

Warm season grass establishment systems in 1996 with 1997 residual year yields at Rosemount, MN Becker, Roger L. and Douglas W. Miller. The objective of this study was to observe the effects of various herbicide treatments and cultural establishment methods on weed control, crop injury, and establishment of five warm season grass species. The experiment was established in 1996 at Rosemount, MN on a Waukegon silt loam soil. The previous crop was soybeans. The plot area was chisel plowed the previous fall. In May 1996, 50 lbs/A N was applied and the plot area was disked once. The area was field cultivated twice one week prior to seeding, killing large populations of giant foxtail and pigweed. A final tillage was performed just prior to seeding with a C-shank field cultivator/cultipacker. The experiment was seeded on June 20 with a cone type seeder. Big bluestem, sideoats grama, Indiangrass, little bluestem, and switchgrass were seeded at rates of 10, 10, 10, 7, and 5 pounds pure live seed per acre respectively. All seed was "de-bearded" to facilitate seeding. The experimental design was a split block. Whole plots were grass species planted in strips 5 feet wide. Sub plots consisted of preemergence or postemergence herbicide treatments or combinations of oat cover crop and clipping treatments. The sub plot treatments were applied to strips 10 feet wide across the five grass species. Preemergence herbicide treatments were applied after planting. Postemergence herbicide applications were made on July 10. The clipping treatments were applied on July 27 and again on August 15. Plant residue was removed from the plot area on July 27 for the oat companion + clip treatment but was left on the plot area for the August clip. Residue was left on the plot areas for both clipping dates with the no herbicide + clip treatment. In July 1997, yields were determined by harvesting a 21 ft² area within each plot. Percentages of warm season grasses, broadleaf and grass weeds were determined by visual observation and hand separations.

Application data

Treatment	Preemergence	Postemergence	Clip
Date Treated	6-20-96	7-10-96	7-27-96
Time	8:00-9:00 pm	11:00-12:00 am	--
Big Bluestem			
Height (inch)	--	0.5-1.5	3-4
Leaf stage	--	1-3	--
Indiangrass			
Height (inch)	--	0.5-2	3-4
Leaf stage	--	1-3	--
Little Bluestem			
Height (inch)	--	0.25-1	3-4
Leaf stage	--	1-2	--
Sideoats- grama			
Height (inch)	--	0.75-2.5	3-4
Leaf stage	--	2-4	--
Switchgrass			
Height (inch)	--	0.5-2	3-4
Leaf stage	--	1-3	--
Colq			
Density (#/yd ²)	--	2	--
Height (inch)	--	1-4"	5-15
Ebns			
Density (#/yd ²)	--	1	--
Height (inch)	--	0.5-2"	5-12
Rrpw			
Density (#/yd ²)	--	6	--
Height (inch)	--	0.5-5"	10-20
Vele			
Densiyt (#/yd ²)	--	1	--
Height (inch)	--	2-6	10-15
Gift			
Density (#/yd ²)	--	3	--
Height (inch)	--	4-8	10-20
Oats			
Height (inch)	--	4-6	12-14
Stage	--	3-4 leaf	flag-boot

Application data (cont.)

Date Treated	6-20-96	7-10-96	7-27-96
Wind (mph)	calm	calm	--
Temperature (°F)			
Air	63	70	--
Soil	68	50	--
Soil Moisture	moist at 0.5"	moist	--
Relative Humidity (%)	46	29	--
Cloud Cover (%)	clear	30	--

Imazameth resulted in poor stands of switchgrass the seeding year at all rates tested but the lower rates did cause less injury applied PRE or POST based on stand establishment. The 0.63 and 0.47 lb ai/A rate of imazameth applied PRE resulted in less stand reduction compared with POST applications and resulted in the highest residual forage yield. Stand reduction or yield did not differ within application timing between these two rates of imazameth. Little bluestem showed poor to moderate tolerance to imazameth with stand reductions of 43% or more in 1996, with stand reduction reduced to 27 to 40% at the lowest rates, 0.047 and 0.063 by the second year. There was a slight trend for improved establishment of little bluestem with PRE application of imazameth. The lowest rates, 0.047 and 0.063 lb ai/A PRE clearly resulted in the best residual year forage yield compared with POST applications, or with PRE or POST applications at the highest two rates, 0.125 and 0.188 lb/A. Big bluestem showed excellent tolerance to imazameth applied either POST or PRE at all rates tested. By season's end, big bluestem stands typically ranged from 61 to 91% of full stand. Yields did not differ within application method across rates. The only significant difference in residual yields was with 0.047 and 0.063 PRE, which were significantly higher than that obtained with 0.188 applied POST. Indiangrass showed moderate tolerance to imazameth. Rates of imazameth of 0.063 lb or lower resulted in the best stands and residual yield. Slightly better stands, but clearly better residual year forage yields were obtained with PRE applications.

