blend adjuvant; Premier 90 = surfactant; WC007 = crop oil concentrate/surfactant blend; L-64 and L-177 = proprietary experimental adjuvants from North Dakota State University; Sub 4+3 = herbicide enhancement spray adjuvant; Sub 4 MSO = methylated seed oil; Dispatch 111 = basic blend adjuvant; LI-222 and LI-227 = proprietary adjuvants from Loveland Industries.

Soybean injury was stunting and yellowing. All treatments controlled redroot pigweed, annual smartweed, and marshelder

Table. Raptor with adjuvants in soybean, Wahpeton (Zollinger and Ries).

Treatments[1]	Rate	July 6		July 13		July 28			
		Fxtl	Corw	Fxtl	Corw	Fxtl	Colq	Corw	Cocb
	(product/A)								
Raptor+Soy-Stik+28-0-0	5fl oz+1% v/v+1qt	93	63	96	73	93	90	80	90
Raptor+W 00	5fl oz+1% v/v	43	33	80	50	60	90	70	70
Raptor+WC013	5fl oz+1% v/v	40	43	70	50	66	77	63	70
Raptor+Premium COC+28-0-0	5fl oz+1% v/v+1qt	57	40	70	47	77	63	60	70
Raptor+Linkage	5fl oz+1% v/v	80	40	73	43	63	57	50	57
Raptor+Premier 90+28-0-0	5fl oz+0.25% v/v+1qt	43	43	70	50	50	90	57	57
Raptor+WC007+28-0-0	5fl oz+0.5% v/v+1qt	60	50	67	53	90	77	67	70
Raptor+L-64	5fl oz+1% v/v	30	20	67	37	60	50	40	40
Raptor+L-177	5fl oz+0.5% v/v	40	67	67	47	57	63	43	47
Raptor+Sub 4+3	5fl oz+1% v/v	33	30	53	33	30	30	30	40
Raptor+Sub 4 MSO	5fl oz+1% v/v	37	67	53	40	50	43	47	47
Raptor+Dispatch 111	5fl oz+1% v/v	40	40	63	40	30	37	37	43
Raptor+LI-222	5fl oz+1% v/v	23	23	70	43	37	20	47	57
Raptor+LI-227	5fl oz+1% v/v	27	23	70	43	70	50	50	57
LSD (0.05)		16	18	8	14	15	17	14	15

[1]Soy-Stik = methylated seed oil; 28-0-0 = urea ammonium nitrate; WC00 = proprietary adjuvant from West Central Inc.; WC013 = methylated seed oil based basic blend adjuvant; Premium COC = petroleum oil concentrate; Linkage = basic blend adjuvant; Premier 90 = surfactant; WC007 = crop oil concentrate/surfactant blend; L-64 and L-177 = proprietary experimental adjuvants from North Dakota State University; Sub 4+3 = herbicide enhancement spray adjuvant; Sub 4 MSO = methylated seed oil; Dispatch 111 = basic blend adjuvant; LI-222 and LI-227 = proprietary adjuvants from Loveland Industries.

At July 6 and July 13, all treatments controlled wild mustard, redroot pigweed, common lambsquarters, and common cocklebur.
At July 28, all treatments controlled wild mustard and redroot pigweed.

Glyphosate with adjuvants in soybean. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Colfax and Fargo, ND, to evaluate weed control in soybean using a combination of adjuvants with Glyphosate herbicides applied POST. At Colfax, Pioneer '91B33' soybean was planted on May 24, 2001. POST treatments were applied July 10 at 10:30 am with 77 F air, 81 F soil surface, 42% relative humidity, 0% clouds, 5 to 7 mph NE wind, dry soil surface, moist subsoil, excellent crop vigor, and no dew present to V-4 to V-5 soybean. Weed species present were: 3 to 18 inch (50-100/ft^2) yellow foxtail; 3 inch to vining (1-5/yd^2) wild buckwheat; 3 to 12 inch (1-5/ft^2) redroot pigweed; 1 to 10 inch (1-3/yd^2) common lambsquarters; and 6 to 24 inch (1-5/yd^2) marshelder.

At Fargo, POST treatments were applied to non-cropland on May 30, 2001 at 12:15 pm with 81 F air, 82 F soil surface, 42% relative humidity, 75% clouds, 9 mph SE wind, dry soil surface, and moist subsoil. Weed species present were: 4 to 5 leaf 6 to 8 inch (35-50/ft^2) yellow foxtail; 4 to 6 leaf 4 inch (3-5/yd^2) wild buckwheat; 4 to 6 inch (1/yd^2)Canada thistle; 3 to 4 leaf 3 to 5 inch (3-5/ft^2) common lambsquarters; 8 to 10 inch (40-50/ft^2) volunteer wheat; and 4 to 8 inch rosette to blossom (3-5/ft^2) prickly lettuce.

Treatments were applied to the center 6.67 feet of the 10 by 40 foot plots with a bicycle-wheel-type plot sprayer delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Table. Glyphosate with adjuvants in soybean, Colfax (Zollinger and Ries).

		July 24				August 7				
Treatment[1]	Rate	Fxtl	Rrpw	Colq	Mael	Fxtl	Rrpw	Colq	Mael	Smwe
	(product/A)	--------- % control ---------				---------- % control ----------				
Roundup UltraMax+AMS	13fl oz	92	70	70	70	99	99	96	96	99
Roundup UltraMax+AMS	6.5fl oz	88	70	70	77	99	96	86	93	99
Roundup UltraMax+AG 00007	6.5fl oz+2.5% v/v	90	77	77	73	99	99	90	99	99
Cornerstone+Preference+AMS	16fl oz+0.5% v/v	93	77	77	82	99	99	99	90	99
Cornerstone+Preference+AMS	8fl oz+0.5% v/v	73	70	70	73	99	89	99	93	99
Cornerstone+Class Act NG	16fl oz+2.5% v/v	92	70	80	99	99	99	99	99	99
Cornerstone+Class Act NG	8fl oz+2.5% v/v	77	70	70	57	96	96	96	93	96
Cornerstone+Class Act NG	8fl oz+1.5% v/v	73	70	70	73	99	90	90	93	99
Cornerstone+AG 01014	8fl oz+5gal	70	70	70	77	90	93	93	73	89
Cornerstone+L-195	8fl oz+1% v/v	63	70	70	73	80	99	99	73	70
Cornerstone+Sub 4 HP+AMS	8fl oz+0.25% v/v	67	70	70	70	96	93	93	93	90
Cornerstone+PCC 1196	8fl oz+0.625gal/100gal	63	57	57	57	86	89	89	83	96
Cornerstone+Liberate+AMS	8fl oz+0.5% v/v	73	50	50	57	96	93	83	90	99
Cornerstone+Surfate	8fl oz+1% v/v	67	63	63	63	83	77	70	77	89
AGH 01004	76.8fl oz	99	99	99	-	99	99	99	-	-
AGH 01004	38.4fl oz	70	70	70	-	89	99	73	-	-
LSD (0.05)		8	7	7	11	7	7	8	6	8

[1]AMS = ammonium nitrate at 2.5% v/v; Preference = surfactant; Class Act NG = Class Act Next Generation = surfactants + fertilizer; AG 00007 and AG 01014 are proprietary adjuvants from Agriliance; L-195 = proprietary experimental adjuvant from North Dakota State University; Sub 4 HP = nonionic surfactant; PCC 1196 = proprietary adjuvant from Loveland Industries; Liberate = nonionic surfactant; Surfate = surfactants +fertilizer.

Glyphosate formulations at the high or lower rates with most adjuvants gave greater than 90% weed control at 28 DAT (August 7).

Table. Glyphosate with adjuvants in soybean, Fargo (Zollinger and Ries).

