

PROGRESS REPORT ON GRASS SEED PRODUCTION RESEARCH

prepared by

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

http://www.mnturfseed.org/html/progress_reports.html

Table 1. Precipitation/Weather Data 1967-2019.

Variety Performance Trials:

Table 2. Perennial Ryegrass Seeded in 2018.

Table 3. Kentucky Bluegrass Seeded in 2017.

Table 4. Tall Fescue Seeded in 2018.

Table 5. Intermediate Wheatgrass Seeded 2017-MagPlots.

Table 6. Perennial Ryegrass Winter Hardiness Trials seeded 2018.

Table 7. Field Pea and Faba beans 2019.

Perennial Ryegrass Management Trials:

Table 8. Fertility Trial and Yearly Yield Summaries-MagPlots.

Table 9. Nitrogen Source and Sulfur-Rice Farms.

Table 10. Spring Herbicide Applications-MagPlots & Marc Tveit.

Table 11. Dormant/Pre-emergent Herbicide Trial-MagPlots.

Table 12. Herbicides Applied to Wheat with Under Seeded Ryegrass.

Table 13. Late Fungicide Application Trial- MagPlots.

Table 14. Fungicide-Herbicide Screen-Marc Tveit.

Table 15. Fungicide Treatments Yearly Yield Summaries.

Table 16. Growth Regulator Applications -MagPlots&Marc Tveit Farm.

Table 17. Plant Power Agriculture Evaluation-Stoller-MagPlots.

Table 18. Spring Clip on Ryegrass-Rice Farms.

Other Trials:

Table 19. Sulfur Applications to 3 Perennial Grass Species-MagPlots.

Table 20. Hard Fescue Herbicide Screen-MagPlots.

Table 21. Tall Fescue Management Trial-MagPlots.

Table 22. Fine Fescue Establishment-MagPlots.

Table 23. Kernza- Large Plot Planting Date Trial Seeded in 2017- MagPlots.

Table 24. Tall Fescue Growth Regulator x Fungicide Trial- Parsley Farms

Table 25. Tall Fescue Fertility- Parsley Farms

Table 26. Spring Wheat and Soybean Fertility Rotation Trial - MagPlots.

Standard Management Practices for University of Minnesota Grass Seed Production Research Plots

General management regime of perennial ryegrass plots on the Magnusson Research Farm:

Spring seeded ryegrass with wheat

Ryegrass seeded at 5-7#/acre with spring wheat
Sterling Blue+ 2,4-D amine 4 (0.75 + 0.75 pint) applied in mid-September
Fertilize 30-30-30 mid-September after small grain harvest
Spike tooth harrow after fall fertilizer application to spread straw
Fertilize 110-0-0 applied early to mid-May, 300 - 600 GDD
Sterling Blue+ 2,4-D amine 4 (0.75+0.75 pint) applied late May, 700 - 900 GDD
Tecoma or Assure II (8-10 oz) applied early June, 800 - 1,000 GDD
Apogee (8 oz) applied early heading, 1,100 - 1,300 GDD
Quilt Excel (10 oz) applied full heading, 1,700 - 1,900 GDD

Fall seeded ryegrass in wheat stubble

Ryegrass seeded at 5-7#/acre after wheat harvest into existing stubble
Pre-harvest glyphosate application to wheat , or
glyphosate applied to wheat stubble prior to seeding ryegrass.
No broadleaf application in fall but other management for fall seeded ryegrass the same as spring seeded.
If planted into summer fallow, nitrogen application is cut about 40%.

Kentucky bluegrass

Variety trial seeded at 3#/acre with 60#/acre of spring wheat on 6/7/2017
Burn in late August
120-40-40-10s applied 10/26/2018
2pt.Curtail + 1pt. Sterling Blue applied 9/26/2018
3 oz. Tilt applied 6/2/2018

Tall Fescue

Seed at 7#/acre under spring wheat at 90#/acre.
60-50-50-10s September and 80-0-0 early May.
.75pt. 2,4-D a + .75pt. Sterling Blue late September.
Clip and bale off straw mid September.

General seed harvest procedure for small research plot

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 and other data are statistically analyzed and results summarized.

On-farm small plot research trials

All crop planting and general management are done by the grower/cooperator.
Application of treatment variables, agronomic notes and harvest by University of Minnesota personnel.
Cooperators asked to avoid 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 may be 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 harvest data.
Experimental design usually consists of 2 or 3 treatment variables and 3 replicates/treatment.

Table 1.

Monthly and Year End Precipitation Totals*
Roseau,Mn 1967-2019.

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	-3.46	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	7.31	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	1.69	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	2.66	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	-4.30	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	-3.52	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	-1.20	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	3.85	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	-4.57	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	-6.79	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	-3.18	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	-2.00	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	-5.16	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	-3.47	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	0.98	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	-2.41	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	-0.67	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	-5.19	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	2.43	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	-3.24	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	-4.70	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	-5.69	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	-0.91	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	-10.94	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	7.67	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	-2.00	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	-0.83	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	-4.02	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	-0.67	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	3.37	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	-1.95	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	2.32	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	0.27	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	5.61	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	-3.83	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	3.20	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	1.85	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	11.51	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	8.67	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	-6.13	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	2.68	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	3.90	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	3.94	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	5.29	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	-4.90	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	-3.52	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	1.45	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	3.12	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	8.53	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	1.45	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	0.54	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	-4.47	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	9.45	35.2
51 year average annual precipitation													22.62		
50 year available mean temperature=														37.3	