Imazamox (0.047) PRE and POST resulted in moderate to excellent stands of all grass species tested. Little bluestem and Indiangrass had the least tolerance with establishment year season end stands reduced 36 to 52%. Tolerance of switchgrass, sideoats grama, and big bluestem was good to excellent at the 0.047 lb rate tested whether applied PRE or POST. High residual forage yields were obtained with all species.

Imazethapyr at 0.063 lb resulted in moderate stands of little bluestem, Indiangrass, and switchgrass. Tolerance was equal to or better for each of these species when applied PRE compared with POST. Big bluestem and sideoats grama had good to excellent tolerance to imazethapyr whether applied PRE or POST. Residual year yields were high relative to other treatments with imazethapyr despite stand and growth reductions, and yields were equal to or higher with PRE applications compared with POST.

Use of metsulfuron-methyl (0.018) resulted in very poor stands of Indiangrass the establishment year when applied POST and poor Indiangrass stands applied PRE. Both application methods resulted in more than 70% stand reduction the second year. Little bluestem also showed moderate and poor tolerance to metsulfuron applied PRE and POST, respectively. Switchgrass, sideoats grama, and big bluestem showed good tolerance POST and good to excellent tolerance PRE to metsulfuron.

The use of atrazine resulted in poor to moderate stands of little bluestem and Indiangrass. Sideoats grama showed moderate to good tolerance and switchgrass and big bluestem good tolerance to atrazine. Residual year yields reflected establishment year crop tolerance with the best yield within species with atrazine on switchgrass.

Use of no herbicide and allowing weeds to complete with warm season grasses resulted in poor stands of all species, similar to 1995 establishment trials. The establishment season had adequate moisture just

after seeding and throughout the critical establishment period such that warm season grasses emerged uniformly, yet weeds greatly reduced successful establishment similar to 1995. Switchgrass, big bluestem and to a lesser degree, sideoats grama produced good residual year forage yields with clipping but without herbicide use to manage weeds. Indiangrass and little bluestem did not yield well without herbicide use. Clipping treatments resulted in some scalping and damaged crowns, but plants seemed to recover by the second year.

Weed control was excellent with all rates of imazameth tested applied PRE or POST, with the exception of POST treatments giving poor to fair control of common lambsquarter. Imazamox provided excellent control of eastern black nightshade and redroot pigweed applied PRE or POST, fair control of giant foxtail, common lambsquarter, and velvetleaf applied PRE, and fair to good control of common lambsquarter POST. Imazethapyr provided excellent control with the exception of poor common lambsquarter control POST, and fair to good velvetleaf control PRE. Metsulfuron and atrazine provided only moderate suppression of giant foxtail, but enough to release warm season grass seedlings. Metsulfuron appeared to release eastern black nightshade from competition with other weeds as well, which would be an issue if seedbanks were present and establishment year grazing was desired. Clipping provided fair control of weeds.

Table 1. Warm Season Grass Establishment Systems at Rosemount, MN - 1996 (Becker and Miller).

