

PROGRESS REPORT ON GRASS SEED PRODUCTION RESEARCH

prepared by

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Grass-Legume Seed Institute Presentation

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This summary and previous annual research summaries are on the Web at:

<https://turf.umn.edu/seed-production-research-progress-reports>

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General management regime of research plots in Northern Minnesota:

Spring seeded ryegrass with wheat-BMP(best management practice)

Ryegrass seeded at 5#/acre with spring wheat
Sterling Blue(dicamba)+ 2,4-D amine 4 (0.75 + 0.75 pint) applied in late September
Fertilize 30-50-50 after small grain harvest
Spike tooth harrow after fall fertilizer application to spread straw
Fertilize 110-0-0-20s(15#ESN) applied early May, 300 - 600 GDD
Sterling Blue+ 2,4-D amine 4 (0.75+0.75 pint) applied late May, 700 - 900 GDD
Tacoma or Assure II (8-10 oz) applied early June, 800 - 1,000 GDD
Apogee (6-8 oz) applied early heading, 1,100 - 1,300 GDD
Priaxor 6oz.or Quilt Xcel 12oz. applied full heading, 1,700 - 1,900 GDD or as needed

Fall seeded ryegrass in wheat stubble

Pre-harvest glyphosate application to wheat , or
glyphosate applied to wheat stubble prior to seeding ryegrass, if needed.
Drill ryegrass at 6#/acre after wheat harvest into existing stubble
Fertilize 30-50-50 at planting
If planting into summer fallow, apply 11-50-50.

Intermediate Wheatgrass/Kernza

Establishment=Seed at 10#/acre in late August in 6"-8" rows.
120-40-40-10s applied in late October.
.75pt. 2,4-D a + .75pt. Sterling Blue late September or May as needed.
Field burn in early September after harvest.

Kentucky bluegrass

Establishment=Seed at 4#/acre in late August to early September.
120-40-40-10s applied in late September.
.75pt. 2,4-D a + .75pt. Sterling Blue late September.
Field burn in August.

General seed harvest procedure for small research plot

Note:Years sited on the summary tables are generally the year the trial was planted or initiaed.
Measured areas are hand cut and bagged for each individual plot.
These samples are then brought to the U of M St.Paul campus
where they are dried, threshed, cleaned and weighed.
Seed yields, quality and other data are statistically analyzed and results summarized.

On-farm small plot research trials

General crop management is done by the grower/cooperator.
Application of treatment variables, agronomic notes and harvest performed by U of Mn personnel.
Effort is made to remove research samples prior to grower harvest.
Cooperators are asked to avoid management applications of treatments involved in the study to the research plot area.

On-farm large plot trial research protocol

These experiments are conducted in fields with growers implementing all of the general field management.
Treatment variables are field scale and are applied either by the grower or University personnel.
University agronomists and grower cooperators work together to insure treatment variables are properly applied.
Plant samples, crop development observations and other applicable notes
are recorded as needed throughout the growing season usually by University personnel.
At harvest, University agronomists will assist the growers in collecting quality samples and recording harvest data.
Experimental design usually consists of 2 or 3 treatment variables and 3 replicates/treatment.

2023 Research Locations

MagPlots=University of Minnesota-Magnusson Research Farm 2 miles north and 4.5 miles west of Roseau,Mn
Northern Resources=West Plant-Roseau
MagFarms=Magnusson Farms- NW of Roseau
Casey Pearson=NW of Roseau
Rice Farms= NW of Roseau
Estling Farm=North of Roosevelt
Stanley Farms=Grygla area

Table 1.

Monthly and Year End Precipitation Totals*
Roseau, Mn 1967-2023.

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Yearly Total(in.)	Mean Deviation	Mean(F ^o) Temperature
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	-3.52	35.8
1968	0.62	T	1.25	0.63	1.46	6.47	6.13	8.49	2.35	1.26	1.06	0.21	29.93	7.25	37.3
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	1.63	37.0
1970	0.71	0.41	1.38	2.56	5.93	4.07	3.55	0.83	2.77	1.49	1.21	0.37	25.28	2.60	35.0
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	18.32	-4.36	36.2
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	-3.58	34.9
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	21.42	-1.26	M
1974	0.88	0.87	0.16	2.72	4.12	1.56	2.56	11.00	0.42	0.66	0.15	1.40	26.47	3.79	M
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	-4.63	M
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	-6.85	36.2
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	-3.24	37.7
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	-2.06	35.3
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	-5.22	32.6
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	-3.53	36.0
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	0.92	38.3
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	-2.47	34.2
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	21.95	-0.73	37.7
1984	T	0.95	T	0.72	0.72	4.46	3.78	0.99	0.37	4.32	0.10	1.02	17.43	-5.25	37.3
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	2.37	34.4
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	-3.30	M
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	-4.76	M
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	16.93	-5.75	M
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	-0.97	M
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	11.68	-11.00	38.2
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	7.61	M
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	-2.06	36.5
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	-0.89	35.5
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	18.60	-4.08	37.7
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	-0.73	35.8
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	3.31	M
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	-2.01	M
1998	0.69	1.05	0.21	0.77	4.55	5.39	3.01	2.20	0.31	4.42	1.39	0.95	24.94	2.26	M
1999	0.15	0.77	0.23	1.31	4.09	6.97	3.46	1.38	3.16	0.43	0.38	0.56	22.89	0.21	40.1
2000	0.45	0.14	0.79	0.38	1.83	7.38	1.63	6.45	2.14	2.89	3.41	0.74	28.23	5.55	38.2
2001	0.21	0.52	0.46	1.89	3.27	1.76	4.74	1.40	0.72	1.76	1.50	0.56	18.79	-3.89	39.8
2002	0.19	0.10	0.45	1.44	2.79	9.94	2.96	4.47	1.62	1.02	0.30	0.54	25.82	3.14	38.1
2003	0.80	0.77	1.60	1.75	2.95	3.56	1.92	1.78	4.55	1.32	1.52	1.95	24.47	1.79	37.6
2004	2.85	0.70	2.14	2.61	8.19	2.98	2.42	5.50	2.97	2.36	0.08	1.33	34.13	11.45	36.0
2005	2.33	0.67	0.82	0.73	3.62	7.55	3.37	3.24	1.77	3.48	2.06	1.65	31.29	8.61	39.0
2006	2.52	0.95	1.01	1.23	1.97	1.00	0.94	2.18	2.42	1.54	0.17	0.56	16.49	-6.19	41.0
2007	0.44	0.56	1.25	0.95	2.75	7.75	2.92	1.37	0.92	5.14	0.39	0.86	25.30	2.62	38.0
2008	0.25	1.29	0.46	2.17	1.56	3.93	4.33	3.63	3.06	2.37	2.00	1.47	26.52	3.84	36.0
2009	1.25	1.75	4.45	1.37	3.59	3.72	1.28	3.92	2.67	1.06	0.28	1.22	26.56	3.88	36.0
2010	0.80	0.43	0.55	1.23	6.47	2.88	3.79	1.50	6.09	2.42	1.14	0.61	27.91	5.23	40.0
2011	1.15	0.20	0.23	3.14	2.63	3.87	2.38	1.63	0.89	1.34	0.19	0.07	17.72	-4.96	39.0
2012	0.59	1.06	2.06	1.39	1.48	3.32	2.74	1.42	0.18	3.64	1.22	0.24	19.10	-3.58	41.0
2013	1.34	1.21	1.05	1.40	4.69	1.70	2.14	3.77	2.65	0.84	1.43	1.85	24.07	1.39	35.0
2014	2.32	0.54	3.31	1.71	3.74	4.23	2.21	1.62	2.68	1.14	0.75	1.49	25.74	3.06	36.0
2015	1.11	0.57	0.71	0.42	5.18	4.33	6.27	4.45	1.43	2.08	1.52	3.08	31.15	8.47	41.0
2016	0.39	0.89	1.31	1.29	3.14	5.71	3.57	1.23	3.97	0.97	0.85	0.75	24.07	1.39	42.0
2017	1.44	1.55	0.59	0.47	0.90	5.55	0.83	0.99	6.22	0.97	0.94	2.71	23.16	0.48	41.2
2018	1.04	0.99	2.76	0.02	2.71	1.89	1.75	1.36	2.05	1.68	0.62	1.28	18.15	-4.53	36.6
2019	0.90	1.65	1.66	0.27	1.42	2.99	4.09	3.42	9.95	4.18	0.80	0.74	32.07	9.39	35.2
2020	0.84	0.29	1.30	0.53	1.66	6.29	8.23	2.30	0.77	1.11	1.19	0.99	25.50	2.82	38.3
2021	0.35	0.23	0.14	1.32	1.64	1.53	1.18	3.52	1.18	3.00	2.07	1.50	17.66	-5.02	42.1
2022	0.54	1.88	0.33	3.45	5.27	2.07	3.54	5.86	1.94	0.91	0.66	1.31	27.76	5.08	36.0
2023	0.34	0.13	0.58	0.62	1.82	1.36	2.62	1.48	1.82	1.81	1.17	1.32	15.07	-7.47	39.8