*Precipitation amounts used are from the Magnusson Research Farm-near Roseau May-October and Minnesota Climatology Working Group nearest location or Fox NDAWN for the remainder of the year. Average precipitation the last 20 years=25.04". Average precipitation the previous 33 years=21.16"
Mean temperature 1967-1990 =36.1 & 1991-2019 = 38.1

table 2

2018 Perennial Ryegrass Seed Production Variety trial
Magnusson Research Farm-Roseau,Mn

Variety	company	Lot#	Seed Yield		Harvest Ht.(in.)	Date	Heading (%)				
			#/acre	% of mean			6/10	6/14	6/17	6/22	6/27
Spreader IIIxArctic Green	U of M	4051	1233	123	21	30-Jul	1	7	28	50	96
Arctic Green	U of M	4038	1347	134	22	30-Jul	4	15	38	63	100
Accent II	check-N.ex	4096	950	95	23	30-Jul	10	30	58	83	100
NK-200	check	3917	810	81	29	5-Aug	0	0	8	28	85
Green EmperorxRoyal Green	U of M	4031	1125	112	21	30-Jul	3	11	33	55	99
3999	U of M	4050	1262	126	22	30-Jul	0	3	20	43	95
Spreader IV	U of M	4029	860	86	21	30-Jul	0	1	15	40	93
Green Emperor	U of M	3976	1060	106	20	30-Jul	1	5	23	45	96
Forageur	U of M	3984	731	73	28	5-Aug	0	0	8	28	88
Green EmperorxArctic Green	U of M	4020	1240	124	21	30-Jul	3	14	35	60	98
Fastball RGL	MVS	4098	1136	113	20	30-Jul	3	13	30	53	100
Thrive	DLF-N.excel	4099	1019	102	20	30-Jul	2	10	25	48	98
Grandslam GLD	Mountain View seed	4084	1145	114	19	30-Jul	3	11	25	48	95
Silver Sun	Pure seed testing	4092	907	91	18	27-Jul	10	30	58	68	100
Silver Dollar	Pure seed testing	4090	950	95	22	30-Jul	9	30	53	73	100
Gray Fox	Pure seed testing	4087	977	98	20	30-Jul	6	28	55	70	100
Silver Sport	Pure seed testing	4091	1130	113	21	27-Jul	8	23	43	68	100
PST-2M20	Pure seed testing	4086	526	52	18	5-Aug	1	6	18	35	94
GT-24	Pure seed testing	4088	745	74	20	2-Aug	3	14	33	50	96
Estelle	Pure seed testing	4089	905	90	21	2-Aug	1	6	18	35	94
LSD @5% level			105	10	2	1	3	8	12	12	5
CV(%)			7	7	6	3	69	46	28	16	3

Experimental design:RCB with 4 reps

No lodging on any plots --- mean #/acre= 1003

Planted in 6" rows with Hege plot seeder with double disk openers @7#/acre
with Linkert spring wheat @ 120#/acre on 6/2/2018

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Table 3.

2017 Kentucky Bluegrass Variety Trial
Magnusson Research farm

2018-19 Data

LINE	Company	MSP#	Seed Yield-#/acre			Harvest		Heading (%)						
			2018	2019	mean	Height	Lodging ¹	Date	5/30	6/1	6/4	6/7	6/14	6/22
Blue Note	Mountain View seed	4052	293	114	204	21	1.0	16-Jul	0	0	0	3	25	90
Bolt	Mountain View seed	4053	376	66	221	27	1.0	16-Jul	0	0	0	10	49	100
A99-3124	MN-Rutgers	3920	303	265	284	18	1.0	16-Jul	0	0	0	0	14	83
A99-2950	MN-Rutgers	3898	296	194	245	22	1.0	16-Jul	0	0	0	1	30	95
A99-2626	MN-Rutgers	3899	349	283	316	18	1.0	16-Jul	0	0	0	0	13	73
Minnfine	check	4063	821	391	606	30	2.5	11-Jul	10	38	68	88	100	100
Park	check	4062	478	170	324	29	3.0	11-Jul	2	4	18	45	88	100
Dragon	check	4054	594	234	414	23	1.0	16-Jul	0	0	2	16	58	96
Exp#1	DLK- seed research	4064	552	106	329	24	1.0	16-Jul	0	0	2	13	45	91
Abbey	check	3608	770	256	513	21	1.0	16-Jul	0	0	0	3	29	79
LSD @5% level			112	86	99	4	0.9	0	2	6	7	10	16	15
CV(%)			16	28	16	11	45	0	120	100	53	41	25	12

Experimental design:RCB with 4 reps

Trial mean #/acre 483 208

¹-Lodging-1=none, 9=flat

table 6.

2018 Perennial Ryegrass Winter Hardiness Trial
Roseau,Mn Magnusson Research Farm & St. Paul Campus

Variety	seed lot	Winter Injury ¹				
		ST.Paul			Mean	Roseau
		6/3/19	4/29/19	5/21/19		5/20/2019
Forageur	4043	4.3	3.8	3.8	3.9	1.0
Forage 1/2 sib	4067	4.5	4.3	4.3	4.3	1.0
Green EmperorxArctic Green	4031	4.5	4.3	4.8	4.5	1.0
MSPxA.Green/R.Green 3999	4050	5.8	4.5	6.0	5.4	1.0
Spreader IV	4029	6.3	5.3	5.8	5.8	1.0
EPR18(early per.ryeg)	4103	6.0	4.8	6.8	5.8	1.0
NK-200	3917	6.0	5.5	6.8	6.1	1.0
Arctic Green	4038	6.5	5.0	7.0	6.1	1.0
Spreader IIIxArctic Green	4030	6.0	5.5	6.8	6.1	1.0
Green Emperor	3976	6.5	5.8	6.8	6.3	1.0
Accent II	4096	6.8	5.8	6.8	6.4	1.0
Spreader 1/2 sib	4066	6.8	5.5	7.0	6.4	1.0
Forage sel-2018	4100	8.5	8.0	8.3	8.3	1.0
Gulf-annual	3983	9.0	9.0	9.0	9.0	4.8
	LSD @5%	1.6	1.4	1.3	1.0	0.5
	CV(%)	17	18	15	12	8

Experimental design:RCB with 4 reps

Planting dates=

Roseau = 9/7/2018 St.Paul =9/12/2018

¹-Winter injury- 1= no injury; 9=dead. Only St.Paul listed for mean as no injury in Roseau

table 7.

