Warm season grass establishment systems in 1997 with 1998 residual year yields at Rosemount, MN Becker, Roger L., Craig C. Sheaffer, Douglas W. Miller, Douglas R. Swanson, and Bradley D. Kinkaid. 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 1997 at Rosemount, MN on a Waukegon silt loam soil. The previous crop was soybeans. The plot area was chisel plowed the previous fall. In April 1997, 50 lbs/A N was applied and the plot area was disked once. Glyphosate (1 lb ae/A) was applied on June 10. One day prior to seeding on June 17, the area was disked once, field cultivated once, and tilled with a C-shank field cultivator/cultipacker. The experiment was seeded with a cone type seeder. Big bluestem ('Bonilla'), sideoats grama (variety not known), Indiangrass ('Tomahawk'), and switchgrass ('Forestburg') were seeded at rates of 10, 10, 10, and 5 pounds pure live seed per acre, respectively. All seed was "de-bearded" to facilitate seeding. Little bluestem was not seeded in 1997, however, due to complications planting seed that had not been debearded and impending rain which prevented hand seeding little bluestem. 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 four grass species. Preemergence herbicide treatments were applied after planting. Postemergence herbicide applications were made on July 16. The clipping treatments were applied on July 28 (after emergence of warm season grasses) when weeds were 12-20 inches tall and the oats were in the early heading stage. In July 1998, yields were determined by harvesting a 21 ft^2 area within each plot.

Application data

Treatment	Preemergence	Postemergence
Date Treated	6-17-97	7-16-97
Time	2:00-2:45 pm	10:00-11:00 am
Big Bluestem		
Height (inch)	--	0.5-2
Leaf stage	--	1-4
Indiangrass		
Height (inch)	--	1-2
Leaf stage	--	1-3
Sideoats grama		
Height (inch)	--	1-3
Leaf stage	--	2-4
Switchgrass		
Height (inch)	--	1-3
Leaf stage	--	1-4
Colq		
Density (#/ft^2)	--	1
Height (inch)	--	0.75-4

Ebns		
Density (#/ft^2)	--	3
Height (inch)	--	0.5-1.5
Rrpw		
Density (#/ft^2)	--	17
Height (inch)	--	0.5-10"
Vele		
Density (#/ft^2)	--	0.5
Height (inch)	--	1.5-6
Grass species (Gift, Yeft, Smgr)		
Density (#/ft^2)	--	2
Height (inch)	--	1-9

Application data (cont.)

Treatment	Preemergence	Postemergence
Date Treated	6-17-97	7-16-97
Oats		
Height (inch)	--	4-6
Stage	--	3-4 leaf
Wind (mph)	10-15 S	2-5 SSW
Temperature (°F)		
Air	69	80
Soil	78	78
Soil Moisture	moist at 2-3"	moist at 0.5"
Relative Humidity (%)	32	70
Cloud Cover (%)	--	10
Rainfall before Application		
Week 1 (inch)	0.38	0.99
Rainfall after Application		
Week 1 (inch)	0.54	5.91
Week 2 (inch)	1.80	1.56

Warm season grass established in 1997 showed less tolerance for many herbicides applications than in 1996. As in the past, switchgrass has relatively low tolerance to imazapic (proposed, Plateau [R]) and showed significant injury even at the lowest rates tested (0.047 lb ai). There was a trend for less stand reduction preemergence, but less growth reduction with postemergence applications. Due to variable emergence, this was only a trend as there were no significant differences between application method in stand reduction or growth reduction, and yields did not differ when equal rates of imazapic where compared. Weed control was excellent with imazapic and as in the past, the lowest rate tested (0.047) may not be low enough for use in Minnesota considering our climate. The only significant reduction in common lambsquarters control occurred with the lowest rate of imazapic (0.047) and only when applied postemergence. The population of surviving lambsquarters would not affect native grass establishment. There were no significant differences in the injury to switchgrass from imazapic with the use of Silkin surfactant with or without 28% N compared with the standard X-77 + 28% N additives. Switchgrass showed good tolerance to imazethapyr and imazamox with moderate to severe growth reduction and moderate stand reduction in the establishment year. Yields were excellent with imazethapyr and imazamox treatments in the second year however, showing excellent recovery from establishment year injury. Metsulfuron and atrazine were good alternatives for switchgrass establishment. Cultural methods generally showed a trend for reduced yield, and in some cases significantly reduced yields, in the second year of establishment when compared with the use of herbicide treatments to establish switchgrass.