Treatment	Timing	Rate (lb ai/A)	Switchgrass						Yield		
			Growth reduction		Stand reduction		Wsg ¹	Brdlf ²	Grs ³		
			8/27/96	6/23/97	10/28/96	6/23/97				(Ton/A)	
Imazamox	Pre	0.047	16	0	22	8	3.19	0.00	0.00		
Imazamox + X-77 ⁴ + 28%N ⁵	Post	0.047 + 0.25% + 1.25%	33	0	25	8	3.30	0.00	0.00		
Imazameth	Pre	0.047	40	0	60	32	2.97	0.00	0.00		
Imazameth + X-77 + 28%N	Post	0.047 + 0.25% + 1.25%	49	12	91	49	1.74	0.00	0.01		
Imazameth	Pre	0.063	60	0	75	49	2.43	0.00	0.00		
Imazameth + X-77 + 28%N	Post	0.063 + 0.25% + 1.25%	49	0	85	62	1.59	0.00	0.00		
Imazameth	Pre	0.125	86	0	97	96	0.25	0.00	0.00		
Imazameth + X-77 + 28%N	Post	0.125 + 0.25% + 1.25%	83	0	98	100	0.09	0.00	0.00		
Imazameth	Pre	0.188	90	0	99	99	0.06	0.00	0.00		
Imazameth + X-77 + 28%N	Post	0.188 + 0.25% + 1.25%	92	0	99	99	0.55	0.00	0.00		
Imazethapyr	Pre	0.063	45	0	32	17	3.01	0.00	0.03		
Imazethapyr + X-77 + 28%N	Post	0.063 + 0.25% + 1.25%	29	22	58	26	2.36	0.00	0.01		
Metsulfuron	Pre	0.018	14	0	19	8	3.34	0.00	0.01		
Metsulfuron + X-77 + 28%N	Post	0.018 + 0.25% + 1.25%	14	12	30	28	2.56	0.00	0.24		
Atrazine	Pre	2.0	20	0	20	14	2.85	0.00	0.08		
Atrazine + X-77 + 28%N	Post	2.0 + 0.25% + 1.25%	4	0	14	7	3.46	0.00	0.05		
Check	--	--	48	32	69	79	0.28	0.10	0.90		
No herbicide + clip	--	--	36	5	36	21	2.28	0.01	0.04		
Oat companion + clip	--	--	--	28	86	58	1.09	0.21	0.32		
Oat companion + (sethoxydim + COC) ⁶	--	(0.188 + 1.25%)	72	0	100	100	0.01	0.97	0.01		
LSD (0.05)			18	22	15	14	0.72	0.18	0.28		

¹ Wsg = warm season grass.

² Brdlf = Broadleaf weeds.

³ Grs = grassy weeds.

⁴ X-77 = X-77 nonionic surfactant.

⁵ 28%N = 28% UAN fertilizer solution.

⁶ Poast Plus 1E + Class crop oil concentrate applied postemergence July 27, 1996.

Table 2. Warm Season Grass Establishment Systems at Rosemount, MN - 1996 (Becker and Miller).

Treatment	Timing	Rate (lb ai/A)	Little Bluestem				Yield		
			Growth reduction		Stand reduction		Wsg ¹	Brdlf ²	Grs ³
			8/27/96	6/23/97	10/28/96	6/23/97			
Imazamox	Pre	0.047	21	0	46	16	2.17	0.01	0.36
Imazamox + X-77 ⁴ + 28%N ⁵	Post	0.047 + 0.25% + 1.25%	30	0	52	25	2.16	0.00	0.01
Imazameth	Pre	0.047	31	0	44	27	2.68	0.00	0.03
Imazameth + X-77 + 28%N	Post	0.047 + 0.25% + 1.25%	27	28	69	41	1.60	0.01	0.00
Imazameth	Pre	0.063	28	0	48	33	2.59	0.00	0.00
Imazameth + X-77 + 28%N	Post	0.063 + 0.25% + 1.25%	29	0	64	40	1.85	0.00	0.02
Imazameth	Pre	0.125	46	0	58	56	1.41	0.00	0.00
Imazameth + X-77 + 28%N	Post	0.125 + 0.25% + 1.25%	40	18	57	42	1.25	0.00	0.00
Imazameth	Pre	0.188	63	0	64	62	1.01	0.00	0.00
Imazameth + X-77 + 28%N	Post	0.188 + 0.25% + 1.25%	59	0	72	70	0.63	0.00	0.00
Imazethapyr	Pre	0.063	32	0	48	27	2.07	0.01	0.04
Imazethapyr + X-77 + 28%N	Post	0.063 + 0.25% + 1.25%	25	25	69	38	1.44	0.02	0.17
Metsulfuron	Pre	0.018	28	0	48	37	1.86	0.00	0.67
Metsulfuron + X-77 + 28%N	Post	0.018 + 0.25% + 1.25%	29	29	62	45	0.92	0.00	0.91
Atrazine	Pre	2.0	36	0	60	50	0.59	0.01	1.49
Atrazine + X-77 + 28%N	Post	2.0 + 0.25% + 1.25%	15	0	51	39	1.07	0.00	0.74
Check	--	--	28	0	87	84	0.09	0.22	1.40
No herbicide + clip	--	--	30	0	79	45	0.95	0.03	0.71
Oat companion + clip	--	--	--	19	98	84	0.49	0.57	0.28
Oat companion + (sethoxydim + COC) ⁶	--	(0.188 + 1.25%)	--	0	100	100	0.00	0.93	0.16
LSD (0.05)			16	ns	21	20	0.82	0.24	0.60

