

PROGRESS REPORT ON SEED PRODUCTION RESEARCH

prepared by

N.J. Ehlke and D.J. Vellekson
Department of Agronomy and Plant Genetics
University of Minnesota
St. Paul, Minnesota 55108

for

PRESENTATION AT THE GRASS-LEGUME SEED INSTITUTE
Roseau, Minnesota

March 17, 1999

Weather:

Table 1. Monthly precipitation at Roseau, MN 1967-1998.

Variety Performance Trials:

- Table 2. Kentucky bluegrass seeded in 1992.
- Table 3. Timothy seeded in 1993.
- Table 4. Reed canarygrass seeded in 1995.
- Table 5. Reed canarygrass seeded in 1993.
- Table 6. Birdsfoot trefoil seeded in 1996.
- Table 7. Red clover seeded in 1996.
- Table 8. Perennial ryegrass seeded in 1997.
- Table 9. Perennial ryegrass winter hardiness trial seeded in 1997.

Other Trials:

- Table 10. Effect of post burn 'Roundup' renovation on 5 Kentucky bluegrass varieties.
- Table 11. Effects of nitrogen source and sulfur on 'Park' Kentucky bluegrass.
- Table 12. Effect of herbicide timing and renovation on 'Park' Kentucky bluegrass.
- Table 13. Effect of management treatments on 5 fine fescue varieties.
- Table 14. Effect of renovation and fertility on 'Venture' reed canarygrass.
- Table 15. Effect of fertilizer applied to 'Endura' kura clover.
- Table 16. Effect of herbicides applied to 'Endura' kura clover.
- Table 17. Legume establishment trial.
- Table 18. Herbicides applied to birdsfoot trefoil.
- Table 19. 'Roundup' timing on selected birdsfoot trefoil population - 1998.
- Table 20. Summary of Roundup timing on selected birdsfoot trefoil populations.

Kentucky Bluegrass

Kentucky bluegrass seed production was below average overall in northern Minnesota in 1998. Extremely wet conditions during harvest was a large factor. Saturated soil in the fall and a dry early spring probably reduced yields also. Peat soils north of Roseau were terribly wet all season making field operations difficult or impossible.

The 1992 Kentucky bluegrass variety trial has data reported with six years of yields included in Table 2. Minnifine and Newport had good overall yields as usual. Barmax and Unique also produced well. Park, Midnight, and Abbey yielded comparatively less than in other trials in which they were included.

Stand renovation is being done on many bluegrass fields older than 3 years. In Table 10, five Kentucky bluegrass varieties were striped post burn with Roundup in 1995 or 1996. Yields were generally higher in the second year after treatment and lower the first year. It would seem the field needs to be left in at least three years after treatment on mineral soils to make the treatment worthwhile. Pre-burn treatments may cause less injury the following year. Table 12 has a pre-burn Roundup treatment applied in 1997. The yield in 1998 was essentially equal to the no treatment. Other considerations in striping Kentucky bluegrass fields include: 1) weeds, especially quackgrass, may become more severe where present; 2) in wet years, the sod is less firm and field operation could become difficult, as was the case in 1998 during harvest; 3) delays in burning may reduce yield the following year; and 4) increased lodging.

Positive effects include: 1) field will burn better; 2) reduction of fertilizer needed by 10%-15%; and 3) maybe less prone to drought stress the following year.

Also in Table 12 are spring vs. fall application of Beacon and 2,4-D + Banvel. Fall application of 2,4-D and Banvel seems to produce a better yield than spring applications. Beacon applied a second consecutive year significantly reduced yields on either a spring or fall application. We have seen this occur on mineral soils in the past. Organic soils probably would have little carryover.

A nitrogen source-sulfur trial was conducted in 1997 and 1998 on the Byron Tviet farm north of Roosevelt. Little effect was seen on any of the treatments. If soil has a low sulfur level, 10#-20# of ammonium sulfate applied with the normal fall fertilizer is probably a good idea, however. Over time, higher seeds yields may pay for the small extra cost of this fertilizer.

Perennial Ryegrass

A perennial ryegrass seed yield trial in Table 8 and a winter hardiness trial in Table 9 have data reported in 1998. The yield trial had winter kill and standing water that made yields variable. Chaparell, NK-200, and experimental PST-2m3 had somewhat higher yields than other varieties, however.

The winter hardiness trial seeded with no cover, had excellent data in 1998. A cold snap after the snow melted in March stressed plants and provided good differentials between varieties. Winter hardy select and Winter hardy x Turf quality germplasms show excellent winter hardiness and will hopefully produce a variety in the near future. Three fescue x ryegrass crosses (festoliums) in the trial winter killed almost completely and may not be adapted to northern Minnesota.