Big Bluestem showed good tolerance to all herbicide applications and generally speaking, showed increased establishment success with the use of herbicides compared to non-herbicide

systems. Imidazolinone herbicides generally showed similar or less growth and stand reduction of big bluestem when compared with the metsulfuron and atrazine alternatives. Indiangrass establishment was excellent with the use of imidazolinone herbicides. The use of imidazolinone herbicides was superior to the use of metsulfuron or atrazine which showed significant growth and stand reduction which resulted in poor yields in the second year. The use of imidazolinone herbicides increased the establishment success of Indiangrass significantly over non-herbicide treatments. Sideoats grama showed good tolerance to imazamox, imazethapyr, and metsulfuron with less tolerance to imazapic, and very poor tolerance to atrazine. When imazapic will be used for sideoats grama establishment, the lowest rate tested (0.047) should be used. Relative to non-herbicide establishment of other warm season grasses, sideoats grama had reasonable good success with the non-herbicide alternative use of clipping during the establishment season to control weeds.

Weed control was excellent with all rates of imazapic tested. Again, this points to the possibility of lowering the use of imazapic in Minnesota to gain better tolerance for grass species such as switchgrass. The other imidazolinone herbicides also provided excellent weed control with similar reduction in common lambsquarters control when applied postemergence. For imazapic, the addition of Silkin + 28% N did not significant alter the control of common lambsquarters when compared to the standard additive, X-77 + 28% N. Imazamox showed reduced control of crabgrass species and of velvetleaf at the 0.047 lb ai rate tested when compared to 0.063 lb ai imazethapyr or 0.047 lb ai imazapic. Metsulfuron gave moderate control of grass species compared with imidazolinone herbicides. As in past establishment trials, eastern black nightshade populations were heavy in metsulfuron treated plots compared with all other treatments, including non-herbicide establishment plots. In non-herbicide establishment treatments, eastern black nightshade generally did not establish well because of severe competition from other weed species present, preventing late season emergence of eastern black nightshade. Atrazine for establishment of warm season grasses gave the best control of weeds when used preemergence. Postemergence application of atrazine resulted in significantly lower control of grass species and velvetleaf. Companion crop oat clipped at the pre-boot stage showed excellent weed control and had little secondary regrowth of most weed species present. The issue is often the use of moisture by the companion crop prior to removal through clipping, and subsequent impact on establishment of moisture sensitive warm season grass seedlings. Clipping was moderately successful in reducing all grass and broadleaf weed species, yet there was significant competition by the end of the first establishment season. The use of sethoxydim to remove an oat companion crop, creating an oat mulch, controlled grass species effectively but did not control small seeded broadleaves resulting in severe competition. Eastern black nightshade did not establish in these plots, again due to competition from broadleaf weeds.

Table 1. Warm season grass establishment systems in 1997 with 1998 residual yields at Rosemount, MN (Becker and Miller).