Treatment[1]	Rate	June 13	June 28
		Prickly lettuce	Prickly lettuce
	(product/A)	-----% control -----	----- % control -----
Roundup UltraMax+AMS	13fl oz	99	99
Roundup UltraMax+AMS	6.5fl oz	99	99
Roundup UltraMax+AG 00007	6.5fl oz+2.5% v/v	80	80
Cornerstone+Preference+AMS	16fl oz+0.5% v/v	99	99
Cornerstone+Preference+AMS	8fl oz+0.5% v/v	85	90
Cornerstone+Class Act NG	16fl oz+2.5% v/v	95	95
Cornerstone+Class Act NG	8fl oz+2.5% v/v	85	99
Cornerstone+Class Act NG	8fl oz+1.5% v/v	65	50
Cornerstone+AG 01014	8fl oz+5gal	85	80
Cornerstone+L-195	8fl oz+1% v/v	65	65
Cornerstone+Sub 4 HP+AMS	8fl oz+0.25% v/v	55	55
Cornerstone+PCC 1196	8fl oz+0.625gal/100gal	70	70
Cornerstone+Liberate+AMS	8fl oz+0.5% v/v	90	95
Cornerstone+Surfate	8fl oz+1% v/v	85	95
AGH 01004	76.8fl oz	95	97
AGH 01004	38.4fl oz	95	95
LSD (0.05)		6	7

[1]AMS = ammonium nitrate at 2.5% v/v; Preference = surfactant; Class Act NG = Class Act Next Generation = surfactants + fertilizer; AG 00007 and AG 01014 are proprietary adjuvants from Agriliance; L-195 = proprietary experimental adjuvant from North Dakota State University; Sub 4 HP = nonionic surfactant; PCC 1196 = proprietary adjuvant from Loveland Industries; Liberate = nonionic surfactant; Surfate = surfactants + fertilizer.

All herbicide treatments controlled volunteer wheat, foxtail, field pennycress, common lambsquarters, and wild mustard. Most glyphosate formulations at the high or lower rates with most adjuvants gave greater than 90% weed control at 28 DAT (August 7). AG 0007 antagonized prickly lettuce control from Roundup Ultra. Reducing Class Act NG from 2.5% to 1.5% v/v resulted in reduced prickly lettuce control. L-195 and Sub 4 HP with Cornerstone gave poor prickly lettuce control. Lower ratings at June 28 was primarily from prickly lettuce regrowth.

Glyphosate with adjuvants-Foxhome. Oltmans and Zollinger. An experiment was conducted near Foxhome, MN to evaluate weed control from glyphosate formulations applied with adjuvants. Asgrow '0801' soybean was planted May 17, 2001. POST treatments were applied June 27, 2001 at 9:15 to 10:15 am with 80 F air, 72 F soil at a 2 to 4 inch depth, 63% relative humidity, 50% clouds, 2 to 8 mph SE wind, dry soil surface, moist subsoil, good crop vigor, and no dew present to 4 trifoliate soybean. Weed species present were: 1 to 6 inch, (5-10 plants/m^2) foxtail; 1 to 6 inch, (20-30 plants/ft^2) redroot pigweed; and 1 to 5 inch, (5-10 plants/m^2) thyme-leaved spurge. Treatments were applied to the center 6.67 feet of the 10 by 40 ft plots with a bicycle-wheel-type plot sprayer equipped with a wind shield delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with four replicates per treatment.

		July 9			July 24		
Treatment	Rate	Rrpw[a]	Fxtl	Tlsp	Rrpw	Fxtl	Tlsp
	(product/A)	% control					
Roundup UltraMax+AMS	13floz+8.5lb/100gal	99	99	98	98	99	98
Roundup UltraMax+AMS	6.5floz+8.5lb/100gal	97	99	97	93	99	95
Roundup UltraMax+Corral AMS Liquid	6.5floz+2.5%v/v	97	99	96	96	99	94
Roundup UltraMax+Class Act Next Generation	6.5floz+2.5%v/v	99	99	93	98	99	87
Roundup UltraDry+AMS	9.2floz+8.5lb/100gal	98	99	97	97	99	97
Roundup UltraDry+AMS	4.6loz+8.5lb/100gal	97	99	93	94	99	90
Roundup UltraDry+Corral AMS Liquid	4.6floz+2.5%v/v	94	99	90	93	99	87
Roundup UltraDry+Class Act Next Generation	4.6floz+2.5%v/v	99	99	98	95	99	98
Touchdown+AMS	16floz+8.5lb/100gal	94	99	95	99	98	97
Touchdown+AMS	8floz+8.5lb/100gal	94	99	86	94	99	73
Touchdown+Corral AMS Liquid	8floz+2.5%v/v	98	99	88	94	98	78
Touchdown+Class Act Next Generation	8floz+2.5%v/v	96	99	93	96	99	93
Roundup Original+AMS+NIS	16floz+8.5lb/100gal+0.5%v/v	95	99	95	92	99	97
Roundup Original+AMS+NIS	8floz+8.5lb/100gal+0.5%v/v	87	97	90	86	99	90
Roundup Original+Corral AMS Liquid+NIS	8floz+2.5%v/v+0.5%v/v	93	99	94	87	98	91
Roundup Original+Class Act Next Generation	8floz+2.5%v/v	90	99	97	88	99	98
Roundup Custom+AMS+NIS	12floz+8.5lb/100gal+0.5%v/v	99	99	97	99	99	93
Roundup Custom+AMS+NIS	6floz+8.5lb/100gal+0.5%v/v	97	99	93	93	98	86
Roundup Custom+Corral AMS Liquid+NIS	6floz+2.5%v/v+0.5%v/v	96	99	89	94	95	86
Roundup Custom+Class Act Next Generation	6floz+2.5%v/v	97	99	89	96	99	85
Untreated		0	0	0	0	0	0
LSD (0.05)		7	1	7	10	2	10

[a]Fxtl = Grft and Yeft; Tlsp = thyme-leaved spurge

Treatments were developed according to the adjuvant load in glyphosate formulations. Roundup UltraMax, Roundup UltraDry, and Touchdown do not require additional surfactant; Roundup Original requires some additional surfactant; and Roundup Custom has no surfactant in the formulation. On July 9, all treatments had greater than 97% foxtail control. Redroot pigweed control ranged from 87 to 99%. All treatments had greater than 90% redroot pigweed control, except 8 floz/A Roundup Original+AMS+NIS. Thyme-leaved spurge control ranged from 86 to 98%. Only four treatments had below 90% thyme-leaved spurge control. Weed control ratings on July 24 were similar to July 9, because of little rainfall throughout the growing season which limited weed seed germination and/or weed seedling growth. On July 24, all treatments had greater than 95% foxtail control. Redroot pigweed control ranged from 86 to 99%. All treatments had greater than 92% redroot pigweed control, except the three 8 floz/A Roundup Original treatments. Thyme-leaved spurge control ranged from 73 to 98% control. Most treatments had greater than 90% thyme-leaved spurge control. Touchdown at 8 floz/A with adjuvant and Roundup Custom at 6 floz/A with adjuvant generally provided the lowest thyme-leaved spurge control. Generally, the most effective treatments were glyphosate at 1/2x with labeled adjuvant, indicating reduced glyphosate rates accompanied with the labeled adjuvant may provide control equal to or greater than the full rate.

Glyphosate with adjuvants-Oakes. Oltmans and Zollinger. An experiment was conducted near Oakes, ND to evaluate weed control from glyphosate formulations applied with adjuvants. Asgrow '0801' soybean was planted May 16, 2001. POST treatments were applied June 27, 2001 at 1:30 to 2:30 pm with 97 F air, 75 F soil at a 2 to 4 inch depth, 40% relative humidity, 50% clouds, 3 to 10 mph SE wind, dry soil surface, moist subsoil, good crop vigor, and no dew present to 4 trifoliolate soybean. Weed species present were: 1 to 7 inch, (5-10 plants/m^2) foxtail; 1 to 7 inch, (5-10 plants/m^2) wild oat; 1 to 7 inch, (1-5 plants/ft^2) marshelder; 1 to 7 inch, (5-10 plants/ft^2) common lambsquarters, and 1 to 7 inch, (5-10 plants/m^2) dry edible bean. Treatments were applied to the center 6.67 feet of the 10 by 40 ft plots with a bicycle-wheel-type plot sprayer equipped with a wind shield delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with four replicates per treatment.