57 year average annual precipitation

22.54

43 year available mean temperature=

37.4

*Precipitation amounts used are from the Magnusson Research Farm-near Roseau April/May-October and Minnesota Climatology Working Group nearest location for the remainder of the year.

Average precipitation the last 20 years=24.94". Average precipitation the previous 33 years=21.16"

2023 Precipitation	May	June	July	August	Sept.	TOTAL
West Plant	1.34	3.06	2.85	1.56	2.55	11.36
Magnusson Research Farm	1.82	1.36	2.62	1.48	1.82	9.10

Table 4.

2020 Kentucky Bluegrass Variety Trial
Magnusson Research Farm-Roseau,Mn

LINE	source	Lot#	Seed Yield (#/acre)			Yield % mean	Harvest			Heading (%)			
			2022	2023	2022-23		Ht.(in.)	Date	Lodging ¹	5/30	6/1	6/4	6/8
Park	check	4062	857	458	658	115	32	27-Jun	2.3	45	78	96	100
Minnfine	check	4063	736	565	651	113	32	27-Jun	2.0	58	88	100	100
Dragon	check	4131	825	721	773	135	25	27-Jun	1.0	20	48	78	100
Desert Moon	PST	4135	705	485	595	104	24	29-Jun	1.0	4	21	63	90
New Moon	PST	4136	594	556	575	100	26	29-Jun	1.0	13	43	73	99
Exp#1	exp	4132	952	514	733	128	27	29-Jun	1.0	11	35	73	100
A99-3124	MN-Rutgers	3920	445	485	465	81	21	29-Jun	1.0	2	8	28	60
318west	UM	4120	429	476	453	79	21	29-Jun	1.0	3	10	33	65
610middle*	UM	4121*	354	407	381	66	19	29-Jun	1.0	8	23	38	63
704east*	UM	4122*	427	482	455	79	21	29-Jun	1.0	6	18	36	70
LSD @5% level			100	81	68	11	2	0	0.6	13	19	21	13
CV(%)			11	11	8	8	5	0	34	54	36	23	11

Experimental design:RCB with 4 reps

Seeded 8/5/2020 @5#/acre

Mean trial yield= 632 515 574

*Significant off type bluegrass contamination in plots of these lines

¹ Lodging-9=Flat;1=Upright

5/25/2023 4oz Tilt+2oz. Grizzly

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Table 5.

2020 Intermediate Wheatgrass-Kernza Variety Trial
Magnusson Research Farm-Roseau,Mn. 2023 data and 2021&2022 Seed Yield

Seed lot#	Variety	Seed Yield-#/acre				Harvest		% heading			
		2021	2022	2023	Mean	Ht.(in.)	Hulled % ¹	6/8	6/12	6/15	6/20
4138	TLI 701	997	1335	1064	1132	55	86	1	9	50	96
4139	TLI 702	955	1141	743	946	56	93	2	23	58	100
4140	TLI 703	1068	1144	874	1029	56	88	2	20	48	93
4141	TLI 704	1108	1037	861	1002	54	91	2	16	48	94
4146	TLI -C5	1001	1079	894	992	56	85	2	16	60	100
4142	MN-1601	948	943	972	955	60	85	0	9	50	96
4143	MN-1603	1012	930	790	911	55	86	0	5	30	90
4144	MN-1605	872	981	863	906	61	88	0	9	58	98
4145	MN-1607	1084	939	888	970	58	85	0	4	33	90
4147	MN-Clearwater	1001	1099	903	1001	57	86	0	9	48	95
LSD @ 5% Level		145	140	104	64	4	4	2	8	17	5
CV(%)		10	9	8	4	5	3	154	48	25	4

Experimental design:RCB with 4 reps

All harvested 8-9-2023

Planted 8-20-2020 @ 10#/acre

¹Hulled %= visual estimate of % hulled seed after processing and cleaning

Fertilizer application= 140-40-40-10s 10/2022

Residue burned 8/29/2022

2pt./acre of Curtail applied 5/23/2023

Table 6.

2023 Field Pea Variety Trial Magnusson Research Farm.

Variety	Yield-Bu/acre ¹		Bushel	Harvest		Flowering		
	2023	Protein	Wt.	ht(in)	Lodging ²	First	50%	End
AAC Chrome	117.7	20.9	64.5	29	2.3	3-Jul	8-Jul	26-Jul
AAC Profit	115.3	23.7	64.4	29	2.0	3-Jul	9-Jul	27-Jul
AAC Julius	104.3	23.3	64.8	28	2.0	1-Jul	8-Jul	28-Jul
5206	109.7	22.9	64.7	30	1.0	30-Jun	8-Jul	28-Jul
LSD @ 5% Level	7	0.7	0.4	NS	NS	3.0	NS	2
CV(%)	3.2	2.4	0.3	7.9	9.8	5.3	3.3	3.6

Experimental Design: RCB w/3 reps

¹Yield=Bushels per acre at 12% moisture and 65#/bu.

²Lodging 9=Flat;1=upright

Management-

Herbicide application-

Authority Elite 1.5pt.acre 5/22/23

4 oz. Section 3 6/11/2023

5oz. Beyond Xtra 6/18/2023

24oz Gramoxone 8/19/2023

Site= Conventional tillage seedbed- Non-irrigated

Fertility application 8-50-50 Soil type- sandy loam

Previous crop- spring wheat

Planting Date= 5/16/2023

Harvest date- 8/28/2023

Field pea Seeding Rate= 350,000PLS/acre

Table 7.