Fine Fescue

Five fine fescue strains were seeded on the Baumgartner farm in 1994. In 1996 and 1997, residue management and renovation treatments, were imposed on each variety. The seed yields and other data are in Table 13. Boreal, 67135, and Hector generally produced the best yields. Hector and 67135 did slightly better with the short clip treatment and Boreal seemed to do better with the burn treatment. Roundup striping did not affect yield significantly. Producing fine fescue seed in northern Minnesota has generally not been successful. No more studies with fine fescue are currently being conducted.

Birdsfoot trefoil

Roseau and Nuelin, two newly released Roundup tolerant birdsfoot trefoil varieties, have been in trials to determine the effect of Roundup applied at different times. Tables 19 and 20 have data reported. Yield difference between these two varieties and the unselected checks vary greatly. Some years with some treatment dates, there are essentially no seed yield differences; other times the selected strains produce significantly higher yields. Environmental factors sometimes allow the checks to recover and produce a normal crop. The selected varieties are always less affected by the treatments, however, and recover more quickly. Weed competition is normally better for this reason.

Table 1. Monthly precipitation and average Park Kentucky bluegrass seed yield, Roseau, MN from 1967 to 1998.

Year	MONTHLY PRECIPITATION (inches)												TOTAL	DEPARTURE FROM NORMAL	Seed Yield lb/A
	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC			
1967	1.13	0.39	0.59	2.89	0.89	2.23	4.95	1.69	0.83	1.11	0.70	1.76	19.16	-1.79	650
1968	0.62	T	1.25	0.63	1.46	6.47	6.13	8.49	2.35	1.26	1.06	0.21	29.98	+9.03	488
1969	3.07	0.11	0.05	1.27	3.31	2.29	3.70	4.28	3.29	1.91	0.30	0.73	24.31	+3.36	673
1970	.71	0.41	1.38	2.56	5.93	4.07	3.55	0.83	2.77	1.49	1.21	0.37	25.28	+4.33	492
1971	0.54	0.13	0.26	1.50	2.24	2.29	3.58	0.69	3.33	2.97	0.29	0.50	19.02	-1.93	405
1972	0.68	0.76	0.50	0.70	1.66	5.03	1.92	1.53	4.22	1.40	0.38	0.32	19.10	-1.85	422
1973	0.09	0.17	1.18	0.90	2.46	2.21	4.04	2.09	5.67	1.19	0.67	0.75	21.40	+0.45	642
1974	0.88	0.87	0.16	2.72	4.12	1.56	2.56	10.97	0.42	0.66	0.15	1.40	26.47	+5.52	504
1975	1.10	0.29	0.64	1.40	1.52	4.96	2.26	1.75	1.79	1.49	0.20	0.65	18.05	-2.90	146
1976	1.13	0.50	1.05	0.77	0.54	5.82	1.52	3.72	0.34	0.07	T	0.37	15.83	-5.12	140
1977	0.14	0.62	1.02	0.27	2.43	3.71	2.28	1.74	3.83	0.87	2.27	0.26	19.44	-1.51	507
1978	0.36	0.26	0.17	1.00	1.97	1.92	6.25	3.25	3.44	0.23	0.98	0.79	20.62	-0.33	415
1979	0.50	1.01	1.06	2.77	1.89	1.91	3.70	1.59	0.45	1.40	1.02	0.16	17.46	-3.49	62
1980	0.55	0.82	0.35	0.00	0.24	1.75	3.35	5.19	4.12	1.66	0.94	0.18	19.15	-1.80	625
1981	0.27	0.16	0.66	0.56	2.79	6.85	2.63	2.41	3.63	1.75	0.90	0.99	23.60	+2.65	595
1982	1.30	0.45	0.74	0.24	1.38	2.00	5.53	2.71	1.92	2.91	0.46	0.57	20.21	-0.74	605
1983	1.31	1.26	1.17	0.53	2.76	4.03	1.62	3.34	2.91	2.26	0.66	0.10	21.85	+0.90	613
1984	T	0.95	T	0.72	0.72	4.46	3.78	0.99	0.37	4.32	0.10	1.02	17.18	-3.77	525
1985	0.12	0.33	0.06	1.07	4.35	4.62	1.08	8.72	1.60	1.04	1.68	0.38	25.05	+4.10	488
1986	0.30	0.90	0.26	2.96	1.40	2.43	3.59	2.04	2.52	0.65	1.97	0.36	19.38	-1.57	288
1987	0.47	0.30	0.10	0.59	4.37	2.25	4.80	2.22	0.82	0.92	0.73	0.35	17.92	-3.03	152
1988	0.60	0.09	1.75	0.00	1.74	1.34	5.53	1.70	2.24	0.12	0.77	1.05	16.81	-4.14	320
1989	3.27	0.32	2.86	0.10	2.82	5.46	1.60	2.56	1.24	0.41	0.62	0.45	21.71	+0.76	160
1990	0.55	0.20	1.12	1.09	0.46	3.19	2.48	0.62	0.91	0.16	0.18	0.72	11.69	-9.26	210
1991	0.56	0.64	0.58	2.87	3.19	5.94	3.40	1.99	7.42	1.64	1.36	0.70	30.29	+9.34	630
1992	0.61	0.68	0.45	2.27	1.99	2.36	2.72	4.51	2.76	0.12	1.27	0.88	20.62	-0.33	490
1993	0.68	0.05	0.27	1.01	1.63	5.06	5.87	4.69	0.72	0.71	0.45	0.65	21.79	+0.84	230
1994	0.21	0.33	0.47	0.02	0.16	2.54	3.03	3.48	3.94	1.38	2.72	0.32	18.59	-2.20	300
1995	0.57	0.59	1.23	0.61	2.50	2.13	4.59	3.59	1.81	1.33	1.54	1.46	21.95	+1.16	250
1996	0.94	0.48	0.22	1.65	4.62	1.64	7.34	1.78	1.77	1.75	2.73	1.07	25.99	+5.20	350
1997	1.06	0.14	1.02	0.84	2.02	3.36	4.02	1.31	4.01	2.45	0.19	0.25	20.67	-1.12	275
1998	0.69	1.05	0.21	0.77	4.55	5.39	3.01	2.20	0.31	4.42	1.39	.95	24.94	+4.39	