Treatments were developed according to the adjuvant load in glyphosate formulations. Roundup UltraMax, Roundup UltraDry, and Touchdown do not require additional surfactant; Roundup Original requires some additional surfactant; and Roundup Custom has no surfactant in the formulation. On July 11, all treatments had greater than 98% foxtail control and 95% marshelder control. Dry edible bean control ranged from 85 to 99%. Most treatments had greater than 92% dry edible bean control. Common lambsquarters control ranged from 78 to 94%. Most treatments had greater than 90% common lambsquarters control, except treatments with Roundup Custom. Weed control ratings on July 25 were similar to July 11, because of little rainfall throughout the growing season, which limited weed seed germination and/or weed seedling growth. On July 25, all treatments had greater than 97% foxtail and marshelder control, and greater than 95% dry edible bean control. Common lambsquarters control ranged from 77 to 99%. Most treatments had greater than 90% common lambsquarters control, except treatments with Roundup Custom. Across glyphosate formulations, Touchdown and Roundup Original at 1/4x with adjuvant generally provided the most effective weed control.

Treatment	Rate	July 11				July 25			
		Fxtl[a]	Mael	DEB	Colq	Fxtl	Mael	DEB	Colq
	(product/A)	% control							
Roundup UltraMax+AMS	13floz+8.5lb/100gal	99	98	99	90	99	99	99	90
Roundup UltraMax+AMS	6.5floz+8.5lb/100gal	99	99	97	78	99	99	96	77
Roundup UltraMax+Corral AMS Liquid	6.5floz+2.5%v/v	99	99	97	90	99	99	99	90
Roundup UltraMax+Class Act Next Generation	6.5floz+2.5%v/v	99	98	99	90	98	97	96	94
Roundup UltraDry+AMS	9.2floz+8.5lb/100gal	99	99	98	94	99	99	99	99
Roundup UltraDry+AMS	4.6loz+8.5lb/100gal	98	95	93	86	99	99	99	86
Roundup UltraDry+Corral AMS Liquid	4.6floz+2.5%v/v	99	99	95	90	99	99	98	91
Roundup UltraDry+Class Act Next Generation	4.6floz+2.5%v/v	99	97	98	95	99	99	99	98
Touchdown+AMS	16floz+8.5lb/100gal	99	99	95	92	99	99	99	93
Touchdown+AMS	8floz+8.5lb/100gal	98	98	99	94	99	99	96	94
Touchdown+Corral AMS Liquid	8floz+2.5%v/v	99	96	97	93	99	99	99	92
Touchdown+Class Act Next Generation	8floz+2.5%v/v	99	98	92	91	99	99	99	93
Roundup Original+AMS+NIS	16floz+8.5lb/100gal+0.5%v/v	99	99	98	91	99	99	98	92
Roundup Original+AMS+NIS	8floz+8.5lb/100gal+0.5%v/v	99	99	94	91	99	99	98	91
Roundup Original+Corral AMS Liquid+NIS	8floz+2.5%v/v+0.5%v/v	99	99	88	90	99	98	99	92
Roundup Original+Class Act Next Generation	8floz+2.5%v/v	99	98	94	90	97	99	95	95
Roundup Custom+AMS+NIS	12floz+8.5lb/100gal+0.5%v/v	99	99	96	86	99	99	99	87
Roundup Custom+AMS+NIS	6floz+8.5lb/100gal+0.5%v/v	99	99	85	88	99	99	97	85
Roundup Custom+Corral AMS Liquid+NIS	6floz+2.5%v/v+0.5%v/v	99	99	99	82	98	98	99	82
Roundup Custom+Class Act Next Generation	6floz+2.5%v/v	99	99	96	89	99	98	97	89
Untreated		0	0	0	0	0	0	0	0
LSD (0.05)		1	3	10	6	1	1	2	6

[a]Fxtl = Grft and Yeft; DEB = dry edible bean; Mael = marshelder

Glyphosate with adjuvants-Wendell. Oltmans and Zollinger. An experiment was conducted near Wendell, MN to evaluate weed control from glyphosate formulations applied with adjuvants. Asgrow '0801' soybean was planted May 12, 2001. POST treatments were applied July 2, 2001 at 9:30 to 10:30 am with 59 F air, 67 F soil at a 2 to 4 inch depth, 72% relative humidity, 100% clouds, 5 to 10 mph S wind, moist soil surface, moist subsoil, good crop vigor, and no dew present to 2 to 3 trifoliolate soybean. Weed species present were: 1 to 8 inch, (5-10 plants/m^2) foxtail; 1 to 7 inch, (10-20 plants/ft^2) redroot pigweed; 2 to 4 inch, (1-5 plants/m^2) biennial wormwood; 1 to 7 inch, (1-5 plants/ft^2) maple-leaved goosefoot; and 1 to 7 inch, (1-5 plants/ft^2) cocklebur. Treatments were applied to the center 6.67 feet of the 10 by 40 ft plots with a bicycle-wheel-type plot sprayer equipped with a wind shield delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with four replicates per treatment.

Treatments were developed according to the adjuvant load in glyphosate formulations. Roundup UltraMax, Roundup UltraDry, and Touchdown do no require additional surfactant; Roundup Original requires some additional surfactant; and Roundup Custom has no surfactant in the formulation. On July 16, all treatments had greater than 92% biennial wormwood, maple-leaved goosefoot, redroot pigweed, foxtail, and common cocklebur control, except the reduced-rate conventional treatment. Weed control ratings on July 27 were similar to July 16, because of little rainfall throughout the growing season which limited weed seed germination and/or weed seedling growth. On July 27, all treatments had greater than 91% biennial wormwood, redroot pigweed, maple-leaved goosefoot, foxtail, and common cocklebur control, except the reduced-rate conventional treatment. All glyphosate formulations and adjuvants were effective, indicating reduced glyphosate rates accompanied with the correct adjuvant may provide weed control equal to or greater than the full rate.

Treatment[a]	Rate	July 16, 2001					July 27, 2001				
		Biww[b]	Rrpw	Gsft	Fxtl	Cocb	Biww	Rrpw	Gsft	Fxtl	Cocb
	(product/A)	% control									
Roundup UltraMax+AMS	13floz+8.5lb/100gal	99	99	98	99	99	98	99	99	99	99
Roundup UltraMax+AMS	6.5floz+8.5lb/100gal	92	99	96	99	99	94	99	95	99	99
Roundup UltraMax+Corral AMS Liquid	6.5floz+2.5%v/v	99	99	98	99	99	97	99	97	99	99
Roundup UltraMax+Class Act Next Generation	6.5floz+2.5%v/v	98	99	99	99	98	99	99	99	99	99
Roundup UltraMax+Victory System	6.5floz	94	99	96	97	99	94	99	96	99	99
Roundup UltraDry+AMS	9.2oz+8.5lb/100gal	95	99	99	97	99	97	99	99	99	99
Roundup UltraDry+AMS	4.6oz+8.5lb/100gal	94	99	96	99	99	95	99	96	99	99
Roundup UltraDry+Corral AMS Liquid	4.6oz+2.5%v/v	93	99	94	99	99	94	99	95	99	99
Roundup UltraDry+Class Act Next Generation	4.6oz+2.5%v/v	96	99	97	99	99	97	99	98	99	99
Roundup UltraDry+Victory System	4.6oz	92	99	98	99	98	96	99	98	99	99
Touchdown+AMS	16floz+8.5lb/100gal	98	99	99	99	99	99	99	99	99	99
Touchdown+AMS	8floz+8.5lb/100gal	98	99	99	99	99	99	99	99	99	99
Touchdown+Corral AMS Liquid	8floz+2.5%v/v	95	99	99	99	97	96	99	99	99	98
Touchdown+Class Act Next Generation	8floz+2.5%v/v	95	99	98	99	99	99	99	99	99	99
Touchdown+Victory System	8floz	94	99	98	99	99	95	99	98	99	99
Roundup Original+AMS+NIS	16floz+8.5lb/100gal+0.5%v/v	97	99	99	99	99	96	99	99	99	99
Roundup Original+AMS+NIS	8floz+8.5lb/100gal+0.5%v/v	93	99	98	99	98	91	99	97	99	99
Roundup Original+Corral AMS Liquid+NIS	8floz+2.5%v/v+0.5%v/v	95	99	96	99	99	96	99	96	99	99
Roundup Original+Class Act Next Generation	8floz+2.5%v/v	94	99	99	99	99	97	99	99	99	99
Roundup Original+Victory System	8floz	95	99	99	99	99	94	99	99	99	99
Roundup Custom+AMS+NIS	12floz+8.5lb/100gal+0.5%v/v	98	99	97	99	98	98	99	98	99	99
Roundup Custom+AMS+NIS	6floz+8.5lb/100gal+0.5%v/v	95	99	98	99	98	93	99	99	99	99
Roundup Custom+Corral AMS Liquid+NIS	6floz+2.5%v/v+0.5%v/v	94	99	98	99	99	95	99	98	99	99
Roundup Custom+Class Next Generation	6floz+2.5%v/v	99	99	99	99	98	99	99	99	99	99
Roundup Custom+Victory System	6floz	92	99	96	99	95	95	99	95	99	99
Ultra Blazer+Harmony GT+Select+Assure II+Victory System	2floz+0.05oz+1floz+1floz	15	84	75	88	86	80	88	85	84	76
Untreated		0	0	0	0	0	0	0	0	0	0
LSD (0.05)		7	1	4	2	3	6	1	4	2	2