**2019 Faba Bean and Field Pea Variety Trial
Magnusson Research Farm-Roseau,Mn**

Faba Beans:	Yield ¹ Bushels/ Acre	Yield ² Rep 2-3 on BU./ac.	Lodging 1-9	Plant Height Inches	Test Weight/ Bushel
Boxer	68	81	1.0	42.0	59.4
Fanfare	70	76	1.0	41.0	60.7
Fabelle	73	81	1.0	40.0	60.3
Laura	73	79	1.0	41.0	60.7
LSD @10% level	13(ns)	18(ns)	0	3.0(ns)	0.9
LSD @5% level	16.3(ns)	25(ns)	0	3.9(ns)	1.2
CV(%)	11.5	9.9	0	4.8	1.0

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Peas:	Yield ¹ Bushels/ Acre	Lodging 1-9	Plant Height Inches
Salamanca	96	4.3	43.0
Spider	96	7.0	41.0
AAC Profit	108	5.7	38.7
AAC Chrome	116	4.3	41.7
AAC Asher	111	3.7	35.7
LSD @10% level	10.8	2.1	4.3
LSD @5% level	13.5	2.6	5.3
CV(%)	6.8	27.8	7.1

Experimental Design: RCB with 3 reps

Yield¹=Bushels per acre at 12% moisture(60#/bu. For peas)

Yield²=yield for only reps 2&3 ; rep 1 was noticeably less vigorous than 2&3

Planting Date= 5/9/2019 Harvest date-Peas=8/30/2019 ; faba beans=11/1/2019

Faba bean Seeding Rate= 197,000PLS/acre

Field Pea Seeding Rate= 350,000PLS/acre

Plot size= 6' x 15' centers(plant 10-6" rows)

Management- Dry land- conventional tillage

Herbicide application- Authority Elite 1.5pt.acre applied pre-emergent on 5/10/2019

Fertilizer application- 11-50-50 pre-plant incorporated 5/7

Previous crop- spring wheat

Table 8.

2018-19 Perennial Ryegrass Fertility Trial
Magnusson Research Farm-Roseau,Mn

2019 Data

Trt#	Fertilizer Rate: Application		Seed Yield ¹		Date	Harvest		RCI ³			L burn ⁴	Color ⁵
	N level	timing	#/acre	% mean		Ht(in.)	Lodging ²	6/1	6/10	6/26	6/17	6/17
1	0		341	20	24-Jul	15	1	160	168	137	0	3
2	140+0+0	30-0-0--10/19	1844	111	28-Jul	22	2.3	469	470	441	0	6
3	140+0+0	30-0-0--10/19+0-40-0	1664	100	28-Jul	22	2.5	426	479	456	0	6
4	140+0+0	No fall N	1644	99	29-Jul	22	3	449	514	460	0	7
5	100+0+0	30-0-0--10/19	1710	103	25-Jul	22	2.3	449	509	384	0	6
6	140+0+0+20s	30-0-0-20s--10/19	1654	99	29-Jul	22	2.8	601	515	422	0	6
7	140+0+0+70s	30-0-0-20s--10/19	1601	96	29-Jul	21	3.3	576	579	482	0	6
8	140+0+0	30-0-0--10/19	1628	98	29-Jul	22	3.8	446	462	473	2	6
9	140+0+0	30-0-0--10/19(spring Liq)	1699	102	28-Jul	22	2.5	512	523	504	0	5
10	100+0+0	30-0-0--10/19(spring Liq)	1566	94	29-Jul	21	2.8	344	463	424	10	6
		LSD @5% level	222	13	2	2	1	94	76	68	1	1
		CV(%)	10	10	5	6	27	14	11	11	42	17

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

¹-Seed Yield- Clean seed yield of each treatment in LBS/Acre and % of trial mean(not including no added N trt#1)²-Lodging-1=upright;9=flat³-RCI-Relative Chlorophyll Index-higher value=more chlorophyll⁴-% leaf burn-visual rating from liquid fertilizer applications⁵-Visual rating of color- 1=light green; 9=dark green

Best management practices used on all plots aside from fertility variables

Mean yield(not including 0# N)= 1668#/ac **8/23/18** **11-50-50 applied to all plots**

9/19/2018 Soil test results

Depth	Olsen P	NH4O-K	% OM	PH	NO3-N
0-6"	33ppm	180ppm	2.6	7.5	4.2ppm
6-24"					2.1ppm

Total #N

Trt#	Season	Treatment applications and timing
1	0	No added N
2	140	30-0-0 10/19/2018+ 110-0-0 5/4/2019
3	140	30-0-0 10/19/2018 + 110-40-0 5/4/2019
4	140	140-0-0 5/4/2019
5	140	30-0-0 10/19/2018+ 70-0-0 5/4/2019
6	140	30-0-0-20s 10/19/2018+ 110-0-0 5/4/2019
7	140	30-0-0-70s 10/19/2018+ 110-0-0 5/4/2019
8	140	30-0-0 10/19/18 + 80-0-0 5/4/19 + 7gal--28%N 6/16/2019(flat fan nozzels)
9	140	30-0-0 10/19/2018+ 110-0-0-20s 5/4/2019
10	100	30-0-0 10/19/18 + 40-0-0 5/4/19 + 7gal--28%N 6/16/2019(flat fan nozzels)

Table 8a.

2011-18 Perennial Ryegrass Fertility Trial Seed Yield Summaries
Magnusson Research Farm-Roseau,Mn

Trt. #	Total added Fertilizer	Nitrogen Timing	Overall ³ Mean	Seed Yield as % of Mean								
				2019	2018	2017	2016	2015	2014	2013	2012	2011
1	0	0	29	20	21	45	38	29	27	28	21	36
2	100+0+0	Split ¹	99	103	90	104	90	----	92	96	112	108
3	140+0+0	Split ¹	107	111	101	99	110	99	104	104	118	118
4	140+40+0	Split ¹ +(0-40-0spring)	112	100	107	106	109	127	120	----	----	----
5	140+0+0+20s	Split ²	102	99	101	102	----	----	110	99	----	----
6	140+0+0	Split ¹ +(90spring+20liq)	103	102	101	99	----	----	106	109	----	----
7	180+0+0	Split ¹	108	----	107	92	111	----	122	111	----	----
LSD @5% level				13	11	13	12	20	11	16	11	12
CV(%)				10	8	9	9	16	8			

Experimental Design:RCB with 4 reps

Variety=Arctic Green

2018 Trial mean(excluding 0-N fertilizer)=1631 #/ac.

¹-Split-30-40-40 applied fall and remainder in spring²-Split-30-0-0-20s(77#AMS/acre)+110-0-0 in early May³-Overall Means- consideration should be given to years
the treatments were made when making comparisons.