* Seed yield estimates of Park Kentucky bluegrass on 2-4 year old stands at Roseau test plots with 100 lbs/A of nitrogen.

Table 2. Powdery mildew, height, harvest date, lodging and seed yield for 16 Kentucky bluegrass varieties seeded on the Baumgartner Farm in 1992.

Variety	MSP #	Powdery mildew ¹				1998 Harvest		Seed yield (lb/A)							94-98 Ave.
		6/17/93	6/15/94	6/6/95	6/6/95	Height (in.)	Date	Lodging ²	1993	1994	1995	1996	1997	1998	
Abbey	2606	1.6	0.5	0	0	21	7/5	1.0	180	394	361	161	103	290	262
Aspen	2608	1.3	0.8	0	0	24	7/5	1.0	176	131	161	109	136	118	131
BA73-366	2716	1.5	0.5	0.4	0.4	20	7/10	1.0	250	359	277	149	85	239	222
Bar VB 1184	2860	1.8	3.5	2.4	2.4	21	7/10	1.5	140	118	89	35	40	76	72
Baritia	2862	1.6	3.8	2.3	2.3	23	7/8	2.5	165	100	107	59	36	87	78
Barnax	2861	0.3	0	0	0	21	7/5	1.0	584	407	564	415	216	277	376
Blacksburg	2857	1.3	2.2	1.1	1.1	20	7/10	1.0	107	74	53	30	20	53	46
Midnight	2858	3.8	2.8	0.4	0.4	22	7/10	1.0	163	374	192	120	107	143	187
Minnifine (2405)	2692	0.3	0	0	0	33	7/3	2.3	521	296	482	348	350	355	366
Newport	2852	0.6	2.0	0.1	0.1	26	7/10	1.3	559	379	277	580	232	372	368
Opal	2654	0	0	0	0	25	7/10	1.3	274	71	243	117	112	145	138
Park OT 433	2601	0	0	0	0	31	---	---	408	102	116	56	NH	NH	---
Park	2556	3.4	2.0	1.4	1.4	31	7/3	1.5	307	250	306	180	210	230	235
Park OT 442	2602	0	0	0	0	31	---	---	499	134	178	66	NH	NH	---
Rugby	2609	3.0	2.5	0.9	0.9	27	7/6	1.0	241	187	239	225	169	243	213
Unique	2859	0.1	0	0	0	21	7/10	1.0	272	412	223	397	350	198	316
LSD at 5% level		0.8	1.7	0.7	0.7	3	2	1.0	128	87	80	72	69	63	40

Experimental design: RCB 4 reps.

¹0 = no mildew, 5 = severe mildew.

²1 = no lodging, 5 = severe lodging.

Table 3. Percent heading, height, lodging, harvest date and seed yield for 5 timothy strains seeded in August, 1993 on Baumgartner Farm, Roseau, MN.¹ 1998 data and 1994-98 seed yield

Variety	MSP No.	Percent Heading 6-19	² Lodging at Harvest	Harvest (in.) 7-22	Harvest Date	Seed Yield (lb/A)					5 yr. Ave.
						1994	1995	1996	1997	1998	
Climax	2713	41	1.8	50	8-7	359	399	522	615	502	479
Goliath	2851	34	4.5	45	8-7	488	479	433	540	488	486
Heidemij	2715	1	3.5	46	8-13	575	439	442	600	540	519
Tarmo	2923	55	5.3	47	8-7	526	671	624	586	395	561
Timfor	2876	78	1.5	48	7-30	577	508	589	544	569	558
LSD at 5% level		6	1.7	1	1	108	127	113	144	126	59

¹ Experimental design: RCB with 4 reps.