¹ Wsg = warm season grass.

² Brdlf = Broadleaf weeds.

³ Grs = grassy weeds.

⁴ X-77 = X-77 nonionic surfactant.

⁵ 28%N = 28% UAN fertilizer solution.

⁶ Poast Plus 1E + Class crop oil concentrate applied postemergence July 27, 1996.

Table 3. Warm Season Grass Establishment Systems at Rosemount, MN - 1996 (Becker and Miller).

Treatment	Timing	Rate (lb ai/A)	Sideoats grama						Yield		
			Growth reduction		Stand reduction		Wsg ¹	Brdlf ²	Grs ³		
			8/27/96	6/23/97	10/28/96	6/23/97				(Ton/A)	
Imazamox	Pre	0.047	26	18	18	23	2.17	0.00	0.02		
Imazamox + X-77 ⁴ + 28%N ⁵	Post	0.047 + 0.25% + 1.25%	36	0	17	16	1.77	0.00	0.00		
Imazameth	Pre	0.047	67	0	49	46	0.56	0.00	0.00		
Imazameth + X-77 + 28%N	Post	0.047 + 0.25% + 1.25%	34	20	21	22	1.45	0.00	0.00		
Imazameth	Pre	0.063	73	0	49	54	0.46	0.00	0.00		
Imazameth + X-77 + 28%N	Post	0.063 + 0.25% + 1.25%	36	19	21	41	1.26	0.00	0.00		
Imazameth	Pre	0.125	77	15	72	76	0.00	0.00	0.00		
Imazameth + X-77 + 28%N	Post	0.125 + 0.25% + 1.25%	47	26	39	72	0.46	0.00	0.00		
Imazameth	Pre	0.188	87	0	79	68	0.00	0.00	0.00		
Imazameth + X-77 + 28%N	Post	0.188 + 0.25% + 1.25%	67	38	44	51	0.07	0.00	0.00		
Imazethapyr	Pre	0.063	29	0	25	32	2.07	0.00	0.01		
Imazethapyr + X-77 + 28%N	Post	0.063 + 0.25% + 1.25%	14	16	16	15	1.88	0.00	0.00		
Metsulfuron	Pre	0.018	2	0	7	38	2.81	0.00	0.03		
Metsulfuron + X-77 + 28%N	Post	0.018 + 0.25% + 1.25%	9	0	19	18	1.88	0.00	0.21		
Atrazine	Pre	2.0	35	0	35	44	1.34	0.00	0.64		
Atrazine + X-77 + 28%N	Post	2.0 + 0.25% + 1.25%	12	0	18	29	1.34	0.00	0.61		
Check	--	--	40	12	48	84	0.75	0.03	0.83		
No herbicide + clip	--	--	47	15	19	15	1.97	0.01	0.04		
Oat companion + clip	--	--	45	12	88	46	1.24	0.08	0.14		
Oat companion + (sethoxydim + COC) ⁶	--	(0.188 + 1.25%)	52	18	99	84	0.08	0.91	0.00		
LSD (0.05)			16	ns	18	39	0.62	0.07	0.45		

¹ Wsg = warm season grass.

² Brdlf = Broadleaf weeds.

³ Grs = grassy weeds.

⁴ X-77 = X-77 nonionic surfactant.

⁵ 28%N = 28% UAN fertilizer solution.