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
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

table 9.

**2019 Ryegrass Sulfur and N Source Fertility Trial-- Rice Farm
North of Roseau,Mn**

Fertilizer ¹	Nitrogen source	Sulfur source	#/acre	harvest		RCI ³		
				lodging ²	height	6/1	6/10	6/26
140-0-0	urea	none	798	1.0	24	328	447	525
140-0-0	am.nitrate	none	888	2.3	24	335	464	621
140-0-0-30s	urea	115#AMS	995	2.3	25	373	571	639
140-0-0-30s	am.nitrate	115#AMS	1032	3.3	25	346	553	713
140-0-0-60s	urea	230#AMS	881	2.0	23	452	554	652
140-0-060s	am.nitrate	230#AMS	1150	4.5	26	459	568	661
LSD @5% level			239	1.8	2.3	95	114	79
CV(%)			16	46	6	16	14	8

Fertilizer ¹	Nitrogen source	Tissue test- 6-28-2019								
		sulfur	nitrogen	phosphorus	potassium	ca	cu	fe	mg	mn
140-0-0	urea	0.14	1.9	0.25	1.7	0.36	3	48	0.34	36
140-0-0	am.nitrate									
140-0-0-30s	urea									
140-0-0-30s	am.nitrate									
140-0-0-60s	urea	0.28	2.8	0.23	1.95	0.58	4.5	95	0.45	60
140-0-060s	am.nitrate									
LSD @5% level		NS	NS	NS	NS	NS	NS	NS	NS	13
CV(%)		7	8	2	1	5	13	12	5	2

Experimental Design:RCB with 4 reps

Variety- Allaire 3 Harvest date- 8/5/2019

All Urea(46-0-0), ammonium nitrate (34-0-0) and ammonium sulfate (21-0-0-26s) applied 5/9/2019
Tissue testing done on 6/28/2019 at full heading on urea with and without sulfur(AMS)

Soil test-5/9/2019	Depth	nitrate	Olsen P	NH ₄ OAc-K	SO ₄ -S	zinc	LOI OM	sol salts	PH
		#/ac	ppm	ppm	#/ac	ppm	(%)	mmho/cm	
Rice sulfur trial 0-6"	0-6"	5	9	102	8-L	.15-VL	2.9	0.2	8
Rice sulfur trial 6-24"	6-24"	9			36			0.19	8.3

table 10.

**2019 Per.Ryegrass Herbicide screen-
MagPlots- Arctic Green Fall Planting**

Trt# Herbicide	Rate	Adjuvant	Application Timing	Seed Yield #/acre	Harvest		Germination ²	
					Ht.(in.)	Lodging ¹	Normal	Abnormal
1 Callisto+Sterling Blue/Tacoma	3oz.+12oz./10oz	.5%HCMSO+2pt AMSOL	5/21 +5/30	2240	23	6.5	91	2
2 Callisto+Sterling Blue/Tacoma	6oz.+12oz./10oz.	.5%HCMSO+28%N	5/21+ 5/30	2159	23	6.0	95	1
3 2,4-D+Sterling Blue/Tacoma	12oz+12oz./10oz.		5/21/2019 +5/30	2018	22	5.8	96	0
4 Talinor /Tacoma	16oz +10oz	3.2oz. CoAct+/	5/21/2019 +5/30	2063	22	5.8	92	2
5 Facet/2,4-D+Sterling	1.5pt./12oz+12oz.	1% COC/	5/21 + 5/30	1942	22	5.5	93	2
6 Facet+2,4-D+Sterling	1.5pt.+12oz+12oz.	1% COC	5/21	2014	22	5.5	93	1
7 Tacoma	10oz.		5/30	1864	23	5.8	95	1
8 Wolverine	1.7pt	1pt Amsol(AMS)	5/21	2161	23	5.8	93	1
9 *Harness-7#/gal+ standard	3 pt+12oz+12oz/10oz		5/21+/30	2040	22	5.3	91	3
10 *Dual II Magnum+standard	1.5pt+12oz+12oz/10oz		5/21+/30	2145	22	4.8	93	1
11 2,4-D+Sterling Blue	12oz+12oz.		5/30	2016	22	4.5	93	1
12 No Treatment				1753	22	4.8	92	1
		LSD @5%level		305	NS	1.6		
		CV(%)		10	5	20		

Experimental design:RCB with 4 reps

Callisto caused bleaching of ryegrass for cpl weeks after application

¹-Lodging-1=no lodging;9=flat

²-Germinations- 4x100 standard germination test. Abnormal not counted with total germination.(only shown as sign of possible injury)

*Apply 2,4-D+Sterling blue/Tacoma to #9,10

1 gal Amsol=3.4# AMS

5/21 applications- 5/30/2019 applications
 7:30am &10:30 10:30am 68F
 57F 50%sun wind 2-5se ESE 5-7mph rh51% hazy sun
 35%RH ryegrass tillering 1-3" ryegrass 4-6"
 4:30pm 73F sw wind 10-15 34%RH sunny wheat 4lf 1-2tillers

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table 11.