² 1 = no lodging, 9 = severe lodging.

Table 4. Harvest height and seed yield for 8 reed canarygrass strains seeded on Cenex Farm 7/26/95.

Variety	MSP#	Harvest date	Harvest height (in.)	Seed Yield (#/AC)			3 yr. Ave.
				1996	1997	1998	
Fu Sr 8702	3010	7-8	67	214	638	372	408
Fu Sr 8703	3011	7-9	66	129	589	190	303
LQ Sr 9102	3012	7-8	70	143	453	274	290
LQ Sr 9104	3013	7-10	66	138	466	138	248
Mn-76	2408	7-9	70	76	299	96	157
Palaton	2983	7-9	71	243	769	230	414
Venture	2661	7-9	66	274	609	274	364
Vantage	2925	7-9	70	187	645	239	357
LSD at 5% level		1	3	77	220	116	100

Experimental design: RCB with 4 reps.

Table 5. Harvest height, harvest date and seed yield for 6 reed canarygrass strains seeded on the Baumgartner Farm, 8/19/93.

Variety	MSP#	Harvest Height (in.)	Lodging ¹	Harvest date	Seed Yield (lb/A)				4 yr. Ave.
					1995	1996	1997	1998	
Lara	2920	68	2.6	7-9	132	149	36	89	101
Palaton	2660	70	1.0	7-9	395	493	350	375	403
PSC 114442LA	2921	70	2.5	7-9	132	125	78	51	96
PS4	2919	69	1.0	7-9	303	453	163	263	295
Vantage	2925	71	1.3	7-9	239	341	100	190	217
Venture	2661	69	1.0	7-9	397	439	198	332	342
LSD at 5% level		6	.6		83	114	85	160	85

Experimental design: RCB with 4 reps.

¹Lodging; 1 = none; 5 = flat.

Table 6. Vigor and seed yield for 15 birdsfoot trefoil strains seeded 6/12/96 on Cenex farm near Roseau.

Strain	MSP [#]	Vigor ¹		Seed yield (lbs/A)		
		7/10/96	5/13/98	1997	1998	2 yr. Ave.
Empire	2947	3.5	4.3	366	524	445
Fusarium resistant Norcen sel.	3057	6.5	5.0	524	658	591
Leo	2951	3.3	6.8	546	830	688
Nueltin (LC6F)	2969	7.3	<u>7.8</u>	426	705	565
NC7-1 yr. Hiforage	2971	7.5	6.0	355	540	447
NC3-2yr.-Hiforage	3063	7.5	6.5	537	787	662
Norcen	2948	6.5	5.8	549	720	634
Roseau (NC3M)	2967	7.3	<u>5.8</u>	506	678	592
Norcen 'F' syn.2 ('N' fixation)	2788	6.8	5.8	602	812	707
Norcen 'N' syn. 2 ('N' utilization)	2789	8.0	5.5	475	685	580
Steadfast (ARS-2620)	3065	6.5	--	314	NH*	--
Trevig	2964	6.3	5.3	497	740	619
Viking	2949	5.5	4.5	415	546	481
Winter Hardy Norcen Sel.	2977	8.0	8.0	413	674	543
WIT	2924	5.5	4.8	468	662	565
LSD at 5% level		1.4	0.9	129	201	120

Experimental Design: RCB with 4 reps.

¹1 = least vigor, 9 = best vigor.

* - not harvested; winter killed.

Table 7. Vigor and seed yield for 6 red clover strains seeded 6/12/96 on Baumgartner farm.

Strain	MSP [#]	Seedling ¹ Vigor 7/10/96	Winter ² injury 6/3/98	1997 Seed Yield (lbs/A)
C456	3074	7.5	6.5	442
C328	3073	7.3	5.3	435
C11	3072	7.5	5.5	404
HC60	3075	7.8	6.5	448
Arlington	3070	3.0	9.8	571
Marathan	3071	6.8	6.5	502
LSD at 5% level		1.5	1.7	99

Experimental Design: RCB w/4 reps.

¹1 = poorest vigor, 9 = best vigor.

²1 = no injury, 10 = dead.

Table 8. Winter injury, lodging and seed yield for 7 perennial ryegrass varieties seeded under spring wheat on 6/10/97 on the Cenex farm near Roseau, MN. 1998 data.

Variety	Msp #	winter injury		Lodging at harvest	Yield(lbs/a)
		5/13/98	6/3/98		
Brightstar	3092	4.6	4.6	3.8	560
Delray	3105	4.9	4.9	0.0	NH
NK-200	3009	3.3	2.9	5.3	752
PST-2m3	3093	4.0	3.7	5.0	783
Tophat	3029	4.5	4.5	3.3	584
P1	3106	4.8	4.7	2.5	475
Chaparell	3174	3.3	3.0	6.5	818
LSD at 5%		0.6	0.7	2.5	296

Experimental design; RCB w 4 reps.
 Winter injury; 1= none; 5=dead.
 Lodging; 1=none, 9= severe lodging.