[a]Victory System = 16floz/100gal SS9+32floz/100gal Vector+1lb/A Vertigro+0.1lb/A AMS+1.5floz/A Microplex+1.5floz/A Foliarplex+1.5floz/A Renew Plus
[b]Biww = biennial wormwood; Gsft = maple-leaved goosefoot

Glyphosate formulations. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Fargo and Wahpeton, ND, to evaluate weed control from different glyphosate formulations applied POST. POST treatments were applied to non-cropland May 30 at 11:30 am with 81 F air, 81 F soil surface, 42% relative humidity, 75% clouds, 9 mph SE wind, dry soil surface, and moist subsoil. Weed species present were: 4 to 5 leaf 6 inch (35-50/ft^2) yellow foxtail; 4 to 6 inch (1/yd^2) Canada thistle; 4 to 6 leaf 4 inch (3-5/yd^2) wild buckwheat; 6 to 8 inch (40-50/ft^2) volunteer wheat; rosette to blossom 4 to 8 inch (3-5/ft^2) prickly lettuce; and 3 to 4 leaf 3 to 5 inch (3-5/ft^2) common lambsquarters.

At Wahpeton, Pioneer '90B93' soybean was planted on May 17, 2001. POST treatments were applied July 10 at 12:00 pm with 79 F air, 91 F soil surface, 32% relative humidity, 5% clouds, 7 mph NE wind, dry soil surface, moist subsoil, good crop vigor, and no dew present to V-3 to V-5 soybean. Weed species present were: 3 to 12 inch (1-10/ft^2) foxtail; 1 to 2 inch (1-5/yd^2) redroot pigweed; 1 to 5 inch (1-5/yd^2) common lambsquarters; 6 to 10 inch (5-15/ft^2) common cocklebur; and 6 to 12 inch (10-25/ft^2) common ragweed.

Treatments were applied to the center 6.67 feet of the 10 by 40 foot plots with a hooded bicycle-wheel-type plot sprayer delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles for POST treatments. The experiment had a randomized complete block design with three replicates per treatment. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Table 1. Glyphosate formulations, Fargo (Zollinger and Ries).

Treatment[1]	Rate	June 13 Prickly lettuce	June 28 Prickly lettuce
	(product/A)	------ % control ------	
Roundup Ultra+Class Act NG	8fl oz+2.5% v/v	99	99
Roundup Ultra+L-195	8fl oz+1% v/v	99	99
Roundup Ultra+Propel AMS	8fl oz+2.5% v/v	99	99
Roundup Ultra+One-Ap	8fl oz+9lb/100gal	70	90
Roundup Ultra+PCC 1196	8fl oz+0.625gal/100gal	70	90
Roundup Ultra+Liberate+AMS	8fl oz+0.5% v/v+2.5% v/v	80	92
Roundup Ultra+RUSA 703	8fl oz+9lb/100gal	85	96
Roundup Ultra+Surfate	8fl oz+1% v/v	90	99
Glyphomax+Class Act NG	8fl oz+2.5% v/v	95	99
Glyphomax+L-195	8fl oz+1% v/v	60	96
Glyphomax+Propel AMS	8fl oz+2.5% v/v	90	70
Glyphomax+One-Ap	8fl oz+9lb/100gal	80	95
Glyphomax+PCC 1196	8fl oz+0.625gal/100gal	99	99
Glyphomax+Liberate+AMS	8fl oz+0.5% v/v+2.5% v/v	99	99
Glyphomax+RUSA 703	8fl oz+9lb/100gal	53	57
Glyphomax+Surfate	8fl oz+1% v/v	62	60
Engame+Class Act NG	19.5fl oz+2.5% v/v	73	73
Engame+L-195	19.5fl oz+1% v/v	87	83
Engame+Propel AMS	19.5fl oz+2.5% v/v	87	83
Engame+One-Ap	19.5fl oz+9lb/100gal	95	99
Engame+PCC 1196	19.5fl oz+0.625gal/100gal	99	99
Engame+Liberate+AMS	19.5fl oz+0.5% v/v+2.5% v/v	99	99
Engame+RUSA 703	19.5fl oz+9lb/100gal	97	99
Engame+Surfate	19.5fl oz+1% v/v	99	99
LSD (0.05)		2	2

[1]Class Act NG = Class Act Next Generation = surfactants + fertilizer; L-195 = proprietary experimental adjuvant from North Dakota State University; Propel AMS = liquid blend of nonionic surfactant and AMS; One-Ap = dry blend of nonionic surfactant, AMS, and drift control agent; PCC 1196 = proprietary adjuvant from Loveland Industries; Liberate = nonionic surfactant; AMS = ammonium sulfate; RUSA 703 = proprietary adjuvant from Rosen's Inc.; Surfate = surfactants + fertilizer.

Table 2. Glyphosate formulations, Wahpeton (Zollinger and Ries).

Treatment[1]	Rate	July 24		August 7	
		Corw	Cocb	Corw	Cocb
	(product/A)	---- % control ----		---- % control ----	
Roundup Ultra+Class Act NG	8fl oz+2.5% v/v	57	93	63	99
Roundup Ultra+L-195	8fl oz+1% v/v	37	43	43	50
Roundup Ultra+Propel AMS	8fl oz+2.5% v/v	43	53	47	67
Roundup Ultra+One-Ap	8fl oz+9lb/100gal	53	70	60	73
Roundup Ultra+PCC 1196	8fl oz+0.625gal/100gal	33	40	43	60
Roundup Ultra+Liberate+AMS	8fl oz+0.5% v/v+2.5% v/v	47	76	47	83
Roundup Ultra+RUSA 703	8fl oz+9lb/100gal	40	66	47	80
Roundup Ultra+Surfate	8fl oz+1% v/v	47	66	50	77
Glyphomax+Class Act NG	8fl oz+2.5% v/v	40	63	47	66
Glyphomax+L-195	8fl oz+1% v/v	30	53	48	70
Glyphomax+Propel AMS	8fl oz+2.5% v/v	33	66	37	73
Glyphomax+One-Ap	8fl oz+9lb/100gal	43	73	57	73
Glyphomax+PCC 1196	8fl oz+0.625gal/100gal	23	53	27	60
Glyphomax+PCC Liberate+AMS	8fl oz+0.5% v/v+2.5% v/v	43	89	47	89
Glyphomax+RUSA 703	8fl oz+9lb/100gal	37	76	43	80
Glyphomax+Surfate	8fl oz+1% v/v	40	66	52	73
Engame+Class Act NG	19.5fl oz+2.5% v/v	37	76	40	76
Engame+L-195	19.5fl oz+1% v/v	40	76	40	73
Engame+Propel AMS	19.5fl oz+2.5% v/v	40	76	37	73
Engame+One-Ap	19.5fl oz+9lb/100gal	43	83	53	89
Engame+PCC 1196	19.5fl oz+0.625gal/100gal	40	86	57	73
Engame+Liberate+AMS	19.5fl oz+0.5% v/v+2.5% v/v	37	73	47	76
Engame+RUSA 703	19.5fl oz+9lb/100gal	37	63	47	73
Engame+Surfate	19.5fl oz+1% v/v	40	79	50	80
LSD (0.05)		10	18	10	13