			Switchgrass					
			Necrosis	Growth reduction		Stand reduction		
Treatment	Timing	Rate	8-28-97	8/28/97	6/5/98	8/28/97	6/5/98	Yield
		(lb ai/A)	---------- (%) ----------					(Ton/A)
Imazamox	Pre	0.047	0	18	11	25	15	3.36
Imazamox + X-77[1] + 28%N[2]	Post	0.047 + 0.25% + 1.25%	0	51	23	22	39	2.93
Imazapic	Pre	0.047	13	75	48	82	79	1.63
Imazapic + X-77 + 28%N	Post	0.047 + 0.25% + 1.25%	8	43	44	91	82	1.18
Imazapic	Pre	0.063	19	79	58	91	87	0.66
Imazapic + X-77 + 28%N	Post	0.063 + 0.25% + 1.25%	8	59	71	96	95	0.68
Imazapic	Pre	0.125	11	95	91	100	99	0.42
Imazapic + X-77 + 28%N	Post	0.125 + 0.25% + 1.25%	4	85	98	100	99	0.13
Imazapic	Pre	0.188	0	100	95	100	99	0.05
Imazapic + X-77 + 28%N	Post	0.188 + 0.25% + 1.25%	0	100	86	100	100	0.00
Imazapic + Silkin[3]	Post	0.063 + 0.25%	3	55	51	89	82	1.08
Imazapic + Silkin + 28%N	Post	0.063 + 0.25% + 1.25%	8	83	70	97	95	0.55
Imazethapyr	Pre	0.063	1	58	28	13	34	2.79
Imazethapyr + X-77 + 28%N	Post	0.063 + 0.25% + 1.25%	0	45	25	31	36	3.10
Metsulfuron	Pre	0.018	0	56	34	31	49	2.91
Metsulfuron + X-77 + 28%N	Post	0.018 + 0.25% + 1.25%	0	44	34	43	36	2.85
Atrazine	Pre	2.0	0	50	10	27	18	3.60
Atrazine + X-77 + 28%N	Post	2.0 + 0.25% + 1.25%	0	1	38	27	24	2.93
Check	--	--	0	25	74	79	67	1.38
No herbicide + clip	--	--	0	30	48	65	42	2.38
Oat companion + clip	--	--	0	69	58	89	68	2.40
Oat companion + (sethoxydim + COC)[4]	--	(0.188 + 1.25%)	0	73	87	97	99	0.21
LSD (0.05)			10	26	26	19	19	0.94

[1] X-77 = X-77 nonionic surfactant.
[2] 28%N = 28% UAN fertilizer solution.
[3] Silkin = surfactant.
[4] Poast Plus 1E + Class crop oil concentrate applied postemergence July 16, 1997.

Table 2. Warm season grass establishment systems in 1997 with 1998 residual yields at Rosemount, MN (Becker and Miller).

			Big Bluestem					
			Necrosis	Growth reduction		Stand reduction		
Treatment	Timing	Rate	8-28-97	8/28/97	6/5/98	8/28/97	6/5/98	Yield
		(lb ai/A)	---------- (%) ----------					(Ton/A)
Imazamox	Pre	0.047	0	23	28	13	30	2.71
Imazamox + X-77[1] + 28%N[2]	Post	0.047 + 0.25% + 1.25%	1	49	46	28	54	2.37
Imazapic	Pre	0.047	0	16	21	5	20	2.83
Imazapic + X-77 + 28%N	Post	0.047 + 0.25% + 1.25%	2	9	23	0	28	2.57
Imazapic	Pre	0.063	0	35	34	5	24	2.98
Imazapic + X-77 + 28%N	Post	0.063 + 0.25% + 1.25%	13	28	46	4	31	2.47
Imazapic	Pre	0.125	20	73	74	16	45	1.88
Imazapic + X-77 + 28%N	Post	0.125 + 0.25% + 1.25%	14	45	56	8	53	2.39
Imazapic	Pre	0.188	40	85	76	38	69	1.04
Imazapic + X-77 + 28%N	Post	0.188 + 0.25% + 1.25%	29	64	71	34	63	1.53
Imazapic + Silkin[3]	Post	0.063 + 0.25%	4	16	21	4	23	2.59
Imazapic + Silkin + 28%N	Post	0.063 + 0.25% + 1.25%	3	23	26	3	25	2.23
Imazethapyr	Pre	0.063	1	36	28	3	30	2.21
Imazethapyr + X-77 + 28%N	Post	0.063 + 0.25% + 1.25%	10	25	48	10	34	2.88
Metsulfuron	Pre	0.018	8	71	70	15	66	2.13
Metsulfuron + X-77 + 28%N	Post	0.018 + 0.25% + 1.25%	16	39	69	19	56	2.38
Atrazine	Pre	2.0	5	48	56	84	60	2.10
Atrazine + X-77 + 28%N	Post	2.0 + 0.25% + 1.25%	0	16	51	35	66	2.13
Check	--	--	0	8	62	49	56	1.50
No herbicide + clip	--	--	0	33	56	36	38	1.69
Oat companion + clip	--	--	0	79	71	94	69	1.39
Oat companion + (sethoxydim + COC)[4]	--	(0.188 + 1.25%)	0	49	90	71	95	0.83
LSD (0.05)			13	26	24	26	29	0.71

[1] X-77 = X-77 nonionic surfactant.
[2] 28%N = 28% UAN fertilizer solution.
[3] Silkin = surfactant.
[4] Poast Plus 1E + Class crop oil concentrate applied postemergence July 16, 1997.