2022-23 Perennial Ryegrass Fertility Trial Magnusson Research Farm-Roseau,Mn

TRT	Total Fertilizer Added ¹	Fall Application	Seed Yield %mean #/acre	Ht(in.) Harvest	Lodging ² Harvest	Treatment Variable Explanation
1	8-40-40		22 255	14	1.0	No added N
2*	140+40+40	30-0-0-10/17	103 1188	19	3.8	30#N late fall(No ESN+No AMS)
3	140+40+40+20s	30-0-0-9/29	101 1164	20	4.0	AMS+No ESN
4*	140+40+40	30-0-0-9/29	108 1239	19	3.3	No ESN+No AMS
5	140+40+40+20s	30-0-0-9/29	101 1159	19	4.0	AMS +ESN 5/3/2023(standard)
6	140+40+40	30-0-0-9/29	100 1153	19	2.3	ESN+No AMS
7	140+40+40+20s	No fall N	96 1101	19	1.8	ESN+AMS & All spring applied N
8	100+40+40+20s	30-0-0-9/29	91 1043	18	2.0	ESN+AMS + low N rate -100#/ac.
LSD @5% level			11 125	2	1.4	
CV(%)			8 8	6	35	

Experimental Design:RCB w/4reps Variety=Arctic Green

Mean yield(not including 0# N)= 1150#/ac

¹-15#N-ESN applied to treatments 5 - 8 on 5-8-2023

²-Lodging-1=upright;9=flat

*-The 2 highest yielding treatments in the trial had no ESN or AMS added. The dry year may have lead to the ESN not being available, whereas the urea source was. It should not be concluded that AMS reduced yield. It's possible there were a couple of treatment 4 plots in a better yielding location.

All plots received 8-40-40 on 9/29/22

fall treatments-10/17/2022

Spring 'N' applications 5/3/2023

Harvest date=7/18/2023

Treatment Explanations:

TRT#	Total Fertilizer Added	Additional Fertilizer ¹
1	8-40-40	None
2	140+40+40	30-0-0 on 10/17/2022 ; 102-0-0 on 5/3/2023
3	140+40+40+20s	30-0-0 on 9/29/2022; 102-0-0-20s(20#AMS) on 5/3/2023
4	140+40+40	30-0-0 on 9/29/2022; 102-0-0 on 5/3/2023
5	140+40+40+20s*	30-0-0 on 9/29/2022; 102-0-0-20s(15#ESN + 20#AMS) on 5/3/2023
6	140+40+40*	30-0-0 on 9/29/2022; 102-0-0(15#ESN) on 5/3/2023
7	140+40+40+20s*	132-0-0-20s(15#ESN+20#AMS)) on 5/3/2023
8	100+40+40+20s*	30-0-0 on 9/29/2022; 62-0-0-20s(15#ESN + 20#AMS) on 5/3/2023

¹-All plots received 8-40-40 on 9/28/2022; fertilizer listed in addition.

10/11/22 Soil test results

Depth	Olsen P	K	% OM	PH	NO3-N
0-6"	7 ppm	106 ppm	2.1	8.1	4#/acre
6-24"					6#/acre

Fertilizer sources=

N(Urea)-46-0-0 (100#N=217# urea/acre)

Sulfur(AMS)21-0-0-24s (20#S=83#AMS/acre)

Poly Coated N(ESN 44-0-0) (15#N=34#ESN/acre)

P & K Sources-P= 11-52-0; K=0-0-60

Table 8.

2011-23 Perennial Ryegrass Fertility Trial Seed Yield Summaries Magnusson Research Farm-Roseau,Mn

Trt. #	Nitrogen Fertilizer	Late Fall Nitrogen	Overall ³ Mean	Seed Yield as % of Mean												
				2023	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011
1	0	0	28	22	25	26	24	20	21	45	38	29	27	28	21	36
2	100+0+0	30#	98	91	----	91	99	103	90	104	90	----	92	96	112	108
3	140+0+0	30#	105	108	77	104	104	111	101	99	110	99	104	104	118	118
4	140+40+0	30#	108	----	106	99	96	100	107	106	109	127	120	----	----	----
5	140+0+0+20s	30#	101	101	117	104	95	99	101	102	----	----	110	99	----	----
6	140+0+0	30#	103	----	----	----	98	102	101	99	----	----	106	109	----	----
7	180+0+0	30#	109	----	----	----	----	----	107	92	111	----	122	111	----	----
8	140+0+0	0	102	96	----	106	104	99	94	91	106	----	96	104	119	115
LSD @5% level				11	15	12	10	13	11	13	12	20	11	16	11	12
CV(%)				8	9	9	8	10	8	9	9	16	8	NA	NA	NA

Experimental Design:RCB with 4 reps

Variety all years=Arctic Green

Yield Trial mean by year (#/acre)-- 1150 1525 1276 1584 1668 1631 1627 1220 1344 1244 1068 1499 1313

¹Split-30-50-50 applied fall and remainder in spring

²Split-30-50-50-20s(77#AMS / acre) applied in fall+110-0-0 in early May

³Treatment overall means should be viewed with caution when there are limited number of years-(ie-#6-7)

Trt. #	Explanation of fertility treatments
1	No fertilizer added
2	30-40-40 applied Sept-Oct. / 70-0-0 applied early May
3	30-40-40 applied Sept.-Oct. / 110-0-0 applied early May (standard)
4	30-40-40 applied Sept-Oct. / 110-40-0 applied early May
5	30-40-40-20s(77#AMS) Sept-Oct. / 110-0-0 applied in early May
6	30-40-40 applied Sept-Oct. / 90-0-0 applied May / 7 gal. 28%UAN applied mid-June
7	30-40-40 applied Sept-Oct./ 150-0-0 applied early May
8	8-40-40 applied Sept.-Oct. / 140-0-0-20s applied early May

Table 9.

**2023 Growth Regulator Applications to Per. Ryegrass
Magnusson Research Farm-Roseau,Mn**

Application		Rate/acre	Additive	Seed Yield	Harvest	Lodging ¹
Date	PGR treat			#/acre	Ht(in.)	Harvest
21-May	Altercel*	10pt	.25%NIS	1076	22	9.0
5-Jun	Altercel*	10pt	.25%NIS	1060	21	8.5
21-May	Palisade+Altercel*	8oz+5pt	.25%NIS	1028	20	6.0
5-Jun	Palisade 1EC	1pt	.25%NIS	1010	18	4.5
5-Jun	Apogee	8oz.	.25%NIS+2.5% UAN	1022	17	4.0
21-May	Apogee + Altercel*	4oz.+5pt.	.25%NIS+2.5% UAN	1112	20	7.5
----	No treatment	----	----	952	22	8.5
LSD @5% level				136	3	1.7
CV(%)				9	9	15

Experimental design=RCB w/4reps

Variety= Arctic Green

Harvest date=7/20/2023

*Adjust SL(CCC) was unavailable last spring and Altercel at an adjusted active ingredient rate(5X) was used in it's place.

*Altercel is a 1#/gal horticultural product vs. the agricultural product Adjust SL at 5.17#/gal

Altercel rate was adjusted to equal the 1-2 pint/acre rates of Adjust or Manipulator(Canadian version of CCC).

¹-Lodging-1=upright; 9=flat

All applications made with a CO2 bike sprayer with T-jet nozzels @28PSI and 12.5GPA

5/21-23 7am 1,3,6 light dew on plants

ryegrass 3-4" 64F 3-4 ssw 49%RH overcast

6/5/2023 10;30am hazy sun 76F gs=6-10"

73%RH 1-10%hdng

Trade Name	#/gal Active	Ingredient	Common name	rate/ac.	adjuvant
Moddus	2.08	trincipac-ethyl		.25-.5pt	.25%NIS
Palisade 1EC	1.00	trincipac-ethyl		.5-1pt	.25%NIS .125# TE/ac.
Apogee	27.50%	prohexadione	calcium	8oz.	.25%NIS +2.5%UAN
Altercel* 11.8%	1.00	chlormequat chloride(CCC)		5-10pt	.25%NIS 1.25#CCC
Adjust SL(CCC)	5.17	chlormequat chloride(CCC)		1-2pt	.25%NIS
Manipulator 620(CCC)	5.17	chlormequat chloride(CCC)		1-2pt	.25%NIS
1gal 28%UAN(urea ammonium nitrate)=3#N					.25%NIS=(.25pt./ac)
					2.5% UAN=(2.5pts/ac.)