**2018 Fall Applied Herbicides in Perennial Ryegrass
Byron Tveit Farm-north of Roosevelt* and Magnusson Research Farm-Roseau,Mn**

Treatment	Rate	Application Date	Seed Yield #/acre	Lodging ¹	Ht.(in.)	Harvest Date	5/30 Injury ²	Tveit-6/13/19		Germination ⁴
								Crop Injury ²	% Wheat Control ³	
1 Atrazine	1pt+.5%Destiny HC	10/27	1657	1.8	22	1-Aug	2.3	4	70	92
2 Atrazine	2pt+.5%Destiny HC	10/27	1424	2.0	22	3-Aug	4.5	5	97	94
3 Prowl H2O	4pts	10/27	1548	1.5	22	30-Jul	1.3	1	0	NA
4 Nortron	2pt.+2pt	10/27 & 5/11	1514	1.8	22	1-Aug	1.3	2.3	98	NA
5 Outlook	1 pt	10/27	1454	2.3	22	5-Aug	4.8	2.5	0	NA
6 Olympus	.8oz+.5%NIS	10/27	1583	1.5	22	4-Aug	2.3	3.7	0	NA
7 Callisto	3oz+.5%HCMSO+28%N	10/27	1679	2.0	24	1-Aug	1.0	2.3	0	NA
8 No treatment			1590	1.8	22	2-Aug	1.5	1	0	92
		LSD @5% level	161	NS	1	4	1.0	1.9	22	
		CV(%)	7	39	4	9	28	41	38	

Experimental Design:RCB with 4 reps (3 reps Tveit location)

*Ryegrass stand in plot area on Tveit location not adequate to harvest yields

¹-Lodging-1=upright;9=flat

²-Crop injury-visual rating 1=none;9=dead

³-% Control of spring wheat volunteers

⁴-Germinations from Magnusson plot harvest

table 12.

**2019 Herbicides Applied to Linkert Spring Wheat
with Underseeded Perennial Ryegrass
Magnusson Research Farm-Roseau,Mn**

trt#	Treatment	Rate/adjuvant	Stand ¹ 28-Oct	Vigor ² 28-Oct	RCI ³ 26-Jun
1	NO treatment		5.5	5.3	504
2	Wolverine Advance	1.7pt+1pt Amsol	6.3	5.8	480
3	Bison + Tacoma	1pt+10oz.	5.8	5.3	480
4	Bison	1pt.	5.5	5.0	458
5	Affinity tank mix+MCPE+Tacoma	.8oz+.5pt+.25%NIS	4.5	4.5	520
6	Everest 2.0 +MCPE	.75oz+.5pt+.25%NIS	4.5	4.5	467
7	Talinor+Tacoma	16oz +10oz+3.2oz. CoAct	5.5	5.0	469
8	Hat Trick + Tacoma	1.5pt+10oz+.25%NIS	5.0	5.8	487
9	Quelex+MCPE+Tacoma	.75oz +1pt+10oz+.25%NIS	5.8	5.8	462
10	Quelex+WideMatch+Tacoma	.75oz+1pt+10oz+.25%NIS	5.3	4.5	466
			NS	1.2	48
			23	15	7

Experimental design:RCB with 4 reps

¹-Stand -1=no plants; 9=full stand

²-Vigor- 1=least ; 9=best

³-Relative chlorophyll index on wheat-higher number is more chlorophyll

Applications made 6/13/2019 4:30pm 73F SW 10-15 34%RH 20% sunny wheat 4lf , 1-2 tillers

MCPE	3.7# MCPE
Talinor	bicyclopyrone .31# + bromoxynil 1.46#
Everest 2.0	flucarbazone .027#
Affinity tank mix	thifensulfuron 40%+tribenuron 10%
Tacoma	fenoxypyr 1#
Bison	2+2 bromoxynil+mcpa
Wolverine Advance	fenoxypyr .4#,pyrasulfotole .13#, bromoxynil .52#
HatTrick	mcpa 1.8#,fluroxypyr .51#,clopypyr .51#
Quelex	.1# halauxifen+.1#florasulum
Wide Match	clopypyr+fluroxypyr(.75#+.75#)

table 13.

**2019 Perennial Ryegrass Late Fungicide Trial
Magnusson Research Farm-Roseau,Mn**

trt#	Treatment Rate/adjuvant	Yield #/acre	Ht(in.) Harvest
1	Quilt Xcel 12oz+.25%NIS	1264	20
2	Priaxor 6oz+.25%NIS	1240	20
3	Folicur 5oz+.25%NIS	1261	19
4	Nexicor 12oz+.25%NIS	1273	20
5	No treat	1204	20
LSD @ 5% Level		NS	NS
CV(%)		5	5

Experimental design:RCB with 3 reps

All applications 7/11/2019

1:00pm wind SSW 6-10 78F

ryegrass fully headed and shedding pollen

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Table 14.

**2019 Perennial Ryegrass Quelex and Fungicide Trial
Marc Tveit Farm-Roseau,Mn**

trt#	Treatment Rate/adjuvant	Yield #/acre	Ht.(in.)	Germination ¹
11*	Quelex/ Quilt Xcel	1495	20	97
12	Quilt Xcel 12oz+.25%NIS	1585	19	96
13	Priaxor 6oz+.25%NIS	1683	19	NA
14	Folicur 5oz+.25%NIS	1503	19	NA
15	No fungicide	1440	20	NA
LSD @ 5% Level		189	NS	
CV(%)		7	2	

Experimental design:RCB with 3 reps

*- Treatment 11= Quelex .75oz+Wide Match 1pt.+Apogee 8oz+.25% Preference+Amsol(AMS) 3 gal. 6/19/2019.

¹-Seed germination tested on harvested seed treatments 11 & 12 only.

6/19/2019 Applied 8oz. Apogee to treatments 12-15

7/8/2019 apply all fungicide treatments to treatments 11-14.

Nexi fluxapyroxad .25#,pyroclostrobin 1.67#,propiconazole 1.04#

Pria: fluxapyroxad 1.39#,pyroclostrobin 2.78#

Tebuconazole 3.6F(Folicur)

Quil Azoxystrobin 1.18#, propiconazole 1.02#

table 15.