[1]Class Act NG = Class Act Next Generation = surfactants + fertilizer; L-195 = proprietary experimental adjuvant from North Dakota State University; Propel AMS = liquid blend of nonionic surfactant and AMS; One-Ap = dry blend of nonionic surfactant, AMS, and drift control agent; PCC 1196 = proprietary adjuvant from Loveland Industries; Liberate = nonionic surfactant; AMS = ammonium sulfate; RUSA 703 = proprietary adjuvant from Rosen's Inc.; Surfate = surfactants + fertilizer.

At Fargo, all herbicide treatments controlled volunteer wheat, foxtail, field pennycress, common lambsquarters, and wild mustard. Prickly lettuce was a good species to rate for adjuvant differences. Roundup Ultra had better over all prickly lettuce control with various adjuvants than Glyphomax or Engame. No adjuvant (except possibly Propel AMS) was consistently lower with any glyphosate formulation.

At Wahpeton, all herbicide treatments controlled foxtail, redroot pigweed, and common lambsquarters. Common ragweed and common cocklebur control was erratic. Weed control did not differ to a great extend from the same adjuvant applied with Roundup Ultra, Glyphomax, or Engame.

Glyphosate formulations in Roundup Ready soybean. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Wahpeton, ND, to evaluate weed control in soybean using a combination of glyphosate formulations POST applied. Pioneer '90B93' soybean was planted on May 17, 2001. POST treatments were applied July 10 at 12:30 pm with 79 F air, 91 F soil surface, 32% relative humidity, 5% clouds, 7 mph NE wind, dry soil surface, moist subsoil, good crop vigor, and no dew present to V-2 soybean. Weed species present were: 3 to 12 inch (1-10/ft^2) foxtail; 1 to 2 inch (1-5/yd^2) redroot pigweed; 1 to 5 inch (1-5/yd^2) common lambsquarters; 6 to 10 inch (5-15/ft^2) common cocklebur; and 6 to 12 inch (10-25/ft^2) common ragweed. Treatments were applied to the center 6.67 feet of the 10 by 40 foot plots with a bicycle-wheel-type plot sprayer delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Table. Glyphosate formulations in Roundup Ready soybean (Zollinger and Ries).

		July 24		August 7	
Treatment	Rate	Colq	Corw	Colq	Corw
	(fl oz/A)	% control			
YF11087V	17	63	67	77	77
YF11087V	23	70	77	80	88
Touchdown 3SL	24	72	72	77	73
Touchdown 3SL	32	78	85	80	90
Roundup Ultramax	19	57	57	67	63
Roundup Ultramax	26	82	77	80	77
YF11740V	17	70	70	77	75
YF11740V	23	70	75	78	85
YF11935V	17	70	62	70	67
YF11935V	23	70	70	73	70
YF11936V	17	37	40	57	63
YF11936V	23	60	53	63	65
YF11937V	17	33	37	57	58
YF11937V	23	43	53	63	72
Untreated		0	0	0	0
LSD (0.05)		12	11	14	15

No injury occurred. July 24 and August 7 refers to 14 and 28 DAT ratings. Complete foxtail, redroot pigweed, and common cocklebur control was observed. Weed control was erratic between glyphosate formulations but reducing rate of each product resulted in lower lambsquarters and cocklebur control.

Glyphosate timing of application. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Fargo, ND, to evaluate weed control from timing of glyphosate formulations applied POST to non-cropland. POST1 treatments were applied May 18, 2001 at 9:00 am with 68 F air, 65 F soil surface, 45% relative humidity, 30% clouds, 2-8 mph S wind, dry soil surface, and moist subsoil. Weed species present were: 1 to 2 leaf (10-50/ft^2) foxtail; rosette (1/yd^2) wild mustard; 0.5 to 1 inch (1-5/yd^2) wild buckwheat; 1 to 2 leaf (5-20/ft^2) volunteer wheat; rosette to blossom (1/yd^2) common dandelion; and 0.5 to 1 inch (1-5/ft^2) common lambsquarters. POST2 treatments were applied May 25 at 1:00 pm with 70 F air, 55 F soil surface, 42% relative humidity, 75% clouds, 13 mph NW wind, dry soil surface, and moist subsoil. Weed species present were: 2 to 3 leaf (10-40/ft^2) foxtail; 1 to 2 inch (1-3/ft^2) wild buckwheat; 4 leaf T-2 (5-20/ft^2) volunteer wheat; rosette to flowering (1/yd^2) common dandelion; and 1 to 2 inch (1-5/ft^2) common lambsquarters. POST3 treatments were applied June 1 at 12:00 pm with 56 F air, 55 F soil surface, 76% relative humidity, 100% clouds, 13 mph NW wind, moist soil surface, and moist subsoil. Weed species present were: 1 to 8 inch (10-40/ft^2) foxtail; 3 to 5 inch vining (1-3/ft^2) wild buckwheat; 10 to 12 inch (5-20/ft^2) volunteer wheat; flowering (1/yd^2) common dandelion; and 1 to 4 inch (1-5/ft^2) common lambsquarters. POST4 treatments were applied June 8 at 3:00 pm with 84 F air, 85 F soil surface, 38% relative humidity, 50% clouds, 1 mph SW wind, dry soil surface, and moist subsoil. Weed species present were: 1 to 8 inch (10-40/ft^2) foxtail; 10 to 16 inch jointing (5-20/ft^2) volunteer wheat; flowering (1/yd^2) common dandelion; and 1 to 6 inch (1-5/ft^2) common lambsquarters. POST5 treatments were applied June 15 at 10:00 am with 64 F air, 64 F soil surface, 61% relative humidity, 20% clouds, 8-12 mph W wind, moist soil surface, and wet subsoil. Weed species present were: 2 to 8 inch (10-40/ft^2) foxtail; 16 to 24 inch jointing to heading (5-20/ft^2) volunteer wheat; rosette to flowering (1/yd^2) common dandelion; and 10 to 16 inch (1-5/ft^2) common lambsquarters. POST6 treatments were applied June 22 at 10:00 am with 72 F air, 85 F soil surface, 46% relative humidity, 10% clouds, 3 mph NW wind, dry soil surface, and moist subsoil. Weed species present were: 4 to 12 inch (10-40/ft^2) foxtail; heading (5-20/ft^2) volunteer wheat; rosette to flowering (1/yd^2) common dandelion; and 12 to 24 inch (1-5/ft^2) common lambsquarters. POST7 treatments were applied June 29 at 10:00 am with 81 F air, 82 F soil surface, 60% relative humidity, 10% clouds, 11 mph SE wind, dry soil surface, and moist subsoil. Weed species present were: 4 to 12 inch (10-40/ft^2) foxtail; headed (5-20/ft^2) volunteer wheat; flowering (1/yd^2) common dandelion; and 18 to 30 inch (1-5/ft^2) common lambsquarters. Treatments were applied to the center 6.67 feet of the 10 by 40 foot plots with a hooded bicycle-wheel-type plot sprayer for POST treatments number 2 and 3 and a non-hooded bicycle-wheel-type plot sprayer for all other applications. All treatments were sprayed at 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Table. Glyphosate timing of application (Zollinger and Ries).