⁶ Poast Plus 1E + Class crop oil concentrate applied postemergence July 27, 1996.

Table 4. Warm Season Grass Establishment Systems at Rosemount, MN - 1996 (Becker and Miller).

Treatment	Timing	Rate (lb ai/A)	Indiangrass				Yield		
			Growth reduction		Stand reduction		Wsg ¹	Brdlf ²	Grs ³
			8/27/96	6/23/97	10/28/96	6/23/97			
Imazamox	Pre	0.047	21	0	36	16	2.21	0.01	0.24
Imazamox + X-77 ⁴ + 28%N ⁵	Post	0.047 + 0.25% + 1.25%	59	8	44	30	2.36	0.00	0.02
Imazameth	Pre	0.047	17	5	39	15	3.04	0.00	0.00
Imazameth + X-77 + 28%N	Post	0.047 + 0.25% + 1.25%	28	5	48	28	1.97	0.00	0.00
Imazameth	Pre	0.063	21	2	41	20	2.90	0.00	0.00
Imazameth + X-77 + 28%N	Post	0.063 + 0.25% + 1.25%	32	10	55	24	1.88	0.00	0.01
Imazameth	Pre	0.125	36	0	54	36	2.32	0.00	0.00
Imazameth + X-77 + 28%N	Post	0.125 + 0.25% + 1.25%	47	18	64	30	1.70	0.00	0.00
Imazameth	Pre	0.188	44	0	58	49	2.06	0.00	0.00
Imazameth + X-77 + 28%N	Post	0.188 + 0.25% + 1.25%	65	15	65	51	1.07	0.00	0.00
Imazethapyr	Pre	0.063	20	0	32	14	2.76	0.00	0.03
Imazethapyr + X-77 + 28%N	Post	0.063 + 0.25% + 1.25%	32	12	59	41	2.01	0.00	0.13
Metsulfuron	Pre	0.018	40	0	77	74	0.12	0.00	1.86
Metsulfuron + X-77 + 28%N	Post	0.018 + 0.25% + 1.25%	56	0	95	72	0.02	0.00	2.06
Atrazine	Pre	2.0	56	0	72	42	0.57	0.00	1.45
Atrazine + X-77 + 28%N	Post	2.0 + 0.25% + 1.25%	40	0	61	54	1.06	0.01	1.08
Check	--	--	49	0	82	70	0.07	0.25	1.14
No herbicide + clip	--	--	50	0	62	35	0.96	0.02	0.80
Oat companion + clip	--	--	--	0	99	79	0.20	0.41	0.46
Oat companion + (sethoxydim + COC) ⁶	--	(0.188 + 1.25%)	--	0	100	100	0.01	0.89	0.04
LSD (0.05)			22	ns	19	25	0.82	0.22	0.52

¹ Wsg = warm season grass.

² Brdlf = Broadleaf weeds.

³ Grs = grassy weeds.

⁴ X-77 = X-77 nonionic surfactant.

⁵ 28%N = 28% UAN fertilizer solution.

⁶ Poast Plus 1E + Class crop oil concentrate applied postemergence July 27, 1996.

Table 5. Warm Season Grass Establishment Systems at Rosemount, MN - 1996 (Becker and Miller).