2016-19 Ryegrass Fungicide Yield Summary
2 Locations Per Year -Roseau and Lake of the Woods

Product	Adjuvant	Rate/ac.	% of Mean				
			2016-19*	2019	2018	2017	2016
No treatment			89	92	93	89	83
Priaxor	.25%NIS	6oz.	105	108	103	104	106
Folicur	.25%NIS	5 oz.	97	97	97	96	99
Quilt Xcel 2.2 SE	1%COG	14 oz.	103	102	101	103	106
Quilt Xcel 2.2 SE+Warrior	1%COG	14oz+2oz	102	----	97	106	----
Tilt(PropiMax)	.25%NIS	4oz.	100	----	100	99	----
Prosaro SC	.25%NIS	6.5 oz.	106	----	107	----	105
Absolute 4.36 SC	1%COG	7.5 oz.	99	----	----	99	99
Aproach2.08	.25%NIS	9 oz.	100	----	103	99	99
Aproach2.08+Tilt	.25%NIS	6 oz.+4oz.	100	----	95	104	----
Aproach2.08+Tilt	.25%NIS	9 oz.+4oz.	103	----	104	102	----
LSD @5% level				8	9	8	12
CV(%)				7	7	5	8

2019 Mean Yield= 1553 #/acre

2018 Mean Yield= 1387 #/acre

2017 Mean Yield= 1675 #/acre

2016 Mean Yield= 1301 #/acre

* Mean of available treatments for 2-3 years.

Table 16.

2019 Perennial Ryegrass Growth Regulator Applications 2 Locations in Roseau, Mn Area*

PGR treat	rate/acre	Adjuvant ¹	Seed Yield #/acre			Ht.(in.)		Lodging ²		Application date	
			MagPlot	Tveit	Mean	Magplot	Tveit	Magplot	Tveit	Magplot	Tveit
1 No treatment			1379	1317	1348	28	24	8.5	8.7	NA	NA
2 Palisade EC	.75pt	.25%NIS	1655	1534	1595	25	22	7.0	6.0	12-Jun	13-Jun
3 Palisade EC	1.5pt	.25%NIS	1931	1516	1724	23	21	4.3	2.0	12-Jun	13-Jun
4 Apogee	8oz.	.25%NIS+3gal AMS	1836	1421	1628	24	19	5.3	1.0	12-Jun	19-Jun
5 Palisade EC	1.5pt	.25%NIS+3gal.AMS	1673	1448	1561	20	20	2.0	1.3	12-Jun	13-Jun
6 Apogee	4oz.	.25%NIS+3gal.AMS	1727	1469	1598	24	22	6.8	5.0	12-Jun	13-Jun
7 Apogee	8oz.	.25%NIS+3gal.AMS	1762	1430	1596	23	22	3.5	3.3	12-Jun	13-Jun
8 Apogee	8oz.	.25%NIS+2.5% UAN	1622	1466	1544	21	20	1.3	2.3	12-Jun	13-Jun
9 Apogee	8oz.	.25%NIS+2.5%AMS	1845	1466	1656	24	21	6.3	2.3	12-Jun	13-Jun
10 Apogee	8oz.	.25%NIS+3gal UAN	1809	NA	NA	23	NA	2.8	NA	12-Jun	NA
11 Apogee+Callisto	8oz.+ 3oz	.25%NIS+3gal AMS	1845	1581	1713	23	21	6.3	3.3	12-Jun	13-Jun
	LSD @5%level		164	140	135	2	NA	2.1	1.8		
	CV(%)		6	5	4	6	NA	30	30		

Experimental Design:RCB w/4reps(Tveit location=3 reps only)

*-Location 1= Magnusson Research Farm; Location 2=Marc Tveit Farm-South of Roseau,Mn

¹-Adjuvants-NIS(Preference non-ionic surfactant)AMS(3gal.Amsol=10# dry AMS)UAN=(28% urea ammonium nitrate)

²Lodging-9=Flat ; 1= Erect

MagPlot applications- 6/12/2019

2:00pm 62F wind 11-17N RH= 29%

GS= late boot

Tveit applications- 7-26-19 harvest

6/13/2019 GS= late boot-early heading

10:00am 60F wind 4-8mph N

6/19/2019 Apply 8oz. Apogee to trt#4 AND 102-105

7/8/2019 apply all other treatments 101-115

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table 17.

2019 Plant Power Agriculture Evaluation on Perennial Ryegrass Magnusson Research Farm-Roseau, Mn

Treatment*	Rate per acre	Seed Yield #/acre	Test weight ¹	Harvest	
				Ht.(in.)	Lodging ²
1 BMP no growth regulator		1440	26.8	27.3	7.8
2 BMP + Apogee 16 oz.	16oz.+24oz UAN+3oz.NIS	12-Jun 1601	28.8	22.0	1.2
BMP + Apogee 8 oz.	8oz.+24oz UAN+3oz.NIS	12-Jun 1703	29.0	22.5	1.8
3 YE+ HMUM	4oz+2.5#	21-May 1385	25.8	26.8	7.7
4 Xcyte+nitrate balancer	8oz+32oz	12-Jun 1421	26.0	26.7	7.5
5 Sugar Power+HMUM	32oz+1#	11-Jul 1495	26.6	26.5	7.8
6 Trts 3-5	3,4 & 5	5/21,6/12,7/11 1512	26.8	27.8	8.2
	LSD @5%level	163	0.5	1.7	0.8
	CV(%)	9	2	6	11

Experimental Design:RCB with 6 reps

Variety-Arctic Green

*All treatments had best management practices(BMP) applied and would normally include a growth regulator ie. treatment 7

¹Test weight- Clean seed test weight per bushel given as measure of seed quality

²Lodging-9=Flat ; 1= Erect

Applications made 7-11-2019 77F wind 10-15 SSW

64%RH GS= post anthesis

trt 3 & 6 5-21-2019 930am 50%sun 61F wind se5-10 mph 30%RH tiller 1-3" ht.

trt 2,4,6 early heading 8-10" ht. 6-12-2019 11:15 am wind N 9-14 mph sunny rh 33%

Table 18.