Treatment[1]	Rate	7 DAT				14 DAT				21 DAT			
		Vwht	Fxtl	Colq	Dali	Vwht	Fxtl	Colq	Dali	Vwht	Fxtl	Colq	Dali
	(product/A)	% control				% control				% control			
POST1													
Roundup Ultra	10.7fl oz	70	70	30	40	90	90	50	40	85	85	30	40
Roundup Ultra	16fl oz	95	90	90	40	99	99	90	60	99	99	50	50
Engame+LI-700	26floz+0.25% v/v	95	95	90	40	95	99	70	50	95	95	50	50
Engame+LI-700	39fl oz+0.25% v/v	95	95	90	40	99	99	70	60	99	99	60	60
Engame+PCC 1133+LI-700	39fl oz+19.2fl oz+0.25% v/v	95	95	55	50	99	99	80	60	95	99	60	60
Landmaster BW	37.5fl oz	85	90	75	45	99	99	90	70	99	99	90	70
POST2													
Roundup Ultra	10.7fl oz	70	70	50	40	80	85	50	30	99	99	70	50
Roundup Ultra	16fl oz	80	80	60	40	99	99	60	50	99	99	75	50
Engame+LI-700	26floz+0.25% v/v	70	70	50	40	99	99	60	50	99	99	75	50
Engame+LI-700	39fl oz+0.25% v/v	85	85	60	40	99	99	70	50	99	99	80	50
Engame+PCC 1133+LI-700	39fl oz+19.2fl oz+0.25% v/v	60	60	60	50	99	99	70	50	99	99	80	50
Landmaster BW	37.5fl oz	50	60	60	50	80	90	95	60	99	99	99	60
POST3													
Roundup Ultra	10.7fl oz	60	70	50	30	99	99	50	40	99	99	60	50
Roundup Ultra	16fl oz	70	80	60	40	99	99	60	50	99	99	75	50
Engame+LI-700	26floz+0.25% v/v	70	80	50	40	99	99	60	50	99	99	75	90
Engame+LI-700	39fl oz+0.25% v/v	75	85	60	40	99	99	70	50	99	99	95	55
Engame+PCC 1133+LI-700	39fl oz+19.2fl oz+0.25% v/v	70	80	60	50	99	99	90	60	99	99	97	65
Landmaster BW	37.5fl oz	65	80	60	60	99	99	80	60	99	99	90	65
POST4													
Roundup Ultra	10.7fl oz	80	90	40	30	99	99	50	40	99	99	99	90
Roundup Ultra	16fl oz	90	95	50	40	99	99	65	50	99	99	99	95
Engame+LI-700	26floz+0.25% v/v	75	90	40	40	99	99	55	50	99	99	99	95
Engame+LI-700	39fl oz+0.25% v/v	80	95	50	40	97	99	75	55	99	99	90	95
Engame+PCC 1133+LI-700	39fl oz+19.2fl oz+0.25% v/v	85	90	50	40	99	99	80	60	99	99	99	80
Landmaster BW	37.5fl oz	70	75	50	50	95	99	70	60	99	99	99	95

[1]LI-700 = surfactant.

Table. cont. Glyphosate timing of application (Zollinger and Ries).

Treatment[1]	Rate	7 DAT				14 DAT				21 DAT			
		Vwht	Fxtl	Colq	Dali	Vwht	Fxtl	Colq	Dali	Vwht	Fxtl	Colq	Dali
	(product/A)	---------- % control ----------				---------- % control ----------				---------- % control ----------			
POST5													
Roundup Ultra	10.7fl oz	75	85	50	40	95	99	85	50	99	99	99	60
Roundup Ultra	16fl oz	80	85	65	50	95	95	85	60	99	99	99	70
Engame+LI-700	26floz+0.25% v/v	80	85	50	40	95	95	85	60	99	99	99	80
Engame+LI-700	39fl oz+0.25% v/v	85	90	50	40	95	95	80	60	99	99	99	80
Engame+PCC 1133+LI-700	39fl oz+19.2fl oz+0.25% v/v	85	95	80	40	95	95	90	65	99	99	99	80
Landmaster BW	37.5fl oz	85	99	50	45	95	90	90	60	99	99	99	70
POST6													
Roundup Ultra	10.7fl oz	30	25	10	5	99	99	99	40	99	99	99	60
Roundup Ultra	16fl oz	40	40	10	5	99	99	99	50	99	99	99	70
Engame+LI-700	26floz+0.25% v/v	50	55	5	5	99	99	99	50	99	99	99	80
Engame+LI-700	39fl oz+0.25% v/v	50	50	15	5	99	99	99	50	99	99	99	80
Engame+PCC 1133+LI-700	39fl oz+19.2fl oz+0.25% v/v	50	50	10	5	99	99	99	50	99	99	99	80
Landmaster BW	37.5fl oz	45	55	15	5	99	99	99	60	99	99	99	80
POST7													
Roundup Ultra	10.7fl oz	10	30	30	0	99	99	99	20	99	99	99	40
Roundup Ultra	16fl oz	30	40	30	0	99	99	99	30	99	99	99	50
Engame+LI-700	26floz+0.25% v/v	30	40	30	0	99	99	9	30	99	99	99	50
Engame+LI-700	39fl oz+0.25% v/v	40	50	40	0	99	99	99	30	99	99	99	50
Engame+PCC 1133+LI-700	39fl oz+19.2fl oz+0.25% v/v	50	60	40	0	99	99	99	30	99	99	99	50
Landmaster BW	37.5fl oz	30	60	40	30	99	99	99	40	99	99	99	50

[1]LI-700 = surfactant.

Volunteer wheat and foxtail were usually completely controlled by 14 DAT. Common lambsquarters was usually controlled by 21 DAT. Lack of common lambsquarters from POST1-3 by 21DAT was due to emergence of other flushes. Landmaster BW usually gave greater dandelion control which may be due to 2,4-D in the formulation. Lower dandelion control rating at POST6-7 was due to poor application from very dense and tall volunteer wheat and foxtail growth.

Timing of Roundup application-Foxhome. Oltmans and Zollinger. An experiment was conducted near Foxhome, MN to evaluate weed control from PRE and POST herbicides. Asgrow '0801' soybean was planted May 17, 2001. PRE treatments were applied May 17, 2001 at 1:00 to 1:15 pm with 75 F air, 75 F soil at a 2 to 4 inch depth, 26% relative humidity, 10% clouds, 10 to 15 mph NW wind, moist soil surface, and moist subsoil. EPOST treatments were applied June 13, 2001 at 5:30 to 5:45 pm with 60 F air, 56 F soil at a 2 to 4 inch depth, 90% relative humidity, 100% clouds, 3 to 7 mph E wind, moist soil surface, moist subsoil, good crop vigor, and no dew present to unifoliate soybean. Weed species present were: 1 to 4 inch, (5-10 plants/m^2) foxtail; 1 to 2 inch, (10-15 plants/ft^2) redroot pigweed; and 1 to 2 inch, (10-15 plants/ft^2) maple-leaved goosefoot. MPOST treatments were applied June 21, 2001 at 1:00 to 2:00 pm with 70 F air, 67 F soil at a 2 to 4 inch depth, 50% relative humidity, 30% clouds, 4 to 10 mph N wind, moist soil surface, moist subsoil, good crop vigor, and no dew present to second trifoliate soybean. Weed species present were: 1 to 5 inch, (1-5 plants/ft^2) foxtail; 1 to 3 inch, (10-15 plants/ft^2) redroot pigweed; and 1 to 2 inch, (15-25 plants/ft^2) maple-leaved goosefoot. POST treatments were applied June 27, 2001 at 10:15 to 10:30 am with 85 F air, 72 F soil at a 2 to 4 inch depth, 55% relative humidity, 50% clouds, 2 to 8 mph SE wind, dry soil surface, moist subsoil, good crop vigor, and no dew present to 4 trifoliate soybean. Weed species present were: 1 to 6 inch, (1-5 plants/ft^2) foxtail; 1 to 6 inch, (20-30 plants/ft^2) redroot pigweed; and 1 to 5 inch, (15-25 plants/ft^2) maple-leaved goosefoot. LPOST treatments were applied July 9, 2001 at 8:30 to 8:45 am with 82 F air, 77 F soil at a 2 to 4 inch depth, 60% relative humidity, 30% clouds, 1 to 4 mph S wind, dry soil surface, dry subsoil, good crop vigor, and no dew present to 10 trifoliate soybean. Weed species present were: 1 to 10 inch, (1-5 plants/ft^2) foxtail; 1 to 14 inch, (25-35 plants/ft^2) redroot pigweed; and 1 to 10 inch, (15-25 plants/ft^2) maple-leaved goosefoot. Treatments were applied to the center 6.67 feet of the 10 by 40 ft plots. PRE treatments were applied with a bicycle-wheel-type plot sprayer equipped with a wind shield delivering 17 gpa at 40 psi through 8002 flat fan nozzles. POST treatments were applied with a bicycle-wheel-type plot sprayer equipped with a wind shield delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with four replicates per treatment.