Table 10.

**2023 Spring Pre-emergent Herbicides applied to Ryegrass
Magnusson Research Farm-Roseau,Mn**

Trt#	Trade Name/ Treatment ¹	Product Rate/acre	Seed	Stand ²	Volunteer wheat		Ht(in.) Harvest	Lodging ⁵ Harvest	Test	% Germination	
			Yield #/acre	reduction 6/2	control ³ 6/2	amount ⁴ 7/18			Weight #/bushel	Strong	Weak ⁶ Abnormal
1	Prowl H2O	3.5pt	1202	1.0	2.0	5.5	18	2.0	28.3	NA*	NA*
2	Outlook	1pt	NH*	7.3	6.3	4.8	16	1.3	NH*	NH*	NH*
3	Harness	2pt	NH*	7.0	7.3	4.5	17	1.0	NH*	NH*	NH*
4	Callisto	6oz.	1190	2.0	4.0	7.8	19	1.8	28.7	NA*	NA*
5	Aatrex	1pt	881	2.5	9.0	9.0	18	1.8	28.0	97	1
6	GoalTender+Nortron	2oz+2pt	1070	1.3	9.0	9.0	17	1.8	29.2	NA*	NA*
7	Nortron	4pt	1197	1.0	8.8	9.0	18	1.8	29.6	97	2
8	Dual II Magnum	1pt	NH*	5.8	5.3	4.0	17	1.3	NH*	NH*	NH*
9	no treat	-----	1110	1.3	1.0	5.0	19	2.0	28.8	95	1
10	no treat-Harrow	-----	1112	1.3	1.0	5.3	17	1.8	28.8	NA*	NA*
11	Trust-Harrow	2pt	1137	1.5	1.5	6.0	18	2.0	28.6	NA*	NA*
	LSD @5% level		132	0.9	1.8	2.7	2	0.7	-----	-----	-----
	CV(%)		8	21	25	30	6	30	-----	-----	-----

Experimental design=RCB w/4reps

Variety=Arctic Green

*NH=Not harvested because of herbicide injury

*NA=Subset of germinations did not include these plots

¹-Applications of treatments 1-8 applied 5/9; treatment 11 and harrow of treatments 10-11 done on 5/18²-Effect of treatment on ryegrass stand- 1= no effect; 9=severe injury³-Visual rating of treatment effect on volunteer wheat control- 1=none;9=good control⁴-Visual rating on amount of volunteer wheat in plot area- 1=heavy; 9=no wheat present⁵-Lodging-1=upright; 9=flat⁶-Weak/abnormal germination-These germinations would not be added in for total germination.

Numbers given as a possible indicator of herbicide injury

Applications of treatments on 5/9/2023 62F wind sse 4-8 sunny

GS-ryegrass just beginning to greenup--wheat stubble 7" high.

.7" rain 5/10/2023

Treatment 11 applied 5/18/2023. Treatments 10-11 spike tooth harrowed immediately after treatment 11 application.

Spray applications made w/ 10' bike sprayer 8002 T-Jet nozzels @26PSI and 12GPA

Plot size=10' x 25'

Aatrex 4# atrazine
 GoalTender 4# oxyfluorfen
 Dual II Magnum 7.6# metalachor
 Nortron 4# ethofumisate
 Callisto 4# Mesotrione
 Warrant 3# acetochlor
 Outlook 6# dimethamid
 Harness 7# acetochlor
 Trust(Treflan) 4# trifluralin
 Prowl H2O 3.8#pendamethalin

8-40-40 applied 9/2022+110-0-0-10s 5/2023

4oz. Apogee to all plots

No post emergent grass control

Table 11.

**2023 Post Emergent Herbicides applied to Perennial Ryegrass
Magnusson Research Farm-Roseau,Mn**

trt Treatment	Rate per acre	Adjuvant	Date of application	Seed	Wheat		Test	% Germination	
				Yield #/acre	control ¹ 13-Jun	Ht(in.) Harvest	Weight #/bushel	Strong	Weak ² Abnormal
1 Callisto+Sterling Blue+2,4-D/Assure II	3oz+12oz+12oz/10oz	.5%HCMSO+2.5%-28%N	5/31+6/5	914	9	17	27.6	91	2
2 Huskie+Assure II	13.5oz+10oz+.25%NIS		6/5	1001	9	18	27.9	91	4
3 Sterling Blue+2,4-D/Assure II	12oz+12oz/10oz		5/31+6/5	1133	9	18	27.0	91	2
4 Sterling Blue+2,4-D+Dual II/Assure II	12oz+12oz+1pt/10oz		5/31+6/5	1076	9	19	28.0	93	2
5 Sterling Blue+2,4-D+Prowl/Assure II	12oz+12oz+3pt/10oz		5/31+6/5	1043	9	17	27.7	92	1
6 Wolverine	1.7pt	1pt Amsol	6/5	1128	3	19	27.8	95	2
7 Wolverine + Dual II	1.7pt+1pt.	1pt Amsol	6/5	1161	4	17	27.8	90	3
8 No herbicide	----	----	----	1197	1	17	27.6	90	2
			LSD @5% level	149	1	2			
			CV(%)	9	12	7			

Experimental design=RCB w/4reps

All harvested on 7/20/2023

¹-Wheat control-9=good control; 1=no control²-Weak/abnormal germination-These germinations would not be added in for total germination.

Numbers given as a possible indicator of herbicide injury

No lodging at harvest

1 Callisto+Sterling Blue+2,4-D/ 1a Assure II	3oz. Callisto+.75pt. 2,4-D +.75pt.Sterling blue+ .5pt Destiny(MSO)+2 pt 28%N applied 5/28 10oz. Assure II + 4oz. Preference(NIS) 6/2
2 Huskie+Assure II	13.5oz.Huskie +10oz. Assure II + 4oz. Preference(NIS) 6/2
3 Sterling Blue+2,4-D/ 3a Assure II	.75pt. Sterling Blue + .75pt. 2,4-D 5/28 (Standard) 10oz. Assure II + 4oz. Preference(NIS) 6/2 (Standard)
4 Sterling Blue+2,4-D+Dual II/ 4a Assure II	.75pt. Sterling Blue + .75pt. 2,4-D + 1pt.Dual II Magnum 5/28 10oz. Assure II + 4oz. Preference(NIS) 6/2
5 Sterling Blue+2,4-D+Prowl/ 5a Assure II	.75pt. Sterling Blue + .75pt. 2,4-D + 3pt. Prowl H2O 5/28 10oz. Assure II + 4oz. Preference(NIS) 6/2
6 Wolverine	1.7pt Wolverine + 1pt. Amsol(.5# AMS)
7 Wolverine + Dual II	1.7pt Wolverine + 1pt. Dual + 1pt. Amsol(.5# AMS)
8 No herbicide	No Treatment

Application 5-31-2023

11am 70%sun, 74F wind ENE2 RH 60%

G. stage 3-5" Early joint 1 node

Application 6-5-2023

11:30am hazy sun 77F wind SE 7 RH67%

G. stage 6-10" 5%heading

Spray applications made w/ 10' bike sprayer 8002 T-Jet nozzels @26PSI and 12GPA

Callisto	4#/gal. Mesotrione
Sterling Blue(Banvel)	4#/gal. dicamba
2,4-D amine(Weedar 64)	3.8#/gal. dichloral phenoxy acetic acid
Huskie	1.75# bromoxynil + .31# pyrasulfotole
Wolverine Advance	1.05# bromoxynil + .13# pyrasulfotole + .4# fenoxypop
Assure II	.88#/gal. quizalofop
Dual II Magnum	7.64#/gal. metolachlor
Prowl H2O	3.8#/gal. pendimethalin

Table 14.