Table 9. Winter hardiness trial for 21 perennial ryegrass and 3 ryegrass x fescue crosses seeded on the Baumgartner farm, Roseau, MN 8/1/97 and at Rosemount, MN 8/25/97. 1998 data.

Variety	MSP#	Roseau	Roseau	Roseau	Rosemount
		winter inj. no cover	winter inj. no cover	winter inj. under wheat	winter inj. no cover
		5/14/98	6/4/98	5/14/98	4/30/98
Affinity	3030	6.0	5.8	9.3	1.0
Barspectra annual	3175	10.0	10.0	10.0	9.8
Brightstar	3159	7.0	5.8	9.3	1.0
Brightstar II	3160	7.3	7.0	9.3	1.0
Charger II	3157	6.0	5.3	9.3	1.0
Citation II	2774	8.0	7.5	9.3	1.0
Citation III	3158	7.3	6.5	10.0	1.0
Delray	3105	6.8	7.3	9.0	1.0
K9 Bulk	3101	2.8	3.0	7.8	1.0
Lafayette	3165	9.3	9.3	10.0	1.0
Chaparell	3174	4.8	4.5	8.5	1.0
NK-200	3179	2.3	1.8	6.5	1.0
NK-200	3009	3.8	3.5	6.0	1.0
p1	3018	8.8	8.5	9.5	1.0
p1 Baumgartner 97	3181	6.8	5.5	9.5	1.0
p1 Helmstetter 96	3106	7.8	8.3	9.5	1.0
Panther	3082	5.5	5.8	8.5	1.0
Polly II	3163	10.0	10.0	10.0	7.3
T.Q. x Spread syn.2	3102	6.0	5.8	6.5	1.0
Tophat	3029	4.8	5.0	7.0	1.0
Winter hardy select	3103	2.5	2.0	7.8	1.0
Winter hardy x t.q. 96	3104	2.3	2.3	4.8	1.0
Kemal (festolium)	3166	9.8	9.5	10.0	3.3
Tandem II (festolium)	3167	10.0	9.9	10.0	4.8
WFL-96 (festolium)	3168	9.8	10.0	9.8	3.8
LSD 5%		1.6	1.7	1.6	0.6

Experimental design: RCB/ 4 reps.
 Winter injury: 1=no injury, 10=dead.
 Roseau plots under wheat had standing water which may have caused more injury.

Table 10. The effect of Post burn Roundup renovation on 5 Kentucky bluegrass varieties seeded in 1988 on the Baumgartner farm, Roseau, MN - 1996-97 data.

Variety	Renovation ¹ Treatment	% heading 6/4/98	Harvest - 1998		Date	Seed yield (lb/A)				
			Ht. (in.)	Lodging ²		1996	1997	1998	97-98	96-98
Abbey	no treatment	43	24	1.0	7-5	661	445	324	385	477
	3" strip - '95	55	27	1.1	7-5	210	508	565		428
	7" strip - '95	43	27	1.5	7-8	66	525	407		333
	3" strip - '96	50	28	1.3	7-6		426	437		432
Aspen	no treatment	35	27	1.0	7-6	278	319	209	264	269
	3" strip - '95	43	29	2.1	7-6	162	375	183		240
	7" strip - '95	43	27	2.0	7-8	32	417	201		217
	3" strip - '96	45	29	2.1	7-7		299	223		261
Midnight	no treatment	18	25	1.0	7-10	367	287	163	225	272
	3" strip - '95	20	25	1.3	7-10	168	304	201		224
	7" strip - '95	24	27	2.0	7-10	43	311	183		179
	3" strip - '96	23	27	2.1	7-10		176	155		166
Park	no treatment	98	34	3.4	7-3	316	328	213	271	286
	3" strip - '95	98	34	4.4	7-3	105	462	310		292
	7" strip - '95	100	36	4.7	7-3	52	498	180		243
	3" strip - '96	100	36	4.7	7-3		330	248		289
Rugby	no treatment	53	32	2.5	7-5	299	398	261	329	319
	3" strip - '95	60	33	4.1	7-6	85	469	269		274
	7" strip - '95	58	32	3.5	7-8	27	408	272		236
	3" strip - '96	53	32	4.4	7-7		252	311		282
LSD at 0.05		13	2	1.1		252	128	91	85	81

¹Roundup applied in 3" and 7" strips every 10" Sept. 13, 1995 and 3" strip on Sept. 4, 1996.

²1=no lodging, 5=severe lodging.

Table 11. Nitrogen-Sulfur Trial Applied to 'Park' Kentucky Bluegrass on the Byron Tviet farm north of Roosevelt, Oct. 15, 1996. Another set of treatments were established in the same field Oct. 15, 1997. 1997-98 data.