At 14 days after application (DAA), all treatments had greater than 92% foxtail control, except Roundup UltraMax+Raptor. Redroot pigweed control ranged from 77 to 99%. Maple-leaved goosefoot control ranged from 74 to 99%. All treatments had greater than 93% redroot pigweed control and maple-leaved goosefoot control, except Roundup UltraMax applied LPOST, Roundup UltraMax tank-mixes and conventional herbicide treatments. Weed control ratings 28 DAA were similar to 14 DAA, because of little rainfall throughout the growing season which limited weed seed germination and/or weed seedling growth. At 28 DAA, redroot pigweed control ranged from 74 to 99%. All treatments had greater than 98% redroot pigweed control, except Roundup UltraMax applied LPOST, Roundup UltraMax tank-mixes and conventional herbicide treatments. On August 7, redroot pigweed control ranged from 78 to 99%. All treatments had greater than 90% redroot pigweed control, except Roundup UltraMax applied LPOST and Roundup UltraMax tank-mixes. At 28 DAA and on August 7, all treatments had greater than 94% foxtail control, except Roundup UltraMax+Raptor. Maple-leaved goosefoot control ranged from 73 to 99%. All treatments had greater than 95% maple-leaved goosefoot control, except Roundup UltraMax applied LPOST and Roundup UltraMax+Raptor. There was no additional weed control gained from applying a PRE herbicide. The reduced rates of Roundup UltraMax were effective for weed control.

Treatment[a]	Rate	Application Stage[b]	14 DAA			28 DAA			August 7, 2001		
			Rrpw[c]	Gsft	Fxtl	Rrpw	Gsft	Fxtl	Rrpw	Gsft	Fxtl
	(product/A)		% control								
Authority/RUM+AMS	3oz/26floz	PRE/M	99	99	99	99	99	99	99	99	99
Authority/RUM+AMS	3oz/13floz	PRE/M	99	99	99	99	99	99	99	99	99
Authority/RUM+AMS	3oz/6.5floz	PRE/M	99	99	99	99	99	99	99	99	97
Roundup UltraMax+AMS	26floz	E	99	99	99	98	98	98	99	99	99
Roundup UltraMax+AMS	26floz	M	99	99	98	98	99	99	99	99	99
Roundup UltraMax+AMS	26floz	P	96	96	97	99	99	99	99	99	99
Roundup UltraMax+AMS	26floz	L	78	88	92	81	88	95	81	88	95
RUM+AMS/RUM+AMS	13floz/13floz	M/L	99	99	98	99	98	99	99	98	99
RUM+AMS/RUM+AMS	9.75floz/9.75floz	M/L	96	97	97	99	98	99	99	98	99
RUM+AMS/RUM+AMS	6.5floz/6.5floz	M/L	94	98	98	99	97	99	99	97	99
RUM+AMS/RUM+AMS/ RUM+AMS	6.5floz/6.5floz/ 6.5floz	M/P/L	93	95	96	99	99	99	99	99	99
Extreme+Quad 7	2.25pt	M	97	98	99	96	99	99	95	97	98
RUM+AMS+Raptor	13floz+3floz	M	77	74	75	76	73	70	79	85	73
RUM+AMS+Flexstar	13floz+0.75pt	M	74	76	94	74	96	97	78	95	96
Pursuit+Quad 7	3floz	M	84	88	94	83	97	96	90	96	94
Raptor+Quad 7	4floz	M	89	90	92	92	95	96	97	96	98
Raptor+Quad 7	3floz	M	84	85	98	88	96	98	93	96	97
Valor/RUM+AMS	1.5oz/19.5floz	PRE/M	99	99	99	99	99	99	99	99	99
Valor/RUM+AMS	2oz/19.5floz	PRE/M	99	99	99	99	99	99	99	99	97
Untreated			0	0	0	0	0	0	0	0	0
LSD (0.05)			7	6	5	7	4	4	7	4	5

[a]RUM = Roundup UltraMax; Quad 7 = basic blend at 1% v/v; AMS = ammonium sulfate at 8.5lb/100gal
[b]E = EPOST; M = MPOST; P = POST; L = LPOST
[c]Fxtl = Grft and Yeft; Gsft = maple-leaved goosefoot

Timing of Roundup application-Mooreton. Oltmans and Zollinger. An experiment was conducted near Mooreton, ND to evaluate weed control from PRE and POST herbicides. Asgrow '0801' soybean was planted May 14, 2001. PRE treatments were applied May 15, 2001 at 8:00 to 8:15 am with 83 F air, 64 F soil at a 2 to 4 inch depth, 52% relative humidity, 80% clouds, 1 to 3 mph S wind, dry soil surface, moist subsoil. EPOST treatments were applied June 16, 2001 at 11:30 to 11:45 am with 75 F air, 60 F soil at a 2 to 4 inch depth, 35% relative humidity, 20% clouds, 6 to 10 mph W wind, moist soil surface, moist subsoil, good crop vigor, and no dew present to first to second trifoliate soybean. Weed species present were: 1 to 3 inch, (25-35 plants/plot) common lambsquarters; 1 to 3 inch, (5-10 plants/ft^2) redroot pigweed; and 1 to 3 inch, (5-10 plants/m^2) wild proso millet. MPOST treatments were applied June 21, 2001 at 9:15 to 10:15 am with 61 F air, 62 F soil at a 2 to 4 inch depth, 70% relative humidity, no clouds, 2 to 8 mph N wind, moist soil surface, moist subsoil, good crop vigor, and no dew present to 3 to 4 trifoliate soybean. Weed species present were: 1 to 6 inch, (1-5 plants/m^2) common lambsquarters; 1 to 6 inch, (15-25 plants/ft^2) redroot pigweed; and 1 to 6 inch, (5-10 plants/m^2) wild proso millet. POST treatments were applied June 27, 2001 at 12:15 to 12:30 pm with 92 F air, 75 F soil at a 2 to 4 inch depth, 48% relative humidity, 30% clouds, 4 to 10 mph SE wind, dry soil surface, moist subsoil, good crop vigor, and no dew present to 5 trifoliate soybean. Weed species present were: 1 to 7 inch, (1-5 plants/m^2) common lambsquarters; 1 to 7 inch, (20-30 plants/ft^2) redroot pigweed; and 1 to 7 inch, (5-10 plants/m^2) wild proso millet. LPOST treatments were applied July 9, 2001 at 10:30 to 10:45 am with 92 F air, 78 F soil at a 2 to 4 inch depth, 57% relative humidity, 5% clouds, 3 to 6 mph W wind, dry soil surface, moist subsoil, good crop vigor, and no dew present to 10 trifoliate soybean. Weed species present were: 1 to 12 inch, (1-5 plants/m^2) common lambsquarters; 1 to 14 inch, (25-35 plants/ft^2) redroot pigweed; and 1 to 14 inch, (5-10 plants/m^2) wild proso millet. Treatments were applied to the center 6.67 feet of the 10 by 40 ft plots. PRE treatments were applied with a bicycle-wheel-type plot sprayer delivering 17 gpa at 40 psi through 8002 flat fan nozzles. POST treatments were applied with a bicycle-wheel-type-plot sprayer equipped with a wind shield delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with four replicates per treatment.