**2018-19 Spring Stubble Clipping Management on Ryegrass Seed Production
Magnusson Research Farm-2019 Yields and Other Data
And 2018 Seed Yields only from Rice Farms-Roseau,Mn**

Trt#	Clip Treatment ¹	Seed Yield-#/acre		Harvest		RCI ⁴		%heading
		2019	2018- ²	Ht.(In.)	Lodging ³	10-Jun	1-Jun	17-Jun
1	Clip only	1497	NA	20	1.8	423	378	10
2	Clip-Rake off	1611	1610	21	1.3	471	406	10
3	No Treatment	1386	1430	21	1.5	446	354	13
	LSD @5% level	197	63	NS	NS	NS	NS	NS
	CV(%)	7	2	6	33	10	10	33

Experimental Design:RCB w/4reps

Varieties= Rice farm- 'Evolution'

Magnusson Research farm-'Arctic Green'

¹-Clip and leave or clip and remove 5/3/2019

Wheat stubble= 7". Clip height=3"

²-Seed yield from Rice Farms location-2018(no clip only yield in 2018)

³-Lodging-1=no lodging ;9=flat

⁴-RCI -Relative chlorophyll index- Higher number = more chlorophyll

Table 19.

2017-18 Sulfur Applications to Ryegrass, Hard Fescue, and Kernza
Magnusson Research Farm-F2B --Roseau, Mn
Perennial Ryegrass

2018 Data--Arctic Green -Perennial Ryegrass									Tissue samples taken 7/10/2018								
Added ¹ Sulfur	Seed			Lodging harvest	Color 5/25/18	RCI 5/25/18	RCI 6/12/18	RCI 7/8/18	% PPM								
	Yield #/acre	Ht(in.) Harvest	mean						N	P	K	S	Ca	Mg	Zn	Fe	Mn
0	616	21	1.5	5.0	192	343	216	1.2	0.23	1.30	0.15	0.25	0.34	16	36	20	5
67#AMS	905	22	3.7	4.5	202	318	259	1.5	0.22	1.25	0.17	0.23	0.35	13	37	25	5
125#AMS	728	23	3	6.0	264	379	195	1.2	0.21	1.20	0.15	0.22	0.33	13	33	22	4.5
LSD @5% level	211	2	NS	NS	NS	NS	50	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV(%)	16	15	19	19	30	10	13	10	11	11	2	7	9	20	28	13	22

2019 Data on trial seeded in 2018. 2018 seed yield only of trial seeded in 2017.

2019 Data on trial seeded in 2018. 2018 seed yield only of trial seeded in 2017.									Tissue samples taken 6/29/2019								
Added Sulfur	Seed Yield(#/acre) ¹			Lodging harvest	RCI			% PPM									
	2018	2019	mean		6/1/19	6/10/19	6/26/19	N	P	K	S	Ca	Mg	Zn	Fe	Mn	B
0	616	1066	841	8	580	599	410	1.9	0.23	1.6	0.15	0.28	0.37	10	44	23	4
67#AMS	905	1008	957	9	716	633	390	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
125#AMS	728	981	854	9	735	678	437	2.3	0.23	1.6	0.21	0.33	0.41	11	56	34	5.5
LSD @5% level	211	72	100	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV(%)	16	4	6	4	15	15	8	2	6	6	16	2	4	5	12	2	10

Intermediate wheatgrass-Kernza

2018 planting- 2019 Data									Tissue samples taken 7/10/2018				
Added Sulfur	Seed			Lodging harvest	Color 5/25/18	RCI 5/25/18	RCI 6/12/18	RCI 7/8/18	% PPM				
	Yield #/acre	Harvest Ht(in.)	mean						N	P	K	S	Ca
0	634	52	1	4.0	287	264	279	2.4	0.18	1.4	0.18	0.53	
125#AMS	623	53	1	4.0	275	292	263	2.4	0.18	1.3	0.20	0.60	
LSD @5% level	NS	1	0	NS	NS	NS	NS	NS	NS	NS	NS	NS	
CV(%)	18	14	0	29	22	12	3	9	0	4	15	22	

Kernza - 75% hulled and 15% ergot

2017 planting- 2019 data plus 2018 yields

2017 planting- 2019 data plus 2018 yields									Tissue samples taken 6/29/2019								
Added Sulfur	Seed Yield(#/acre)			Harvest Ht(in.)	RCI			% PPM									
	2019	2018	mean		6/1/19	6/10/19	6/26/19	N	P	K	S	Ca	Mg	Zn	Fe	Mn	B
0	728	641	684	61	567	525	413	3.2	0.22	1.7	0.23	0.56	0.52	9	78	44	6
125#AMS	774	852	813	62	589	511	414	3.6	0.22	1.6	0.24	0.57	0.5	9.5	77	44	5.5
LSD @5% level	NS	NS	84	1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV(%)	6	13	5	1	13	6	8	4	2	4	6	4	0	16	1	1	9

Kernza - 75% hulled and 15% ergot

Hard Fescue- HD-1

2018 planting- 2019 Data--MN-HD1-Hard fescue									Tissue samples taken 6/29/2019								
Added Sulfur	Seed ¹			Harvest heading Ht(in.)	% Harvest heading			% PPM									
	Yield #/acre	6/1/19	6/10/19		6/26/19	5/30/19	N	P	K	S	Ca	Mg	Zn	Fe	Mn	B	
0	1046	622	401	351	25	67	1.6	0.18	2	0.09	0.18	0.22	5	80	30	3.5	
125#AMS	881	601	338	353	25	65	1.7	0.17	2	0.10	0.19	0.22	4.5	72	38	4	
LSD @5% level	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
CV(%)	11	15	11	9	10	10	7	20	7	10	14	18	31	4	12	13	

2017 planting-2019 data plus 2018 yields

2017 planting-2019 data plus 2018 yields					
Added Sulfur	Seed Yield(#/acre) ¹			Harvest Ht(in.)	Lodging harvest
	2018	2019	mean		
0	985	383	684	25	1
125#AMS	1044	283	664	25	1
LSD @5% level	NS	NS	NS	NS	0
CV(%)	18	35	11	5	0

Experimental design; RCB w/4 replications

Establishment and general management:

Plots of all 3 species were planted in a randomized complete block design in both 2017 and 2018.