Fertilizer	Harvest		Seed Yield (lbs/A)		
	Ht. (in.)	Lodging	1997	1998	2 yr. Ave.
50# AS+ 70# Amm. Nit.	33	3.7	500	213	356
50# AS+ 70# Urea	32	2.2	461	165	313
120# Urea32	31	1.5	485	218	351
120# Amm. Nit.	33	3.5	479	153	316
LSD at 5% level	NS	1.0	N.S.	N.S.	N.S.

50# AS = 50# 'N' + 57# Sulfur.

other rates are actual nitrogen ('N') rates.

Experimental design: RCB w/3 reps in 1997.

Table 12. 'Park' Kentucky Bluegrass Renovation - Weed Control Study.¹ Cenex farm - Roseau, MN. 1997-98 data.

Treatment ²	Timing	Harvest		Seed Yield (lbs/A)		
		Ht. (in.)	Lodging ³	1997	1998	2 yr. ave.
1. 3/4 pt./Ac. Banvel+ 3/4 pt./Ac. 2,4-D Amine	Fall 9/10/97	32	3.1	460	341	401
2. 3/4 pt./Ac. Banvel+ 3/4 pt./Ac. 2,4-D Amine	Spring 5/20/98	31	2.4	391	250	320
3. .025#/Ac. Beacon+ 0.25% nonionic surfactant	Fall 9/10/97	29	1.0	381	197	289
4. .025#/Ac. Beacon+ .25% nonionic surfactant	Spring 5/20/98	30	1.6	509	283	396
5. Banvel+ 2,4-D+ ⁴ Roundup strip	Fall 9/10/97 Fall 8/23/96	34	3.9	392	389	390
6. Beacon+ ⁴ Roundup strip	Fall 9/10/97 Fall 8/23/96	30	1.5	336	207	272
7. ⁵ Roundup strip + 3/4 pt Banvel + 3/4 pt 2,4-D	7/30/97 9/10/97	33	2.5	---	381	---
8. No treatment	-----	32	3.1	402	385	393
LSD at 5% level		2	.9	122	99	91

Experimental design - RCB w/4 reps.

¹Seeded in 1990.

²3/4 pt./Ac. Banvel = .375A#: Dicamba.

3/4 pt./Ac. 2,4-D = .375#A:2,4-D.

.025# /Ac. Beacon = .02# A:Primisulfuron.

³1= no lodging, 5 = severe lodging.

⁴3" Roundup strip applied every 10" at 1/2 pt./Ac. after burning.

⁵3" Roundup strip applied every 10" at 1/2 pt./Ac. before burning.

Table 13. Fine Fescue Variety X Residue Management Trial Seeded on the Baumgartner Farm 7/24/94. 1998 data and '97-'98 seed yield.

Strain Species	Residue Treatment ¹	Harvest		Seed Yield lbs/A		2 yr. Ave.	
		Ht. Lodging ²	Date	1997	1998		
Boreal Creeping red fescue	Burn	36	5.0	7-15	442	519	481
	Rake off straw	35	5.0	7-15	373	267	320
	Rake off clip 1 1/2"	35	6.3	7-15	442	414	428
	Rake off strip	35	4.7	7-15	412	340	376
Hector Strong Creeping fescue	Burn	34	4.7	7-15	372	380	376
	Rake off straw	32	3.7	7-15	394	158	276
	Rake off clip 1 1/2"	34	6.0	7-15	500	313	407
	Rake off strip	34	5.7	7-15	385	191	288
Mary Chewings fescue	Burn	30	1.0	7-9	150	97	124
	Rake off straw	29	1.0	7-9	279	49	165
	Rake off clip 1 1/2"	30	1.0	7-9	141	101	121
	Rake off strip	29	2.0	7-9	204	89	147
Victor Creeping red fescue	Burn	34	3.3	7-15	248	250	249
	Rake off straw	33	4.3	7-15	235	279	257
	Rake off clip 1 1/2"	33	3.3	7-15	238	256	247
	Rake off strip	33	3.7	7-15	193	282	238
67135 Sheep fescue	Burn	36	5.0	7-9	337	420	379
	Rake off straw	36	6.0	7-9	384	393	389
	Rake off clip 1 1/2"	36	6.0	7-9	428	448	439
	Rake off strip	37	7.3	7-9	266	429	348
LSD at 5% level		2	3.8		153	124	82

Experimental Design: RCB w/4 reps.

¹Plots cut 7/24/97. Burn treatment 8/13/97. Residue removed on other plots 8/8/97. 1 1/2" clip treatment 8/11/97.

Rake off strip = 10" Roundup strip every 20" to renovate stand. Fusilade DX @ 3/4 pt/Ac applied 5/13/98. To all plots.

²1 = no lodging; 9 = severe lodging.

Table 14. 'Venture' Reed Canarygrass Renovation X Fertility Trial - Cenex farm Roseau, MN 1996-1998 data.