At 14 and 28 days after application (DAA), all treatments had greater than 90% redroot pigweed and 92% wild proso millet control. At 14 DAA and 28 DAA, all treatments had greater than 91 and 95% wild proso millet and common lambsquarters control, respectively, except Roundup UltraMax+Raptor. Weed control ratings on August 7 were similar to 14 and 28 DAA, because of little rainfall throughout the growing season which limited weed seed germination and/or weed seedling growth. On August 7, all treatments had greater than 90% redroot pigweed and common lambsquarters control, and greater than 92% wild proso millet control. There was no additional weed control gained from applying a PRE herbicide. The reduced rates of Roundup UltraMax were effective for weed control.

Treatment[a]	Rate	Application Stage[b]	14 DAA			28 DAA			August 7, 2001		
			Rrpw[c]	Colq	Wipm	Rrpw	Colq	Wipm	Rrpw	Colq	Wipm
	(product/A)		% control								
Authority/RUM+AMS	3oz/26floz	PRE/M	99	99	99	99	99	99	99	99	99
Authority/RUM+AMS	3oz/13floz	PRE/M	99	99	99	99	99	99	99	99	99
Authority/RUM+AMS	3oz/6.5floz	PRE/M	99	99	99	99	99	99	99	99	99
Roundup UltraMax+AMS	26floz	E	99	99	99	98	99	99	99	99	98
Roundup UltraMAx+AMS	26floz	M	99	99	99	99	99	99	99	99	99
Roundup UltraMax+AMS	26floz	P	99	99	99	99	99	99	99	99	99
Roundup UltraMax+AMS	26floz	L	90	91	92	90	95	98	90	95	98
Roundup UltraMax+AMS/ Roundup UltraMax +AMS	13floz/13floz	M/L	99	99	99	99	99	99	99	99	99
Roundup UltraMax+AMS/ Roundup UltraMax+AMS	9.75floz/9.75floz	M/L	98	99	99	99	99	99	99	99	99
Roundup UltraMax+AMS/ Roundup UltraMax+AMS	6.5floz/6.5floz	M/L	96	97	99	99	99	99	99	99	99
Roundup UltraMax+AMS/ Roundup UltraMax+AMS/ Roundup UltraMax+AMS	6.5floz/6.5floz/ 6.5floz	M/P/L	98	97	99	99	99	99	99	99	99
Extreme+Quad 7	2.25pt	M	99	99	99	99	99	99	99	99	99
RUM+AMS+Raptor	13floz+3floz	M	94	83	96	90	85	91	90	90	92
RUM+AMS+Flexstar	13floz+0.75pt	M	99	99	99	94	98	99	96	99	97
Pursuit+Quad 7	3floz	M	96	96	99	98	99	99	99	99	99
Raptor+Quad 7	4floz	M	95	97	99	98	99	99	97	99	99
Raptor+Quad 7	3floz	M	97	98	99	98	98	99	98	99	99
Valor/Roundup UltraMax+AMS	1.5oz/19.5floz	PRE/M	99	99	99	99	99	99	97	99	99
Valor/Roundup Ultra+AMS	2oz/19.5floz	PRE/M	99	99	99	99	99	99	99	99	97
Untreated			0	0	0	0	0	0	0	0	0
LSD (0.05)			4	4	3	4	4	2	4	2	3

[a]RUM = Roundup UltraMax; Quad 7 = basic blend at 1% v/v; AMS = ammonium sulfate at 8.5lb/100gal

[b]E = EPOST; M = MPOST; P = POST; L = LPOST

[c]Fxtl = Grft and Yeft; Wipm = wild proso millet

POST soybean herbicides with adjuvants in dry edible bean. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Prosper, ND, to evaluate weed control in dry edible beans using herbicides with a combination of a adjuvants applied POST. Two rows of 'Navigator' navy and 'Winchester' pinto bean were planted in each plot on June 26, 2001. POST treatments were applied July 12, at 9:00 am with 73 F air, 77 F soil surface, 57% relative humidity, 0% clouds, 4 mph NE wind, dry soil surface, moist subsoil, good crop vigor, and no dew present to V-2 to V-3 dry bean. Weed species present were: 3 to 12 inch (5-30/yd^2) foxtail; 2 to 4 inch (1-2/yd^2) redroot pigweed; 2 to 5 inch (1-3/yd^2) common lambsquarters; and 1 to 5 inch (1/yd^2) hairy nightshade. Treatments were applied to the center 6.67 feet of the 10 by 40 foot plots with a bicycle-wheel-type plot sprayer delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Table. POST soybean herbicides with adjuvants in dry edible bean (Zollinger and Ries).

		July 26			August 9		
Treatment[1]	Rate	Fxtl	Rrpw	Colq	Fxtl	Rrpw	Colq
	(product/A)	---------- % control ----------			---------- % control ----------		
Raptor+Soy-Stik+28-0-0	4 fl oz+1% v/v	90	99	99	99	99	99
Raptor+WC00	4 fl oz+1% v/v	67	80	56	66	73	40
Raptor+WC013	4 fl oz+1% v/v	87	99	85	96	99	93
Raptor+Premium COC+28-0-0	4 fl oz+1% v/v	82	96	95	98	99	99
Raptor+Linkage	4 fl oz+1% v/v	67	72	63	70	75	80
Raptor+Premier 90+28-0-0	4 fl oz+0.25% v/v	82	89	50	91	93	85
Raptor+WC007+28-0-0	4 fl oz+0.5% v/v	85	91	50	96	96	99
Raptor+L-64	5 fl oz+1% v/v	80	86	70	93	99	70
Raptor+LI-177	5 fl oz+0.5% v/v	83	99	80	62	99	80
Raptor+Sub 4+3	5 fl oz+1% v/v	43	73	30	30	70	20
Raptor+Sub 4 MSO	5 fl oz+1% v/v	75	98	50	86	99	60
Raptor+ Dispatch111	5 fl oz+1% v/v	73	93	80	85	96	70
Raptor+LI-222	5 fl oz+1% v/v	78	93	99	88	96	92
Raptor+LI-227	5 fl oz+1% v/v	90	98	90	96	99	99
Rezult+Premium COC+28-0-0	1.6pt+1.6pt+1pt	89	76	40	99	86	60
Rezult+WC00	1.6pt+1.6pt+1% v/v	92	83	70	99	93	61
Rezult+Linkage	1.6pt+1.6pt+1% v/v	72	70	80	83	80	66
Rezult+WC013	1.6pt+1.6pt+1% v/v	92	66	79	99	66	66
Rezult+WC007+28-0-0	1.6pt+1.6pt+0.5% v/v	95	85	72	99	89	65
Reflex+WC00	0.75pt+1% v/v	-	77	66	-	90	63
Reflex+WC013	0.75pt+1% v/v	-	70	70	-	83	62
Reflex+Premium COC+28-0-0	0.75pt+1% v/v	-	67	83	-	83	69
Reflex+Linkage	0.75pt+1% v/v	-	37	66	-	27	69
Reflex+Premier90+28-0-0	0.75 pt+0.25% v/v	-	40	50	-	70	50
Relex+Scoil	0.75pt+1.5pt	-	89	80	-	95	87
LSD (0.05)		8	12	13	14	11	11

[1]Soy-Stik = methylated seed oil; 28-0-0 = urea ammonium nitrate at 1 qt/A; WC00 = proprietary adjuvant of West Central Inc.; WC013 = methylated seed oil based basic blend; Premium COC = petroleum oil concentrate; Linkage = basic blend adjuvant; Premier 90 = surfactant; WC007 = crop oil concentrate/surfactant blend; L-64 = proprietary experimental adjuvant from North Dakota State University; LI-177, LI-222, and LI-227 = proprietary adjuvant from Loveland Industries; Sub 4+3 = herbicide enhancement spray adjuvant; Sub 4 MSO = methylated seed oil; Dispatch 111 = basic blend adjuvant.

No dry bean injury was observed. Weed rating were variable. Weed ratings for Raptor + Sub 4+3 adjuvant usually were lower than Raptor with other adjuvants.