

Warm season grass establishment systems in 1998 with 1999 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 and a prairie wildflower mixture. The experiment was established in 1998 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 1998, 50 lbs/A N was applied and the plot area was disked once. One day prior to seeding on June 22, 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 (cv. 'Bison'), sideoats grama (cv. 'Pierre'), Indiangrass (cv. 'Holt'), little bluestem (variety not stated), switchgrass (cv. 'Sunburst'), and a wildflower mix were seeded at rates of 10, 10, 10, 7, 5, and 5 pounds pure live seed per acre, respectively. The experimental design was a split block. Whole plots were grass species or the wildflower mix 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 six whole plot strips. Preemergence herbicide treatments were applied after planting. The sethoxydim treatment was applied on July 10 to 5" to 8" oats, warm season grass species were beginning to emerge and were up to 1 inch tall. All other postemergence herbicide applications were made on July 17. The clipping treatments were applied on July 29 (after emergence of warm season grasses) when weeds were 12-20 inches tall and the oats were in the late boot to early heading stage. Yields were determined by harvesting a 21 ft² area within each plot in 1999.

Application data

Treatment	Preemergence	Postemergence
Date Treated	6-23-98	7-17-98
Time	8:00-9:00 am	1:00-1:40 pm
Big Bluestem		
Height (inch)	--	1.5-2
Leaf stage	--	1-3
Little Bluestem		
Height (inch)	--	1-1.5
Leaf stage	--	2-5
Indiangrass		
Height (inch)	--	1.5-2
Leaf stage	--	2-5
Sideoats grama		
Height (inch)	--	2-3
Leaf stage	--	3-6
Switchgrass		
Height (inch)	--	2-3
Leaf stage	--	3-5
Wildflower mix	--	--
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

Application data (cont.)

Treatment	Preemergence	Postemergence
Date Treated	6-23-98	7-17-98
Vele		
Density (#/ft ²)	--	0.5
Height (inch)	--	1.5-6
Grass species (Gift, Yeft, Smgr)		
Density (#/ft ²)	--	2
Height (inch)	--	1-9
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

Wildflowers were a commercial mix^a containing:

Species	%	Species	%
Purple coneflower	10.8	Indian blanket	2.75
Lance-leaved coreopsis	10.6	Prairie coneflower	2.33
Blue flax	8.84	Evening primrose	2.00
Dames's rocket	8.51	Catchfly	2.00
Scarlet flax	7.45	Corn poppy	1.96
Cornflower	5.98	Prairie aster	1.95
Black-eyed susan	5.85	Blazing star	1.93
Blanketflower	5.58	Showy evening primrose	1.92
Annual baby's breath	5.13	Plains coreopsis	1.41
Shasta daisy	4.85	New England aster	0.99
Purple prairie clover	3.83	Baby snapdragon	0.57

^a Peterson Seed Company
P.O. Box 346
Savage, MN 55378

Switchgrass showed the most injury with the imazapic treatments during establishment in 1998 (Table 1). There was an increase in growth reduction with the 0.047 lb rate applied preemergence compared with postemergence applications (early rating) and for the 0.125 rate + 2,4-D applied preemergence compared to postemergence applications (early rating). The reverse was true by the late rating for the DF formulation where the preemergence application had significantly less growth reduction compared to postemergence applications. The preemergence application of 0.063 lb of the DF formulation resulted in significantly less growth reduction than applying the same rate of the 2L formulation (late rating). There was a significantly higher level of stand reduction with preemergence compared to postemergence applications at all comparisons of the 2L formulation (early rating). There were no differences in stand reduction when comparing the same application method and the same rate of imazapic when 2,4-D was added. As noted for growth reduction, there was significantly less stand reduction with the preemergence application (0.063) of the DF formulation compared to postemergence application (late rating).