**2023-24 Evaluation of Perennial Ryegrass Assure II Crosses With Elite Germplasm
St.Paul campus University of Minnesota**

<u>St.Paul seeded 9/22/2023</u>		<u>St.Paul</u>		
<u>Roseau Seeded 8/30/2023</u>		<u>Injury¹</u>		
Assure II Screen Trial	Seed lot#	11/15/2023	12/15/2023	
1 Arctic Green	4171	1.0	1.0	Tolerant check
2 Silver Sport	4169	6.5	7.5	Parent
3 Silver Sport-A1	4161	4.0	3.0	First Assure II cross(A1)
4 Silver Sport-A2	4165	2.5	2.5	Second Assure II backcross(A2)
5 Silver Sun	4170	5.5	5.5	Parent
6 Silver Sun-A1	4162	3.5	2.5	First Assure II cross(A1)
7 Silver Sun-A2	4166	2.0	2.0	Second Assure II backcross(A2)
8 Gray Fox	4168	8.5	8.0	Parent
9 Gray Fox-A1	4160	2.5	3.0	First Assure II cross(A1)
10 Gray Fox-A2	4164	1.5	1.5	Second Assure II backcross(A2)
11 Tayo rye	11	9.0	9.0	Rye check
LSD @5% level		2.0	2.7	
CV(%)		21	29	

Experimental design-St.Paul and Roseau= RCB with 2 reps

¹ Visual Injury- 1=no injury; 9=dead

St.Paul application

Assure II @ 20oz.+25% NIS/acre sprayed 10/10/2023 52F wind NW4-10mph
GS-Just emerged to 3leaf

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Table 15.

**2022-23 Sonalan Product Fall Application on Lentils
Magnusson Research Farm-Roseau,Mn**

Trt	Application rate			
No. Treatment ¹	#/acre	%stand ²	Pigweed ²	Foxtail ²
1 Untreated Check	-----	55	17	12
2 Sonalan 10G	5.5	48	6	4
3 Sonalan 10G	7.5	68	9	13
4 GWN 10469	5.5	53	8	8
5 GWN 10469	7.5	53	9	7
LSD @5%level		20	NS(14)	NS(12)
CV(%)		24	96	89

Experimental Design=RCB w/4 Reps

¹Treatments all applied 11/1/2022 after fall tillage

Herbicide Treatment area=8' x 17'

² Visual Rating of % stand 6/20/2023 and predominant weed species present-

Pigweed= redroot and prostate pigweed --foxtail=Green and yellow

Seeding rate=22 seeds/ft.2

Lentil VNS--98% Germ-Agassiz seed

Planting date=5/16/2023

Sonalan 10G = Ethalfluralin 10%G

Table 16 .

**2020-23 Kernza Residue Management and Summary
Magnusson Research Farm. 2023 Data and 2021-22 Yields.***

TRT Treatment	Seed yield #/acre				Dry matter Tons/ac	Harvest Ht(in.)	% Heading			
	2021	2022	2023	mean			8-Jun	12-Jun	15-Jun	20-Jun
1 Burn	594	773	732	700	3.9	57	2	23	58	96
2 Bale straw	433	509	496	479	3.5	53	0	11	40	89
LSD @ 5% Level	201	122	121	NA	0.7	8	3	13	8	4
CV(%)	30	13	8	NA	9	7	139	35	7	2

Experimental Design:RCB/w 4 reps

Kernza variety=MN-Clearwater

Harvest Date= 8-9-2021 , 8/22/2022, 8-11-2023

2023 Management-

Mow all 8/26/2022, bale off 8/30/2022, burn 9/1/2022

Fertilizer=130-40-40-5s 10-23-2022

*- 2021-2022 trials were planted in 2019 and residue treatments imposed in 2020 & 2021 on the same plot areas.
2023 harvested trial was a different location planted in 2021 with residue treatments in 2022.

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Table 17 .

**2020-22 Kernza Residue Management
Magnusson Research Farm. 2022 Data and 2021-22 Yields.**

TRT# Treatment	Seed yield #/acre			Harvest Ht(in.)	% Heading			
	2021	2022	mean		22-Jun	26-Jun	1-Jul	5-Jul
1 Burn	594	773	683	60	18	63	91	99
2 Bale straw	433	509	471	54	10	48	81	94
3 Bale-Short clip+Bale	392	418	405	49	8	40	68	86
4 No Treatment	264	499	382	56	1	28	65	90
LSD @ 5% Level	201	122	139	5	6	13	12	5
CV(%)	30	13	18	6	47	18	10	3

TRT# Treatment	Dry Matter(T/acre)		Protein ¹		RCI ³	
	2021	2022	%DM	%TDN ²	3-Jun	17-Jun
1 Burn	2.5	5.4	4.9	68.0	395	385
2 Bale straw	2.1	3.8	5.0	68.3	340	302
3 Bale-Short clip+Bale	1.8	3.3	4.5	68.3	307	317
4 No Treatment	1.4	4.2	6.8	67.7	306	418
LSD @ 5% Level	0.7	1.5	1.1	0.6	NS	76
CV(%)	25	23	13	1	18	13

Experimental Design:RCB/w 4 reps

Harvest Date= 8-9-2021 , 8/22/2022 Kernza variety=MN-Clearwater

Harvested 8/5/2020

Trt#1 Burned 8-11-2020, 8/25/2021

Trt#2 Raked off 8-10-2020, 8/11/2021

Trt#3 Clip-Rake 9-9-2020,9/27/2021 Flail chopped off to 4" ht.

Trt#4 Kernza harvested and residue left on plot

¹ %Protein on Dry Matter basis

² Total digestible nutrients of the dry matter.

Table 18.