Treatment	Timing	Rate (lb ai/A)	Big Bluestem						
			Growth reduction		Stand reduction		Yield		
			8/27/96	6/23/97	10/28/96	6/23/97	Wsg ¹	Brdlf ²	Grs ³
			-----		-----		-----		
			(%)		(Ton/A)				
Imazamox	Pre	0.047	33	0	12	6	2.38	0.00	0.02
Imazamox + X-77 ⁴ + 28%N ⁵	Post	0.047 + 0.25% + 1.25%	48	0	30	15	2.52	0.00	0.00
Imazameth	Pre	0.047	18	0	9	5	2.90	0.00	0.00
Imazameth + X-77 + 28%N	Post	0.047 + 0.25% + 1.25%	14	0	20	13	2.38	0.00	0.00
Imazameth	Pre	0.063	23	0	18	10	2.98	0.00	0.00
Imazameth + X-77 + 28%N	Post	0.063 + 0.25% + 1.25%	12	2	20	10	2.68	0.00	0.00
Imazameth	Pre	0.125	34	8	25	19	2.68	0.00	0.00
Imazameth + X-77 + 28%N	Post	0.125 + 0.25% + 1.25%	12	8	21	11	2.35	0.00	0.00
Imazameth	Pre	0.188	43	10	39	30	2.47	0.00	0.00
Imazameth + X-77 + 28%N	Post	0.188 + 0.25% + 1.25%	25	10	20	23	2.02	0.00	0.00
Imazethapyr	Pre	0.063	24	0	15	6	2.57	0.00	0.02
Imazethapyr + X-77 + 28%N	Post	0.063 + 0.25% + 1.25%	19	10	20	11	2.34	0.00	0.00
Metsulfuron	Pre	0.018	11	8	18	10	2.59	0.00	0.10
Metsulfuron + X-77 + 28%N	Post	0.018 + 0.25% + 1.25%	38	29	36	27	0.99	0.00	0.72
Atrazine	Pre	2.0	12	0	21	14	1.86	0.00	0.53
Atrazine + X-77 + 28%N	Post	2.0 + 0.25% + 1.25%	28	10	31	24	1.14	0.00	0.92
Check	--	--	32	30	82	32	0.48	0.13	1.12
No herbicide + clip	--	--	54	5	50	14	2.11	0.06	0.03
Oat companion + clip	--	--	--	30	99	36	1.22	0.13	0.29
Oat companion + (sethoxydim + COC) ⁶	--	(0.188 + 1.25%)	--	0	99	98	0.14	0.79	0.00
LSD (0.05)			21	ns	16	16	0.74	0.16	0.56

¹ Wsg = warm season grass.

² Brdlf = Broadleaf weeds.

³ Grs = grassy weeds.

⁴ X-77 = X-77 nonionic surfactant.

⁵ 28%N = 28% UAN fertilizer solution.

⁶ Poast Plus 1E + Class crop oil concentrate applied postemergence July 27, 1996.

Table 6. Warm Season Grass Establishment Systems at Rosemount, MN - 1996 (Becker and Miller).

Treatment	Timing	Rate (lb ai/A)	Weed control (8/27/96)				
			Gift	Colq	Ebns	Rrpw	Vele

			(%)				
Imazamox	Pre	0.047	74	84	100	100	78
Imazamox + X-77 ¹ + 28%N ²	Post	0.047 + 0.25% + 1.25%	90	80	100	99	100
Imazameth	Pre	0.047	99	100	100	100	90
Imazameth + X-77 + 28%N	Post	0.047 + 0.25% + 1.25%	100	35	100	100	100
Imazameth	Pre	0.063	100	100	100	100	92
Imazameth + X-77 + 28%N	Post	0.063 + 0.25% + 1.25%	100	46	100	100	100
Imazameth	Pre	0.125	100	100	100	100	100
Imazameth + X-77 + 28%N	Post	0.125 + 0.25% + 1.25%	100	46	100	100	100
Imazameth	Pre	0.188	100	100	100	100	100
Imazameth + X-77 + 28%N	Post	0.188 + 0.25% + 1.25%	100	61	100	100	100
Imazethapyr	Pre	0.063	89	98	90	100	82
Imazethapyr + X-77 + 28%N	Post	0.063 + 0.25% + 1.25%	96	39	100	100	90
Metsulfuron	Pre	0.018	55	100	42	100	88
Metsulfuron + X-77 + 28%N	Post	0.018 + 0.25% + 1.25%	44	100	36	100	99
Atrazine	Pre	2.0	48	100	100	100	81
Atrazine + X-77 + 28%N	Post	2.0 + 0.25% + 1.25%	38	100	100	100	70
Check	--	--	0	0	0	0	0
No herbicide + clip	--	--	62	50	60	51	89
Oat companion + clip	--	--	79	82	61	64	89
Oat companion + (sethoxydim + COC) ³	--	(0.188 + 1.25%)	97	52	49	32	45
LSD (0.05)			20	19	18	11	17

¹ X-77 = X-77 nonionic surfactant.

² 28%N = 28% UAN fertilizer solution.

³ Poast Plus 1E + Class crop oil concentrate applied postemergence July 27, 1996.