Little bluestem showed considerable variability in stand establishment among replications during establishment in 1998 (Table 2). Generally speaking, there was an increase in growth reduction with preemergence compared postemergence applications for all comparisons except for the DF treatments at the early rating. The addition of 2,4-D actually decreased the injury of the postemergence application of 0.125 lb of imazapic (early rating). There was an increased in growth reduction with 0.063 lb of the 2L formulation compared to the DF formulation when applied preemergence at the early and late rating. This was not apparent with the same rate applied postemergence. Stand reductions differed only at the first rating. There was an increase in stand reduction when 2,4-D was added compared to the 0.125 lb rate of imazapic use alone when applied preemergence. Also, when the 0.125 lb rate of imazapic was tank mixed with 2,4-D, it caused more stand reduction applied preemergence compared to the same rates applied postemergence.

Indiangrass showed relatively poor tolerance to imazapic during establishment in 1998 (Table 3). Adding 2,4-D to imazapic decreased growth reduction of Indiangrass at the 0.125 lb ai rate (early rating), and with the 0.063 lb rate (late rating), both when applied postemergence. Adding 2,4-D to imazapic also decreased the amount of growth reduction with imazapic applied preemergence at the 0.063 lb rate (early rating). Very few differences in stand reduction existed between treatments. One notable difference was an increase in stand reduction for the 0.063 lb rate applied preemergence when 2,4-D was added (late rating). The DL formation of imazapic resulted in less stand reduction for both ratings and less growth reduction at the late rating when applied preemergence when compared with the DL formation applied postemergence.

There was relatively good tolerance of big bluestem to imazapic during establishment in 1998 (Table 4). There was a significant increase in growth reduction with preemergence applications compared with postemergence applications for the 0.047 applied alone and 0.125 plus 2,4-D treatments at the early rating. There were no differences in growth reduction by the late rating. There was an increase in stand reduction at the 0.047 lb. rate applied preemergence compared to postemergence (early rating), and for the 0.125 lb rate plus 2,4-D applied preemergence compared to postemergence (late rating). There were no differences in performance when using the DF or the 2L formulation. The addition of 2,4-D did not alter growth reduction or stand reduction compared to imazapic applied alone.

Sideoats grama had excellent tolerance to imazapic at 0.047 or 0.063 lb ai applied postemergence based on stand reduction during establishment in 1998 (Table 5). Observations showed that growth reduction and stand reduction were significantly higher with preemergence applications of imazapic with every comparison. There was less injury with the DF formation compared with the 2L formation when applied preemergence. Postemergence treatments did not show this difference in injury between formations. The addition of 2,4-D occasionally increased stand reduction (0.063, late rating) but also decreased stand reduction (0.125, late rating).

Wildflower establishment generally showed increased growth reduction with preemergence compared to postemergence applications of imazapic during establishment in 1998 (Table 6). Adding

2,4-D to imazapic decreased growth reduction with preemergence applications at the 0.063 lb rate (late rating). The planting of an oat companion crop increased growth reduction of wildflowers compared to clipping and other nonherbicide or glyphosate burndown treatments. Stand reductions were significantly higher with preemergence applications with imazapic at all rates and tank mixes tested at the early rating. These differences were present only with the 0.047 lb imazapic and 0.063 + 2,4-D treatments by the late rating. Species richness of wildflowers was generally higher (more diverse) with preemergence applications at the 0.063 or 0.125 lb rate when applied with 2,4-D. Species richness generally was greatest with the nonherbicide treatments. The use of the DF formulation of imazapic decreased growth reduction, decreased stand reduction (postemergence), and increased species richness compared with the 2L formulation.

The imazapic treatments provided excellent weed control during establishment in 1998 at all rates preemergence or postemergence with one exception (Table 7). Common lambsquarters control was significantly lower for every rate of imazapic applied alone (early rating) when applied postemergence compared to preemergence applications. This difference increased in magnitude by the late rating. The addition of 2,4-D eliminated this difference, yet there was a nonsignificant trend for improved control over imazapic applied alone. There were no differences in the weed control performance of the DF vs. 2L formulations. As in past studies in Minnesota, except for common lambsquarters, the lowest rate of imazapic tested, 0.047 lb ai/A provided excellent control of all weed species present. Preemergence applications of imazapic even controlled common lambsquarters at the 0.047 lb rate. Of the nonherbicide options, clipping treatments generally providing the best weed control when weeds overstore the grasses. Sethoxydim treatments used to remove an oat companion crop resulted in extremely poor broadleaf control with broadleaf populations so dense that later flushes of grass weeds could not establish. Additionally, some of the warm season grasses had emerged before the application of sethoxydim, but the overstore oat did not prevent herbicide contact with the desirable grass seedlings and high mortality occurred.