2022 Cover Crop Evaluation
Magnusson Research Farm-Roseau,Mn

Wheat stubble-F4							Top Growth			Root Growth				
Planted 9/1/2022							Fresh wt.	Dry wt.	%dry	Fresh wt.	Dry wt.	%dry	%Stand 2023	
Treat#	Species	Variety	Stand ¹	Vigor ²	%GC ³	Ht(in.)	#/acre	#/acre	matter	#/acre	#/acre	matter	5/11/23	6/2/23
						10/7	10/10	10/10	10/10	10/10	10/10	10/10		
1	Canola	L340PC	6.3	7.7	35	3	6428	748	12	-----	-----	-----	63	63
2	Radish	Tapmaster Daikon	5.7	6.3	20	3	2878	365	13	193	27	14	0	0
3	Rape	Barsica forage	6.3	6.3	40	3	3358	422	13	-----	-----	-----	8	23
4	Turnip	Barkant	7.0	7.7	53	5	8731	988	12	414	58	14	13	10
5	pea	Austrian winter peas	3.0	5.7	10	3	6716	1238	19	-----	-----	-----	0	0
6	crimson clover	VNS	8.3	8.3	22	1	-----	-----	-----	-----	-----	-----	0	2
7	Red clover	Ruby	7.0	6.3	22	1	-----	-----	-----	-----	-----	-----	88	90
8	hairy vetch	VNS	3.7	5.0	25	3	-----	-----	-----	-----	-----	-----	83	80
9	buckwheat	VNS	8.3	6.3	10	2	384	115	31	-----	-----	-----	0	0
10	Flax	Omega	9.0	9.0	40	4	1343	192	15	-----	-----	-----	0	0
11	Triticale	Surge	7.0	6.3	37	4	3358	556	17	-----	-----	-----	78	58
12	barley	ND Genesis	7.7	7.7	50	6	4125	633	16	-----	-----	-----	0	0
13	wheat	Linkert	7.0	6.3	37	5	1823	317	17	-----	-----	-----	0	0
14	oats	Laker-forage	8.3	8.3	47	6	4126	691	17	-----	-----	-----	0	0
	LSD @5% Level		1.5	1.9	9	1	420	46	3	-----	-----	-----	10	12
	CV(%)		13	16	17	13	60	45	9	-----	-----	-----	26	30

Experimental design:RCB with 3 reps

*Frost prior to harvest reduced fresh weight

¹Stand 9/22 - 9= ideal;1=no plants²Vigor 9/22 -9=best plant vigor;1=poor vigor³GC 10/7 = %ground cover

Planted 9/1/2022

Fallow -F4							Top Growth			Root Growth				
Planted 9/1/2022							Fresh wt.	Dry wt.	%dry	Fresh wt.	Dry wt.	%dry	%Stand 2023	
Treat#	Species	Variety	Stand ¹	Vigor ²	%GC ³	Ht(in.)	#/acre	#/acre	matter	#/acre	#/acre	matter	5/11	6/2
						10/7	10/10	10/10	10/10	10/10	10/10	10/10		
1	Canola	L340PC	8.0	9.0	88	7	11034	1391	12.7	-----	-----	-----	30	40
2	Radish	Tapmaster Daikon	8.0	9.0	88	6	10074	1199	11.9	1545	173	11	0	0
3	Rape	Barsica forage	7.5	8.0	73	6	7676	1045	13.7	-----	-----	-----	47	47
4	Turnip	Barkant	9.0	9.0	65	7	13720	1641	12.0	911	144	14.1	7	7
5	pea	Austrian winter peas	8.0	9.0	55	5	3262	691	21.0	-----	-----	-----	30	2
6	crimson clover	VNS	9.0	9.0	23	1	576	192	33.5	-----	-----	-----	0	0
7	Red clover	Ruby	8.0	7.0	11	1	192	77	35.0	-----	-----	-----	77	73
8	hairy vetch	VNS	5.5	7.0	45	3	1439	336	21.5	-----	-----	-----	83	99
9	buckwheat	VNS	9.0	9.0	66	9	2059	998	48.5	-----	-----	-----	0	0
10	Flax	Omega	9.0	9.0	33	4	1535	307	19.8	-----	-----	-----	0	0
11	Triticale	Surge	7.0	7.5	69	7	7196	1238	17.5	-----	-----	-----	80	80
12	barley	ND Genesis	9.0	9.0	86	9	9979	1449	14.5	-----	-----	-----	0	0
13	wheat	Linkert	8.5	7.5	50	7	5660	1017	18.1	-----	-----	-----	0	0
14	oats	Laker-forage	9.0	9.0	73	9	7484	1238	16.5	-----	-----	-----	0	0
	LSD @5% Level		1.3	1.1	12	1	2591	345	3.0	-----	-----	-----	18	21
	CV(%)		11	9	14	13	31	26	8	-----	-----	-----	42	50

Experimental design:RCB with 4 reps

3 row plots - rows 1' apart x 10'-17' long

All Planted 9/1/2022

Handed watered 5 days after planting

¹Stand 9/22 - 9= ideal;1=no plants²Vigor 9/22 -9=best plant vigor;1=poor vigor³GC 10/7 = %ground cover⁴Frost damage 10/16-10=completely desiccated;1=no injury

frost damage-10-16-2022

canola 10%

radish 20%

rape 40%

turnip 5%

9/27=30F

9/28=31F

10/7 =22F

Soil test 9/15/2022	pH	OM	N1 lb	N2 lb	N-(N1+N2)	P-O ppm	K ppm
Wheat stubble F4	8	3.1	9	6	15	9	99
Fallow F8	7.8	2.8	28	48	76	13	134

Table 19.

2023 Cover Crop Evaluation
Magnusson Research Farm-Roseau,Mn

Wheat stubble-F4							Top Growth			Top Growth			Root Growth		
							Fresh wt. #/acre	Dry wt. #/acre	%dry matter	Fresh wt. #/acre	Dry wt. #/acre	%dry matter	Fresh wt. #/acre	Dry wt. #/acre	%dry matter
Treat#	Species	Variety	Stand ¹	Vigor ²	%GC ³	Ht(in.) 10/14	10/14	10/14	10/14	11/15	11/15	11/15	11/15	11/15	11/15
1	Canola	L340PC	6.7	6.7	48	3.7	6812	1076	15.8	-----	-----	-----	-----	-----	-----
2	Radish	Daikon	6.0	5.7	35	3.2	3454	461	13.3	16023	2341	-----	10822	806	-----
3	Rape	forage	6.0	4.3	38	3.7	4701	806	17.1	-----	-----	-----	-----	-----	-----
4	Turnip	barkant	6.3	4.7	42	3.7	5181	643	12.4	16196	2456	-----	3915	441	-----
5	Pea	Australian	7.3	7.7	25	3.5	1247	240	19.2	-----	-----	-----	-----	-----	-----
6	Crimson clover	VNS	5.7	4.0	17	1.3	384	77	20.1	-----	-----	-----	-----	-----	-----
7	Red clover	Ruby	3.7	2.0	8	0.5	38	16	42.1	-----	-----	-----	-----	-----	-----
8	Hairy vetch	VNS	5.3	6.0	23	2.2	2495	403	16.2	-----	-----	-----	-----	-----	-----
9	Buckwheat*	VNS	7.0	7.3	12	5.7	413	230	55.7	-----	-----	-----	-----	-----	-----
10	Flax	Omega	5.7	5.7	32	3.0	1247	201	16.1	-----	-----	-----	-----	-----	-----
11	Triticale	Tulus	6.7	6.0	22	5.0	1823	365	20.0	-----	-----	-----	-----	-----	-----
12	Barley	genesis	6.7	7.3	37	7.3	3742	729	19.5	-----	-----	-----	-----	-----	-----
13	Wheat	Linkert	5.7	6.3	32	6.7	1631	326	20.0	-----	-----	-----	-----	-----	-----
14	Oats	Deon	7.7	7.3	50	8.0	4510	911	20.2	-----	-----	-----	-----	-----	-----
LSD @5% Level			1.9	1.1	17	2.0	2782	643	4.8	NS	NS	-----	3699	220	-----
CV(%)			18	12	33	29	62	79	11	22	15	-----	10	9	-----