Renovation Treatment ¹	Fertility ²	Harvest Height (in.)	Harvest Date	Seed Yield lb/A			3 yr. Ave.	
				1996	1997	1998		
3" Roundup strip every 10" - 9/13/95	60+0+0	52	7-10	126	292	60	160	
	120+0+0	61	7-13	202	498	220	307	
	180+0+0	65	7-13	298	460	359	372	
No treatment	60+0+0	49	7-10	258	211	43	170	
	120+0+0	59	7-13	521	398	160	360	
	180+0+0	65	7-13	611	423	387	474	
LSD at 5% level				2	86	43	75	41

¹All plots burned March 30, 1998.

²Fertilized 4/21/98 with urea. No rain until 5/10/98 may have contributed to nitrogen loss.

Table 15. Fertility trial on 'Endure' Kura Clover. Cenex farm - 1997-1998 data.

Fertility level	Seed Yield (lbs/A)			Soil Test lbs/A 10/10/98		
	1997	1998	2 yr. Ave.	K ₂ O	P ₂ O ₅	SO ₄
0	578	566	572	6	170	10
50+0+0	580	600	590	6	160	10
0+0+80	640	526	583	4	174	70
0+0+240	575	580	578	6	276	26
0+40+80+10 sulfur	526	537	532	14	240	28
50+40+80+10 sulfur	584	473	529	8	194	134
LSD at 5% level	NS	NS	NS			

Experimental Design: RCB w/reps.

¹Fertilizer applied 4/21/98.

Table 16. Herbicides applied to 'Endure' Kura Clover. Cenex farm. 1997-1998 yield data.

Herbicide ¹	Seed Yield lbs/A		
	1997	1998	2 yr. Ave.
Princep 10/15/97	NA	270	---
Velpar 10/15/97	NA	201	---
Sencor 10/15/97	NA	223	---
Pursuit 6/13/97 + 6/4/98	586	161	373
Pursuit Prowl 5/21/97 + 5/13/98	568	288	428
Sencor 5/21/97 + 6/4/98	389	120	255
No treatment	344	212	278
LSD at 5% level	219	NS	149

Experimental Design: RCB w/4 reps.

3 oz. Pursuit (.047# Ai/Ac. Imazethapyr) + 2 pt/Ac Prefer 28.

3 pts. Prowl (1.25# Ai/Ac. Pendimethalin).

1.2# Sencor (1# Ai/Ac. Metribuzin).

3 pts. Princep (1.5 #/Ac Simazine).

3 pts. Velpar (.75 #/Ac Hexazinone)

1.2# Sencor (1#/Ac Metribuzin).

Table 17. Herbicides were applied to 6 legumes as an aid to establishment in 1998. Each species was seeded in a randomized complete block design with 3 reps in 5- 1' rows per plot on the Magnusson farm 6/3/98. Treflan and Eptam were applied pre-plant incorporate. All other treatments were applied July 22 with a bicycle sprayer at 12 GPA and 28 PSI. Weeds were 2"-4" high. All treatments except no treatments clipped 8/20/98.

Treatment	Trade name	Common name	Application rate	#/Ac. active	Timing	Additives
1	Treflan	Trifluralin	1.5pt	.75#	PPI	
2	Eptam	EPTC	4pt.	3.5#	PPI	
3	Ally	Metsulfuron	.13 oz.	.0067#	Post	1/4 pt Preference
4	Roundup Ultra	Glyphosate	1pt.	.375#	Post	
5	Pursuit	Imazethapyr	3 oz.	.047#	Post	1pt. Prefer 28
6	Raptor	Imazamox	4 oz.	.03#	Post	1pt. Prefer 28
7	Gramoxone extra	Paraquat	1pt.	.31#	Post	1/4pt Preference
8	Clip					
9	No treatment					

Species	Variety	Herbicide Treatment						
		1	2	3	4	5	6	7
		injury rating 8/13/98 ¹						
Nueltin	birdsfoot trefoil	1.7	2.3	9.0	4.7	1.7	2.7	7.7
Roseau	birdsfoot trefoil	2.3	1.7	9.3	8.7	1.7	2.7	9.0
Marathon	red clover	2.3	2.3	10.0	7.0	2.7	3.0	7.0
GH 766	alfalfa	2.3	2.0	9.3	7.0	2.3	2.3	8.0
Endura	kura clover	2.3	2.3	10.0	7.3	1.7	2.7	7.0
Lutana	cicer milkvetch	2.0	2.7	9.3	8.0	2.0	4.0	10.0
	LSD at 5%	1.5						

¹Injury rating. 1= none; 10=dead.

Not able to rate the clip and no treatment plots because of weeds.

Norcen

Table 18. The effect of herbicides applied to established 'Norcen' birdsfoot trefoil on the Craig Brandt farm south of Roseau, MN. 1998.