As expected, glyphosate residue in the soil did not affect the warm season grasses or wildflowers directly, but secondary flushes of weeds did. With glyphosate or non-herbicide treatments, wildflowers did reasonably well competing with the weeds without the use of residual imazapic treatments.

Residual year data (1999) reflected the impact of establishment method used in 1998 on establishment. The six imazapic treatments applied preemergence resulted in 8 cases where stand reduction was significantly higher a year later in 1999 compared to the identical imazapic treatment applied postemergence, and only two cases where the reverse was true confirming the higher incidence of stand reduction observed with preemergence applications of imazapic during establishment in 1998. Stunting of plants was diminishing by 1999 although still severe in many cases with growth reduction ratings showing no clear differences across treatments rates or method of application within species or across species. There still was a clear reduction in injury, both stand reduction and growth reduction, with the use of the DF formulation of imazapic compared with the 2L liquid formulation and this was reflected in higher yields in 1999 with the DF formulation. This reduction in injury was less clear when comparing both formulations applied postemergence. The DF formulation was clearly less injurious applied preemergence compared with the same DF formulation applied postemergence and resulted in higher grass yield for all species but switchgrass in 1999 comparing these two methods of application. By 1999, cultural practices without herbicide use resulted in more weeds present in the second year stand. The three treatments without herbicide use compared to imazapic treatments generally resulted in lower yields for little and big bluestem, yields equal to or lower for Indiangrass, and comparable or higher yields for sideoats grama and switchgrass, the latter due in part to the ability of sideoats grama to compete well with weeds during establishment, and the sensitivity of switchgrass to imazapic. There was a general trend for the presence of more wildflower species with postemergence application of imazapic or no herbicide treatments compared to preemergence application of imazapic. There was a significant increase in the biomass of wildflower species with postemergence application of imazapic or no herbicide treatments compared to preemergence application of imazapic. (Department of Agronomy and Plant Genetics, University of Minnesota, St. Paul).

Table 1. Warm season grass establishment systems in 1998 with 1999 residual yields at Rosemount, MN (Becker et al.).

Treatment	Timing	Rate (lb ai/A)	Switchgrass						Yield (Ton/A)
			Growth reduction			Stand reduction			
			8/5/98	9/28/98	6/9/99	8/5/98	9/28/98	6/9/99	
			----- (%) -----						
Imazapic 2L + Silkin ¹	Pre	0.047 + 0.25%	97	86	40	92	96	88	0.45
Imazapic 2L +Silkin	Post	0.047 + 0.25%	83	67	39	13	85	74	0.60
Imazapic 2L + Silkin	Pre	0.063 + 0.25%	88	79	38	86	88	85	0.55
Imazapic 2L +Silkin	Post	0.063 + 0.25%	81	68	34	25	91	92	0.40
Imazapic 2L +2,4-D amine + Silkin	Pre	0.063 + 0.125 + 0.25%	89	83	34	78	90	82	0.53
Imazapic 2L +2,4-D amine + Silkin	Post	0.063 + 0.125 + 0.25%	82	74	42	6	55	80	0.59
Imazapic 2L + Silkin	Pre	0.125 + 0.25%	94	93	58	93	99	92	0.05
Imazapic 2L + Silkin	Post	0.125 + 0.25%	84	99	56	16	99	94	0.10
Imazapic 2L +2,4-D amine + Silkin	Pre	0.125 + 0.25 + 0.25%	97	87	44	95	98	96	0.08
Imazapic 2L +2,4-D amine + Silkin	Post	0.125 + 0.25 + 0.25%	84	93	49	10	95	96	0.10
Imazapic 70DF + Silkin	Pre	0.063 + 0.25%	68	26	2	30	33	26	1.93
Imazapic 70DF +Silkin	Post	0.063 + 0.25%	72	62	14	18	60	46	1.27
Glyphosate ²	Pre	1.0	26	62	45	20	75	71	0.36
Check	--	--	14	50	35	34	74	70	0.82
No herbicide + clip	--	--	10	72	21	31	53	46	1.02
Oat companion + clip	--	--	60	48	22	79	70	62	0.40
Oat companion + (sethoxydim + COC) ³	--	(0.188 + 1.25%)	91	81	68	97	98	99	0.00
LSD (0.05)			11	21	30	20	24	19	0.60