Experimental design:RCB with 3 reps

*Frost prior to harvest reduced fresh weight

¹Stand 9/18/2023 - 9= ideal;1=no plants

²Vigor 9/18/2023 -9=best plant vigor;1=poor vigor

³GC 10/14/2023 = %ground cover

Fallow -F4							Top Growth			Top Growth			Root Growth		
							Fresh wt. #/acre	Dry wt. #/acre	%dry matter	Fresh wt. #/acre	Dry wt. #/acre	%dry matter	Fresh wt. #/acre	Dry wt. #/acre	%dry matter
Treat#	Species	Variety	Stand ¹	Vigor ²	%GC ³	Ht(in.) 10/14	10/14	10/14	10/14	11/15	11/15	11/15	11/15	11/15	11/15
1	Canola	L340PC	8.0	5.0	83	6.0	35117	4460	12.7	-----	-----	-----	-----	-----	-----
2	Radish	Daikon	7.0	6.7	67	7.3	36843	4384	11.9	73496	9901	13	81938	4107	5
3	Rape	forage	7.0	4.3	50	6.0	15351	2103	13.7	-----	-----	-----	-----	-----	-----
4	Turnip	barkant	8.0	6.0	93	7.7	51331	6160	12.0	98826	10938	11	38379	2955	7
5	pea	Australian	7.0	7.0	38	1.6	2399	504	21.0	-----	-----	-----	-----	-----	-----
6	crimson clover	VNS	7.7	3.7	25	3.8	768	169	22.0	-----	-----	-----	-----	-----	-----
7	Red clover	Ruby	3.7	1.3	10	2.7	96	20	21.0	-----	-----	-----	-----	-----	-----
8	hairy vetch	VNS	5.3	5.3	28	1.1	1535	330	21.5	-----	-----	-----	-----	-----	-----
9	buckwheat	VNS	8.7	7.3	30	14.0	3934	1101	28.0	-----	-----	-----	-----	-----	-----
10	Flax	Omega	8.0	7.0	43	5.3	1919	380	19.8	-----	-----	-----	-----	-----	-----
11	Triticale	Tulus	7.7	7.0	47	3.1	5085	890	17.5	-----	-----	-----	-----	-----	-----
12	barley	genesis	8.0	8.0	60	9.3	18631	2702	14.5	-----	-----	-----	-----	-----	-----
13	wheat	Linkert	7.0	6.3	43	7.0	6524	1181	18.1	-----	-----	-----	-----	-----	-----
14	oats	Deon	8.3	8.0	57	9.3	18613	3071	16.5	-----	-----	-----	-----	-----	-----
LSD @5% Level			1.3	1	15	4.0	3820	655	3.0	11560	856	2	32560	866	2
CV(%)			10	10	18	39	52	80	8	26	8	9	9	9	9

Experimental design:RCB with 4 reps

3 row plots - rows 1' apart x 10'-17' long

All Planted 9/1/2022

Handed watered 5 days after planting

¹Stand 9/18/2023 - 9= ideal;1=no plants

²Vigor 9/18/2023 -9=best plant vigor;1=poor vigor

³GC 10/14/2023 = %ground cover

Soil test 10/4/2023	pH	OM	N1 lb	N2 lb	N-(N1+N2)	P-O ppm	K ppm
Wheat stubble F6	8.3	2.6	7	9	16	6	88
Fallow F4	7.5	2.3	56	72	128	18	123

Table 20.

**2022-3 Fall and Spring Planted Cover Crop Seed Production
Magnusson Research Farm-Roseau,Mn**

	Fall Planting	Variety	Seed Yield		%stand			Vigor ¹	Harvest
			#/acre	9/22/22	5/11/23	6/2/23	9/22/23	Date	
7	Australian Winter Pea	VNS	NH	75	10	6	9.0	NH	
8*	Hairy Vetch/w triticales	vetch-VNS	NH ¹	55	30	5	8.5	NH	
9	Winter Canola	Mercedes	574#	75	80	77	9.0	7/17/2023	
10	Winter Hybrid rye	Tayo	126 Bu.	75	89	97	9.0	7/18/2023	
		LSD @5%	NA	NS	20	15	NS	NA	
		CV(%)	NA	20	58	65	5	NA	

Experimental Design=RCB w 4 reps All planted in 12" rows on 9/1/2022

*With the dry conditions, the hairy vetch did not compete with the triticales or produce seed

¹-Vigor-1=poor vigor;9=good vigor

	Fall Planting	Variety	Seed rate #/acre	Row spacing	Planting Date
7	Australian Winter Pea	VNS	80	6"	9/1/2022
8*	Hairy Vetch/w triticales	MN/+Tulus	20/45	12"	9/1/2022
9	Winter Canola	Mercedes	5	6"	9/1/2022
10	Winter Hybrid rye	Tayo	40	6"	9/1/2022

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	Spring plant	Variety	Seed Yield #/Ac.	%stand 5/26/2023	Harvest Date
1	Daikon Radish	Tapmaster	392	83	8/29/2023
2	Yellow Mustard	VNS	1718	91	8/29/2023
3	Berseem clover	Peaceful Valley	214	5	10/5/2023
4	Crimson clover	VNS	160	33	10/5/2023
5	Buckwheat	VNS	739	95	8/15/2023
6	Flax	Omega	1085(20Bu)	92	8/29/2023
		LSD @5%	204	7	
		CV(%)	19	7	

	Spring plant	Variety	Seed rate #/acre	Row spacing	Planting Date
1	Daikon Radish	Tapmaster	7	6"	5/17/2023
2	Yellow Mustard	VNS	9	6"	5/17/2023
3	Berseem clover	Peaceful Valley	4	6"	5/17/2023
4	Crimson clover	VNS	4	6"	5/17/2023
5	Buckwheat	VNS	50	6"	5/17/2023
6	Flax	Omega	42	6"	5/17/2023

Table 21.

**2022-23 Effects of Red Clover Planted as Cover In Hybrid Rye Production Field
2-Locations-Magnusson Farms and Estling Farms-Variety=Tayo**

Plant date	Red clover ¹			Rye Bu./acre ²		
	%stand*	T/A Fresh	T/A Dry*	Mag ³	Estling ³	Mean
11/6/2022	94	4.9	1.5	115	118	116
4/25/2023	56	3.1	0.9	103	110	107
5/9/2023	70	3.6	1.0	102	119	111
None	NA	NA	NA	100	116	108
LSD @5% level	10	17	3.8	17	22	15
(CV)	8	12	9	10	12	8

Experimental Design=RCB w 4 reps

Rye harvested 7/18/2023 at both locations

*Red clover data only from Magnusson Farm- Estling Farm location red clover stand was lost

Red clover harvest date=10/14/2023. Cutting height=1"

15oz.MCPE applied to Estling location 5/14/2023; no herbicide to Magnusson location

¹ First date listed=Magnusson; Second date=Estling

Mammoth Red clover @12#/acre

Germ. 63%+30%hard

²-Bu./acre=56#/Bu @12%moisture

³-Locations=Magnusson farm 3 miles west and 1 north of Roseau,Mn
Estling farm 6 miles north of Roosevelt,Mn

Estling- Soil test 10/18/2022

N03-N #/acre			pH	OM	P-O ppm	K ppm	Mg ppm	S1 lb	Zn ppm	Cu ppm	B ppm	Mn ppm	CEC meq	CCE% D1
0-6"	6-24"	0-24"												
7	6	13	7.7	3.6	38	245	599	8	1.87	0.8	0.91	1.43	23.6	0.2

Magnusson Farms -soil test 9/21/2022

N03-N #/acre			pH	OM	P-O ppm	K ppm	Mg ppm	S1 lb	Zn ppm	Cu ppm	B ppm	Mn ppm	CEC meq	CCE% D1
0-6"	6-24"	0-24"												
10	21	31	6.3	1.4	5	38	139	18	0.23	0.12	0.21	2.99	6.42	0.1

Table 22.