Table 3. Warm season grass establishment systems in 1997 with 1998 residual yields at Rosemount, MN (Becker and Miller).

			Sideoats grama					
			Necrosis	Growth reduction		Stand reduction		
Treatment	Timing	Rate	8-28-97	8/28/97	6/5/98	8/28/97	6/5/98	Yield
		(lb ai/A)	(%)					(Ton/A)
Imazamox	Pre	0.047	0	25	18	26	20	2.00
Imazamox + X-77[1] + 28%N[2]	Post	0.047 + 0.25% + 1.25%	0	33	13	5	12	1.95
Imazapic	Pre	0.047	8	72	45	83	80	1.10
Imazapic + X-77 + 28%N	Post	0.047 + 0.25% + 1.25%	0	31	26	9	28	1.73
Imazapic	Pre	0.063	18	79	70	85	91	0.45
Imazapic + X-77 + 28%N	Post	0.063 + 0.25% + 1.25%	3	45	45	17	38	1.38
Imazapic	Pre	0.125	0	100	100	100	100	0.00
Imazapic + X-77 + 28%N	Post	0.125 + 0.25% + 1.25%	19	74	79	39	77	0.30
Imazapic	Pre	0.188	0	91	95	100	99	0.04
Imazapic + X-77 + 28%N	Post	0.188 + 0.25% + 1.25%	38	81	85	39	88	0.16
Imazapic + Silkin[3]	Post	0.063 + 0.25%	0	41	19	6	22	1.61
Imazapic + Silkin + 28%N	Post	0.063 + 0.25% + 1.25%	3	61	43	12	51	1.20
Imazethapyr	Pre	0.063	0	45	6	1	9	2.18
Imazethapyr + X-77 + 28%N	Post	0.063 + 0.25% + 1.25%	0	30	8	3	13	1.97
Metsulfuron	Pre	0.018	0	1	15	1	11	2.30
Metsulfuron + X-77 + 28%N	Post	0.018 + 0.25% + 1.25%	0	10	9	5	10	2.08
Atrazine	Pre	2.0	0	100	78	100	98	0.04
Atrazine + X-77 + 28%N	Post	2.0 + 0.25% + 1.25%	0	43	71	59	53	1.06
Check	--	--	0	27	75	56	48	0.76
No herbicide + clip	--	--	0	16	39	35	26	1.52
Oat companion + clip	--	--	0	69	60	90	63	1.27
Oat companion + (sethoxydim + COC)[4]	--	(0.188 + 1.25%)	0	56	91	90	96	0.32
LSD (0.05)			8	23	22	25	24	0.51

[1] X-77 = X-77 nonionic surfactant.
[2] 28%N = 28% UAN fertilizer solution.
[3] Silkin = surfactant.
[4] Poast Plus 1E + Class crop oil concentrate applied postemergence July 16, 1997.

Table 4. Warm season grass establishment systems in 1997 with 1998 residual yields at Rosemount, MN (Becker and Miller).