¹ Silkin = surfactant.² Glyphosate = Roundup Ultra used as a postemergence burndown preplant.³ Poast Plus 1E + Class crop oil concentrate applied postemergence July 10, 1998.

Table 2. Warm season grass establishment systems in 1998 with 1999 residual yields at Rosemount, MN (Becker et al.).

Treatment	Timing	Rate (lb ai/A)	Little Bluestem						Yield (Ton/A)
			Growth reduction			Stand reduction			
			8/5/98	9/28/98	6/9/99	8/5/98	9/28/98	6/9/99	
			----- (%) -----						
Imazapic 2L + Silkin ¹	Pre	0.047 + 0.25%	54	45	33	17	50	26	0.57
Imazapic 2L +Silkin	Post	0.047 + 0.25%	26	30	58	27	45	46	0.25
Imazapic 2L + Silkin	Pre	0.063 + 0.25%	72	56	42	25	33	42	0.42
Imazapic 2L +Silkin	Post	0.063 + 0.25%	38	34	45	23	39	42	0.31
Imazapic 2L +2,4-D amine + Silkin	Pre	0.063 + 0.125 + 0.25%	70	53	34	32	49	42	0.40
Imazapic 2L +2,4-D amine + Silkin	Post	0.063 + 0.125 + 0.25%	38	55	10	15	46	18	0.46
Imazapic 2L + Silkin	Pre	0.125 + 0.25%	77	56	63	31	33	70	0.19
Imazapic 2L + Silkin	Post	0.125 + 0.25%	56	66	58	26	50	54	0.21
Imazapic 2L +2,4-D amine + Silkin	Pre	0.125 + 0.25 + 0.25%	90	63	79	53	63	82	0.16
Imazapic 2L +2,4-D amine + Silkin	Post	0.125 + 0.25 + 0.25%	35	49	39	9	13	39	0.39
Imazapic 70DF + Silkin	Pre	0.063 + 0.25%	43	18	1	16	36	5	0.94
Imazapic 70DF +Silkin	Post	0.063 + 0.25%	28	14	38	6	54	18	0.28
Glyphosate ²	Pre	1.0	22	35	80	33	66	82	0.04
Check	--	--	18	34	68	34	44	74	0.13
No herbicide + clip	--	--	23	68	42	45	76	40	0.25
Oat companion + clip	--	--	45	61	77	92	95	76	0.04
Oat companion + (sethoxydim + COC) ³	--	(0.188 + 1.25%)	46	63	--	88	97	100	0.00
LSD (0.05)			20	37	21	19	41	27	0.22

¹ Silkin = surfactant.² Glyphosate = Roundup Ultra used as a postemergence burndown preplant.³ Poast Plus 1E + Class crop oil concentrate applied postemergence July 10, 1998.

Table 3. Warm season grass establishment systems in 1998 with 1999 residual yields at Rosemount, MN (Becker et al.).