**2022-23 Fall Nitrogen Fertilizer added to Tayo Hybrid Rye
Magnusson Farms-3miles west and 1 mile north of Roseau,Mn.**

Treatment ¹	Bu./acre ²	RCI ³
Farmer Practice	98	652
Farmer Practice+50#N	96	707
LSD @5%level	NS	NS
CV(%)	18	22

Experimental Design=RCB w 4 reps

50#N added 10/18/2022 to +50N plots

¹-Farmer Practice=Current best management practice

²-Bu./acre=56#/Bu @12%moisture

³-RCI=Relative Chlorophyll Index-Higher number =more chlorophyll relative to other treatments

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Table 22a.

**2022 Ryegrass Cover Crop for Seed Production in 2023
Casey Pearson-Northwest of Roseau,Mn**

Treatment ¹	Seed Yield	Dry Mat	Harvest	
	Lbs/acre	Tons/ac	Ht(in.)	Lodging ²
Farmer Practice	723	1.58	18	1.0
Farmer Practice+40#N	823	2.09	20	2.2
LSD @5%level	NS	0.37	1	0.8
CV(%)	10	9	2	21

Experimental Design=RCB w 4 reps Harvest Date=7/17/2023

¹-Farmer practice=100#N applied 5/2/2023 to entire field

40#N added on 10/18/2022 to +40N plots

²-Lodging-9=Flat ;1=upright

Soil test 9/21/2022

N03-N #/acre			pH	OM	P-O ppm	K ppm	Mg ppm	S1 lb	Zn ppm	B ppm	Mn ppm
0-6"	6-24"	0-24"									
15	9	24	7.9	2	16	67	298	32	0.27	0.33	1.44

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**2021-22 Red Clover Spring Dormant Planted as a Cover In Hybrid Rye Production Field
Jade Estling Farm-North of Roosevelt,Mn**

Mammoth red clover planted with an ATV spin spreader 4/24/2022 into a field of Serafino Rye

10/10/2022 Red clover harvest= 1.57 tons/acre of dry matter.

Table 24 .

**2021-22 & 2022-23 Rye Seed Treatment Trial
Magnusson Research Farm**

Seed treatments-	2021 Planting			2022 Planting		
	Yield ¹ Bu/acre	Plants ² 9/28/21	Vigor ³ 5/15/22	Plants ² 10/7/22	Vigor ³ 11/9/22 5/11/23	
1=untreated	140	15	8.8	18	8.0	7.3
2=Seamac+ZN+CU	133	13	9.2	23	8.0	7.0
3=Seamac+MN+ZN+CU +F4019-4	137	15	9.6	20	8.0	7.3
4=F-4019-4	141	12	9.3	19	8.3	7.3
5=Semac + 4019-4	136	14	9.0	21	8.0	6.5
LSD @5% level	NS	2	NS	6	NS	NS
CV(%)	10	13	14	20	4	6

Experimental Design=RCB w 4reps

NA*- Treatment #6 not included in 2021 seeding

¹Yield=Bushels per acre corrected to 12%moisture.

2023 harvest was not done because of hail damage.

²Plants=plant counts/ft.2

³Vigor: 1=poor; 10=best

Seeding rate=40#/acre

120-50-50 applied 5/19/22 to all plots; 120-0-0-20s applied 5/13/2023

Planting dates=9-15-2021; 9-29-2022

Table 25.

True Armyworm (*Mythimna unipuncta*) moth capture at seven locations in Roseau County in 2023

<u>Date</u>	<u>Location</u>							<u>Total</u>
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	
19-May	8	2	0	0	0	0	0	10
23-May	2	2	1	6	7	9	6	33
31-May	1	1	1	0	9	8	6	26
2-Jun	0	0	0	0	2	3	9	14
4-Jun	19	18	14	6	3	0	0	60
5-Jun	25	25	14	8	15	27	21	135
13-Jun	0	0	0	0	13	14	8	35
19-Jun	0	1	4	1	7	25	28	66
25-Jun	2	2	3	0	0	14	13	34
29-Jun	2	0	16	0	0	3	2	23
Total	59	51	53	21	56	103	93	436

The seven armyworm moth trapping locations in 2023:

Location 1: Dieter Township, Section 3, NW quarter. Trap placed in the middle of a perennial ryegrass field.

Location 2: Jadis Township, Section 7, SW quarter. Trap placed in the middle of a perennial ryegrass field.

Location 3: Jadis Township, Section 5, SW quarter. Trap placed in the border of a perennial ryegrass field.

Location 4: Stafford Township, Section 3, NW quarter. Trap placed in the middle of a perennial ryegrass field.

Location 5: Malung Township, Section 18, SW quarter. Trap placed on field border of two perennial ryegrass fields.

Location 6: Laona Township, Section 4, SE quarter. Trap placed field border of two perennial ryegrass seed field.

Location 7: Chilgren Township, Section 30, SW quarter. Trap placed on the border of two perennial ryegrass fields.

In 2023, this armyworm moth trapping project documented five flights with moth captures that averaged over 3 moths/night.

The calendar dates and the number of moths collected were:

- May 19-23 = 43
- May 31-June2 = 40
- June 4-5 = 195
- June13-19 = 101
- June 25-29 = 57

Summary

Over a two-year period, this armyworm moth trapping project documented that the Scentry pheromone trap was effective in trapping armyworm moths.

This moth trapping project documented four major flights in 2022 and five flights in 2023.

Low-level jet stream maps produced by the University Center for Atmospheric Research (UCAR), can be used to document low-level jet stream events in the perennial ryegrass growing regions of northern MN.

Localized thunderstorms and rain events seem to be important in the deposition of armyworm moths into the perennial ryegrass growing region of northern MN.

The next step in this project will be to build information learned from this armyworm moth trapping project and try and determine a correlation between the number of trapped moths and number of armyworm larvae in ryegrass fields.

Table 26.

2023 Canola Insect Monitoring Project-Roseau,Mn Bertha Armyworm² and Diamondback Moth

¹ Location		Bertha Armyworm	Diamondback Moth	Canola Growth stage
Magnusson Farm-	3-Jul	0	4	first bloom
	10-Jul	1	38	mid-flower-lower pods elongating
	14-Jul	5	5	lower pods starting to fill
	21-Jul	62	48	end flowering, seed enlarging in lower pods
	28-Jul	48	27	seed in lower pods green
	4-Aug	8	58	seed in lower pods green-yellow
	11-Aug	4	57	seed in lower pods yellow or brown
Total insects trapped 6/23 - 8/11		128	237	

¹ Location		Bertha Armyworm	Diamondback Moth	Canola Growth stage
Northern Resources-	3-Jul	0	0	first bloom
	10-Jul	1	19	mid-flower-lower pods elongating
	14-Jul	1	8	lower pods starting to fill
	21-Jul	8	27	end flowering, seed enlarging in lower pods
	28-Jul	16	17	seed in lower pods green
	4-Aug	14	15	seed in lower pods green-yellow
	11-Aug	16	22	seed in lower pods yellow or brown
Total insects trapped 6/24 - 8/11		56	108	

¹Location-

Magnusson Farm- 2 miles north and 6 miles west of Roseau,Mn

Northern Resources- 0.5 miles west of Roseau,Mn

²Pheromone trap monitors put into field margin on 6/23/2023 on Magnusson farm location and on 6/24/2023 at the Northern Resources location.

Bertha armyworm- green bucket traps

Diamondback moth-wing traps

Fresh lure put into traps at both locations on 7/21.