			Indiangrass					
			Necrosis	Growth reduction		Stand reduction		
Treatment	Timing	Rate	8-28-97	8/28/97	6/5/98	8/28/97	6/5/98	Yield
		(lb ai/A)	(%)					(Ton/A)
Imazamox	Pre	0.047	0	13	31	11	18	3.14
Imazamox + X-77[1] + 28%N[2]	Post	0.047 + 0.25% + 1.25%	1	60	54	31	40	2.25
Imazapic	Pre	0.047	0	13	13	5	9	3.41
Imazapic + X-77 + 28%N	Post	0.047 + 0.25% + 1.25%	1	29	24	22	18	3.26
Imazapic	Pre	0.063	4	31	29	5	26	3.29
Imazapic + X-77 + 28%N	Post	0.063 + 0.25% + 1.25%	5	43	53	17	37	2.68
Imazapic	Pre	0.125	6	49	54	16	48	2.27
Imazapic + X-77 + 28%N	Post	0.125 + 0.25% + 1.25%	13	51	57	42	44	2.14
Imazapic	Pre	0.188	20	68	83	63	58	1.11
Imazapic + X-77 + 28%N	Post	0.188 + 0.25% + 1.25%	23	64	67	74	56	1.15
Imazapic + Silkin[3]	Post	0.063 + 0.25%	0	24	16	7	23	2.64
Imazapic + Silkin + 28%N	Post	0.063 + 0.25% + 1.25%	0	30	36	31	50	2.37
Imazethapyr	Pre	0.063	1	29	33	8	21	2.92
Imazethapyr + X-77 + 28%N	Post	0.063 + 0.25% + 1.25%	6	40	23	15	22	3.00
Metsulfuron	Pre	0.018	10	68	48	99	66	0.01
Metsulfuron + X-77 + 28%N	Post	0.018 + 0.25% + 1.25%	11	60	85	96	84	0.02
Atrazine	Pre	2.0	0	90	83	99	71	0.01
Atrazine + X-77 + 28%N	Post	2.0 + 0.25% + 1.25%	8	59	84	94	82	0.26
Check	--	--	0	59	81	75	65	0.95
No herbicide + clip	--	--	0	34	51	51	51	1.43
Oat companion + clip	--	--	0	61	88	99	70	0.61
Oat companion + (sethoxydim + COC)[4]	--	(0.188 + 1.25%)	0	45	86	79	76	0.81
LSD (0.05)			12	27	23	21	26	0.76

[1] X-77 = X-77 nonionic surfactant.
[2] 28%N = 28% UAN fertilizer solution.
[3] Silkin = surfactant.
[4] Poast Plus 1E + Class crop oil concentrate applied postemergence July 16, 1997.

Table 5. Warm season grass establishment systems in 1997 with 1998 residual yields at Rosemount, MN (Becker and Miller).

Treatment	Timing	Rate	Gift	Weed control (8/28/97) Crabgrass[1]	Colq	Ebns	Rrpw	Vele
		(lb ai/A)	---------- (%) ----------					
Imazamox	Pre	0.047	94	70	92	96	96	77
Imazamox + X-77[2] + 28%N[3]	Post	0.047 + 0.25% + 1.25%	98	74	84	97	100	84
Imazapic	Pre	0.047	100	100	100	100	100	100
Imazapic + X-77 + 28%N	Post	0.047 + 0.25% + 1.25%	100	100	78	100	100	99
Imazapic	Pre	0.063	100	100	100	100	100	100
Imazapic + X-77 + 28%N	Post	0.063 + 0.25% + 1.25%	100	100	83	100	100	96
Imazapic	Pre	0.125	100	100	100	100	100	100
Imazapic + X-77 + 28%N	Post	0.125 + 0.25% + 1.25%	100	100	96	100	100	100
Imazapic	Pre	0.188	100	100	100	100	100	100
Imazapic + X-77 + 28%N	Post	0.188 + 0.25% + 1.25%	100	100	100	100	100	100
Imazapic + Silkin[4]	Post	0.063 + 0.25%	100	99	74	100	100	100
Imazapic + Silkin + 28%N	Post	0.063 + 0.25% + 1.25%	100	100	86	100	100	100
Imazethapyr	Pre	0.063	100	100	99	100	100	100
Imazethapyr + X-77 + 28%N	Post	0.063 + 0.25% + 1.25%	100	100	69	100	100	100
Metsulfuron	Pre	0.018	77	78	99	43	100	95
Metsulfuron + X-77 + 28%N	Post	0.018 + 0.25% + 1.25%	76	69	100	36	100	100
Atrazine	Pre	2.0	93	65	100	100	100	86
Atrazine + X-77 + 28%N	Post	2.0 + 0.25% + 1.25%	43	40	92	97	81	55
Check	--	--	--	--	--	--	--	--
No herbicide + clip	--	--	65	53	65	80	59	84
Oat companion + clip	--	--	96	98	90	92	86	96
Oat companion + (sethoxydim + COC)[5]	--	(0.188 + 1.25%)	99	99	0	92	0	0
LSD (0.05)			14	12	12	13	5	12

[1] Crabgrass - Lacg and Smcg.
[2] X-77 = X-77 nonionic surfactant.
[3] 28%N = 28% UAN fertilizer solution.
[4] Silkin = surfactant.
[5] Poast Plus 1E + Class crop oil concentrate applied postemergence July 16, 1997.