Treatment	Timing	Rate (lb ai/A)	Indiangrass						Yield (Ton/A)
			Growth reduction			Stand reduction			
			8/5/98	9/28/98	6/9/99	8/5/98	9/28/98	6/9/99	
			----- (%) -----						
Imazapic 2L + Silkin ¹	Pre	0.047 + 0.25%	70	72	28	79	75	68	0.90
Imazapic 2L +Silkin	Post	0.047 + 0.25%	56	78	41	85	84	64	0.44
Imazapic 2L + Silkin	Pre	0.063 + 0.25%	66	71	24	65	57	46	1.25
Imazapic 2L +Silkin	Post	0.063 + 0.25%	64	82	42	75	81	70	0.56
Imazapic 2L +2,4-D amine + Silkin	Pre	0.063 + 0.125 + 0.25%	64	77	24	81	78	72	0.83
Imazapic 2L +2,4-D amine + Silkin	Post	0.063 + 0.125 + 0.25%	56	55	24	66	68	48	1.40
Imazapic 2L + Silkin	Pre	0.125 + 0.25%	70	84	35	77	79	70	0.62
Imazapic 2L + Silkin	Post	0.125 + 0.25%	70	82	41	74	89	74	0.47
Imazapic 2L +2,4-D amine + Silkin	Pre	0.125 + 0.25 + 0.25%	81	88	55	81	87	88	0.22
Imazapic 2L +2,4-D amine + Silkin	Post	0.125 + 0.25 + 0.25%	53	75	36	80	81	77	0.90
Imazapic 70DF + Silkin	Pre	0.063 + 0.25%	39	39	4	56	38	21	1.83
Imazapic 70DF +Silkin	Post	0.063 + 0.25%	51	74	49	75	81	64	0.48
Glyphosate ²	Pre	1.0	33	93	74	70	98	90	0.14
Check	--	--	26	76	76	65	79	90	0.16
No herbicide + clip	--	--	23	75	32	68	82	50	0.64
Oat companion + clip	--	--	86	68	76	94	90	82	0.16
Oat companion + (sethoxydim + COC) ³	--	(0.188 + 1.25%)	82	99	80	93	99	99	0.00
LSD (0.05)			16	15	21	16	18	16	0.52

¹ Silkin = surfactant.

² Glyphosate = Roundup Ultra used as a postemergence burndown preplant.

³ Poast Plus 1E + Class crop oil concentrate applied postemergence July 10, 1998.

Table 4. Warm season grass establishment systems in 1998 with 1999 residual yields at Rosemount, MN (Becker et al.).

Treatment	Timing	Rate (lb ai/A)	Big Bluestem						Yield (Ton/A)
			Growth reduction			Stand reduction			
			8/5/98	9/28/98	6/9/99	8/5/98	9/28/98	6/9/99	
			----- (%) -----						
Imazapic 2L + Silkin ¹	Pre	0.047 + 0.25%	70	45	18	43	43	40	2.05
Imazapic 2L +Silkin	Post	0.047 + 0.25%	44	34	40	13	44	31	1.09
Imazapic 2L + Silkin	Pre	0.063 + 0.25%	66	40	19	18	34	31	1.71
Imazapic 2L +Silkin	Post	0.063 + 0.25%	21	26	22	17	18	18	1.43
Imazapic 2L +2,4-D amine + Silkin	Pre	0.063 + 0.125 + 0.25%	54	41	28	20	25	21	2.13
Imazapic 2L +2,4-D amine + Silkin	Post	0.063 + 0.125 + 0.25%	29	18	11	4	0	12	1.84
Imazapic 2L + Silkin	Pre	0.125 + 0.25%	76	52	35	25	53	56	1.73
Imazapic 2L + Silkin	Post	0.125 + 0.25%	56	46	38	18	35	36	1.19
Imazapic 2L +2,4-D amine + Silkin	Pre	0.125 + 0.25 + 0.25%	86	74	60	34	61	80	0.70
Imazapic 2L +2,4-D amine + Silkin	Post	0.125 + 0.25 + 0.25%	43	49	48	20	29	46	1.20
Imazapic 70DF + Silkin	Pre	0.063 + 0.25%	41	19	11	15	16	16	2.17
Imazapic 70DF +Silkin	Post	0.063 + 0.25%	36	34	26	18	36	29	1.24
Glyphosate ²	Pre	1.0	13	59	72	30	85	74	0.49
Check	--	--	28	61	62	16	69	72	0.39
No herbicide + clip	--	--	21	60	51	28	55	44	0.61
Oat companion + clip	--	--	70	66	66	59	85	64	0.24
Oat companion + (sethoxydim + COC) ³	--	(0.188 + 1.25%)	79	79	--	79	95	100	0.00
LSD (0.05)			27	30	24	22	30	26	0.70

¹ Silkin = surfactant.

² Glyphosate = Roundup Ultra used as a postemergence burndown preplant.