Tradename	a.i.or a.e./ acre	Product/a	Adjuvant/ ac.	Injury ¹ 7/3/98	Seed Yield ² lbs/A
Ally60DF	0.01	.267oz.	120ml non-ionic	8.8	45
Velpar+Ally	1+.01		120ml non-ionic	9.8	20
Princep+Ally	2+.01		120ml non-ionic	9	35
Roundup	0.375	1pt.		6.5	225
Princep	2	4pt		1.8	250
Express75%DF	0.024	.5oz.		6.8	238
Velpar	1	4pt.		2.8	338
Pursuit	0.047	3oz.	3pts-Prefer28	1.8	225
no treatment	----	----	----	1	231
LSD at 5% level				0.6	104

¹Injury rating; 1=none; 10=dead.

²Seed yields are visual rating-not actually harvested.

Princep and Velpar applied April 22, 1998.

All others applied June 3, 1998.

Table 19. The effect of timing of Roundup applications on selected birdsfoot trefoil populations seeded in St. Paul 7/30/97.

Roundup treatment	Population	% thistle infestation	% weeds infestation	seed yield lbs/A
5/5/98	Norcen	1	3	214
5/5/98	Roseau(NC3M)	0	1	213
5/5/98	Leo	4	5	168
5/5/98	Nueltin(LC6F)	1	1	264
5/21/98	Norcen	0	24	354
5/21/98	Roseau(NC3M)	0	2	262
5/21/98	Leo	0	16	303
5/21/98	Nueltin(LC6F)	0	3	422
6/10/98	Norcen	1	5	241
6/10/98	Roseau(NC3M)	0	0	259
6/10/98	Leo	0	6	182
6/10/98	Nueltin(LC6F)	0	0	251
5/5/98+6/10/98	Norcen	1	75	0
5/5/98+6/10/98	Roseau(NC3M)	0	1	388
5/5/98+6/10/98	Leo	0	78	0
5/5/98+6/10/98	Nueltin(LC6F)	0	2	424
no treatment	Norcen	13	20	238
no treatment	Roseau(NC3M)	14	21	204
no treatment	Leo	13	20	216
no treatment	Nueltin(LC6F)	18	26	257
no treatment	Norcen	4	13	177
no thistles planted	Roseau(NC3M)	6	10	180
	Leo	6	11	279
	Nueltin(LC6F)	11	18	186
		6	9	134

% thistle and % weeds = % of total biomass.

Roundup Ultra applied at 2 pts/ac. on each treatment date.

Thistles transplanted into all plots except treatment 6 - August 15, 1997.

Table 20. The effect of timing of Roundup applications on selected birdsfoot trefoil populations. Summaries of thistle infestations and seed yields in 4 trials seeded between 1994 and 1997.

Roundup treatment	LOCATION YEAR SEEDED DATA YEAR	F8		F1a		X24		F8		Brandt		F1a	X24					
		1994	1995	1994	1996	1995	1996	1994	1995	1994	1995			1995	1996			
Population		% thistle infestation																
		seed yield lbs/A																
early	Roseau(NC3M)	53		70		85		0		297		234		153		408		213
early	Norcen	63		70		85		1		169		127		85		183		214
early	Nueltin(LC6F)	47		70		85		1		264		245		90		289		264
early	Leo	65		70		85		4		207		47		3		194		168
intermediate	Roseau(NC3M)	17		5		5		0		377		309		98		430		262
intermediate	Norcen	36		5		5		0		244		65		7		169		354
intermediate	Nueltin(LC6F)	18		5		5		0		330		234		96		579		422
intermediate	Leo	46		5		5		0		171		58		31		243		303
late	Roseau(NC3M)	0		3		6		0		193		434				323		259
late	Norcen	0		3		6		1		17		471				361		241
late	Nueltin(LC6F)	0		3		6		0		185		450				426		251
late	Leo	0		3		6		0		19		448				468		182
early+late	Roseau(NC3M)	0		4		10		0		319		424				453		388
early+late	Norcen	9		4		10		1		32		114				303		0
early+late	Nueltin(LC6F)	0		4		10		0		325		433				379		424
early+late	Leo	0		4		10		0		8		98				292		0
no treatment	Roseau(NC3M)					100		14						77		359		204
no treatment	Norcen					100		13						107		262		238
no treatment	Nueltin(LC6F)					100		18						63		353		257
no treatment	Leo					100		13						64		378		216
no thistles planted	Roseau(NC3M)	80		100		100		6		351		69				339		180
no treatment	Norcen	78		100		100		4		344		83				261		177
	Nueltin(LC6F)	89		100		100		11		434		120				274		186
	Leo	91		100		100		6		416		245				290		279

LSD at 5%

Roundup Ultra applied at 2pts/ac. each treatment date.

Thistles transplanted into all plots except treatment 6.

LOCATION= F8 & F1a Baumgartner farm

Brandt-Craig Brandt farm south of Roseau

X24 -St. Paul campus

Roundup timing= early- mid-May

intermediate-early June

late- mid-late June

N.S.