³ Poast Plus 1E + Class crop oil concentrate applied postemergence July 10, 1998.

Table 5. Warm season grass establishment systems in 1998 with 1999 residual yields at Rosemount, MN (Becker et al.).

Treatment	Timing	Rate (lb ai/A)	Sideoats grama						Yield (Ton/A)
			Growth reduction			Stand reduction			
			8/5/98	9/28/98	6/9/99	8/5/98	9/28/98	6/9/99	
			----- (%) -----						
Imazapic 2L + Silkin ¹	Pre	0.047 + 0.25%	96	94	51	62	75	89	0.14
Imazapic 2L +Silkin	Post	0.047 + 0.25%	69	33	40	10	41	38	0.67
Imazapic 2L + Silkin	Pre	0.063 + 0.25%	92	82	51	65	86	86	0.31
Imazapic 2L +Silkin	Post	0.063 + 0.25%	70	29	50	25	48	45	0.59
Imazapic 2L +2,4-D amine + Silkin	Pre	0.063 + 0.125 + 0.25%	98	92	67	81	82	90	0.11
Imazapic 2L +2,4-D amine + Silkin	Post	0.063 + 0.125 + 0.25%	67	35	40	8	24	38	0.81
Imazapic 2L + Silkin	Pre	0.125 + 0.25%	97	98	83	89	96	98	0.00
Imazapic 2L + Silkin	Post	0.125 + 0.25%	81	66	65	19	55	71	0.13
Imazapic 2L +2,4-D amine + Silkin	Pre	0.125 + 0.25 + 0.25%	96	99	90	99	99	99	0.00
Imazapic 2L +2,4-D amine + Silkin	Post	0.125 + 0.25 + 0.25%	70	64	59	21	26	44	0.43
Imazapic 70DF + Silkin	Pre	0.063 + 0.25%	72	34	21	26	34	10	1.57
Imazapic 70DF +Silkin	Post	0.063 + 0.25%	60	11	38	5	26	28	0.84
Glyphosate ²	Pre	1.0	26	30	44	36	57	55	0.50
Check	--	--	0	45	60	8	51	63	0.55
No herbicide + clip	--	--	8	34	12	18	25	16	1.60
Oat companion + clip	--	--	44	40	41	80	45	49	0.33
Oat companion + (sethoxydim + COC) ³	--	(0.188 + 1.25%)	54	65	73	79	69	87	0.00
LSD (0.05)			11	24	24	19	25	24	0.44

¹ Silkin = surfactant.² Glyphosate = Roundup Ultra used as a postemergence burndown preplant.³ Poast Plus 1E + Class crop oil concentrate applied postemergence July 10, 1998.

Table 6. Warm season grass establishment systems in 1998 with 1999 residual yields at Rosemount, MN (Becker et al.).

Treatment	Timing	Rate (lb ai/A)	Flowers						Biomass (% of full)
			Growth reduction		Stand reduction		Species Richness		
			8/5/98	9/28/98	8/5/98	9/28/98	9/28/98	7/15/99	
			----- (%) -----						
			--- # of species ---						
Imazapic 2L + Silkin ¹	Pre	0.047 + 0.25%	96	99	99	0.3	3.5	34	
Imazapic 2L +Silkin	Post	0.047 + 0.25%	69	61	67	2.0	5.0	81	
Imazapic 2L + Silkin	Pre	0.063 + 0.25%	100	100	96	0.8	2.5	10	
Imazapic 2L +Silkin	Post	0.063 + 0.25%	70	60	73	2.8	3.0	61	
Imazapic 2L +2,4-D amine + Silkin	Pre	0.063 + 0.125 + 0.25%	73	99	97	1.3	1.0	12	
Imazapic 2L +2,4-D amine + Silkin	Post	0.063 + 0.125 + 0.25%	75	70	45	4.0	4.8	58	
Imazapic 2L + Silkin	Pre	0.125 + 0.25%	98	99	99	0.3	1.8	7	
Imazapic 2L + Silkin	Post	0.125 + 0.25%	79	65	91	1.3	3.0	42	
Imazapic 2L +2,4-D amine + Silkin	Pre	0.125 + 0.25 + 0.25%	100	100	100	0	1.8	3	
Imazapic 2L +2,4-D amine + Silkin	Post	0.125 + 0.25 + 0.25%	85	59	74	2.8	3.0	28	
Imazapic 70DF + Silkin	Pre	0.063 + 0.25%	70	91	70	3.0	3.5	28	
Imazapic 70DF +Silkin	Post	0.063 + 0.25%	63	45	52	2.5	4.0	61	
Glyphosate ²	Pre	1.0	10	15	56	3.3	4.0	68	
Check	--	--	1	13	60	3.0	4.3	54	
No herbicide + clip	--	--	5	10	48	4.5	4.5	80	
Oat companion + clip	--	--	61	90	50	4.5	4.5	74	
Oat companion + (sethoxydim + COC) ³	--	(0.188 + 1.25%)	28	28	79	3.0	4.8	85	
LSD (0.05)			24	17	30	1.8	1.9	27	

¹ Silkin = surfactant.² Glyphosate = Roundup Ultra used as a postemergence burndown preplant.³ Poast Plus 1E + Class crop oil concentrate applied postemergence July 10, 1998.

Table 7. Warm season grass establishment systems in 1998 with 1999 residual yields at Rosemount, MN (Becker et al.).

Treatment	Timing	Rate (lb ai/A)	Weed control									6/9/99	
			8/5/98			9/28/98						Gift	Brd ¹
			Gift	Colq	Rrpw	Gift	Colq	Ebns	Rrpw	Wocq	Vele	Gift	Brd ¹
			----- (%) -----										
Imazapic 2L + Silkin ²	Pre	0.047 + 0.25%	100	99	100	100	100	100	100	100	100	100	92
Imazapic 2L + Silkin	Post	0.047 + 0.25%	100	74	97	100	21	100	100	100	100	100	73
Imazapic 2L + Silkin	Pre	0.063 + 0.25%	100	100	100	100	100	100	100	100	100	100	91
Imazapic 2L + Silkin	Post	0.063 + 0.25%	100	77	96	100	45	93	99	100	100	100	85
Imazapic 2L +2,4-D amine + Silkin	Pre	0.063 + 0.125 + 0.25%	100	100	100	100	100	100	100	100	100	100	90
Imazapic 2L +2,4-D amine + Silkin	Post	0.063 + 0.125 + 0.25%	100	100	94	100	83	100	99	100	99	100	86
Imazapic 2L + Silkin	Pre	0.125 + 0.25%	100	99	100	100	99	100	100	100	100	100	95
Imazapic 2L + Silkin	Post	0.125 + 0.25%	100	84	99	100	59	100	100	100	100	99	74
Imazapic 2L +2,4-D amine + Silkin	Pre	0.125 + 0.25 + 0.25%	100	99	100	100	100	100	100	100	100	100	78
Imazapic 2L +2,4-D amine + Silkin	Post	0.125 + 0.25 + 0.25%	100	99	96	100	75	100	100	100	100	100	81
Imazapic 70DF + Silkin	Pre	0.063 + 0.25%	100	99	100	100	90	100	100	87	100	100	71
Imazapic 70DF + Silkin	Post	0.063 + 0.25%	100	78	98	100	18	83	91	100	75	87	81
Glyphosate3	Pre	1.0	0	0	0	93	16	18	34	100	19	72	59
Check	--	--	0	0	0	75	34	68	34	100	28	62	64
No herbicide + clip	--	--	0	0	0	74	67	100	83	93	97	85	55
Oat companion + clip	--	--	--	--	--	95	66	60	79	88	81	56	59
Oat companion + (sethoxydim + COC) ⁴	--	(0.188 + 1.25%)	--	--	--	--	0	0	0	--	25	92	50
LSD (0.05)			1	10	5	14	36	22	15	ns	31	20	22

¹ Brd = broadleaf weeds (broadleaf plantain, daisy fleabane, shepherds purse, and velvetleaf).

² Silkin = surfactant.

³ Glyphosate = Roundup Ultra used as a postemergence burndown preplant.

⁴ Poast Plus 1E + Class crop oil concentrate applied postemergence July 10, 1998.