Perennial ryegrass was harvested in only 1 year following planting and stands were then terminated

Individual plots of Hard fescue and Kernza were/will be maintained and harvested for 2 years on each planting.

Ryegrass @ 6#/acre and Kernza @ 10#/acre were planted with spring wheat on 6/2/2017 and 5/20/2018.

MN-HD1 hard fescue @6#/acre was planted on 6/2/2017 and 5/20/2018 with no cover

Wheat was removed at harvest in August.

40-0-0 was applied to all plots on 10/27/2017 and 10/18/2018 and

AMS(ammonium sulfate) and urea (80#N/ac for ryegrass and 40#N/ac for hard fescue and kernza)

was applied by hand on 5/7/2018. An additional 40-0-0 was applied to kernza and perennial ryegrass on 6/1/2018.

Soil test on 2017 planting 5/5/2018-prior to spring fertilizer

Olsen P --3PPM, K 87PPM, OM 3.3%, PH 8.4, SO4-S 11PPM

Soil test on 2018 planting 10/28/2018- prior to fertilizer applications

Olsen P --5PPM, K 128PPM, OM 2.4%, PH 8.1, SO4-S 18PPM

Harvest dates- MN-HD- 6/28/2018 and 7/6/2019, Perennial ryegrass 7/19/2018 and 7/24/2019, Kernza 8/10/2018 and 8/24/2019

table 20.

2017 Tall Fescue Residue Management Trial Magnusson Research Farm

Variety=Hounddog

Treatment ¹	Seed Yield-#/acre		Harvest	RCI ³	%heading
	Actual	Estimate ⁻²	Ht.(ln.)	10-Jun	17-Jun
No Treatment	990	650	35	421	26
chop box	1205	825	35	478	11
Gramox-burn	1082	600	34	514	38
burn	1198	650	35	465	26
LSD @5% level	210	136	1	NS	17
CV(%)	12	12	3	16	42

Experimental design; RCB w/4 replications

Treatment¹

No Treatment	Straw left in place after harvest in 2018
Chop box	Straw chopped to 4" and removed after 2018 harvest
Desiccate burn	Area sprayed with 1.5pts. Gramoxone+.25%Preference after harvest(8/3-18) then burned on 8/9/2018
Burn	Area burned after harvest on 8/9/2018

Table 20.

2016-19 MN-HD Hard Fescue Herbicide Screen¹

Magnusson Research farm-Roseau,Mn.

2016-19 seed yields and other 2019 data

Treatment	Rate/Adjuvant	Seed Yield-#/acre ¹					4 Yr Ave.	Vigor ²		Ht (in.)	
		2016	2017	2018	2019	6/25		6/14	Harvest		
Section 2	12oz+1%COC	35	605	0	0	160	1	5	5		
Fusilade	10oz.+1%COC	1789	851	762	1311	1134	7	20	25		
Callisto	3oz.+1%COC+2.5%-28%N	1552	801	454	1065	936	7	18	21		
Clarity	.75pt	1629	584	537	721	917	7	19	22		
2,4-D amine	.75pt	1451	813	682	1187	982	6	20	23		
2,4-D+Clarity	.75pt+.75pt.	1341	863	531	837	912	6	19	23		
No Treatment		1439	946	792	1104	1059	7	19	23		
	LSD @ 5% level	393	307	257	194	114	1	2	3		
	CV(%)	16	22	26	12	7	11	5	7		

Experimental Design:RCB with 3 reps

¹-2016 and 2017 and the 2018 and 2019 were herbicide applications to the same plot on 2 years.

²Vigor-1=least;9=best vigor.

General applications to all plots -- 3/4pt. 2,4-D + 3/4pt. Clarity applied 9/15/2015 ,9/25/2016 and 9/25/2017

Trade name	common name	Al/gallon
Callisto	mesotrione	4#/gal
Section 2	clethodim	2#/gal
Fusilade DX	fluaxifop	2#/gal
Clarity	Dicamba	4#/gal
2,4-D Amine	2,4-D	4#/gal

Harvest date=7/11/2019---visual estimate=20%shatter loss but no corrections made to data

Applications made 5/20/2019 GS= late-boot no heading 4" tall

at 5:00pm sunny wind 2-4mph

Fall application .75pt 2,4D+.75pt.Clarity 10/2/2018 to all plots

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table 21.

2017 Tall Fescue Residue Management Trial

Magnusson Research Farm

Variety=Hounddog

Treatment	Seed Yield-#/acre		Harvest Ht.(In.)	RCI ³ 10-Jun	%heading 17-Jun
	Actual	Estimate ⁻²			
No Treatment	990	650	35	421	26
chop box	1205	825	35	478	11
Gramox-burn	1082	600	34	514	38
burn	1198	650	35	465	26
LSD @5%	210	136	1	NS	17
CV(%)	12	12	3	16	42

Experimental design; RCB w/4 replications

Treatment¹

No Treatment Straw left in place after harvest in 2018

Chop box Straw chopped to 4" and removed after 2018 harvest

Desiccate Area sprayed with 1.5pts. Gramoxone+.25%Preference after harvest(8/3-18)
then burned on 8/9/2018

Burn Area burned after harvest on 8/9/2018

table 22.

2018 Fine Fescue Establishment Trial-2019 Data
St.Paul campus X11 and Roseau-Magnusson Research farm

Roseau cultivars	species	Cover wheat	Seed Yield(#/acre)			Ht(in.) at harvest		Lodging at harvest	
			Roseau	St.Paul	Mean	Roseau	St.Paul	Roseau	St.Paul
Artic green	perennial	none	381	661	521	23	26	2.5	2.3
Artic green	ryegrass	yes	1143	874	1009	24	27	1.0	3.8
Chantilly	strong	none	852	1244	1048	26	33	6.0	7.0
Chantilly	cr.red fescue	yes	549	347	448	27	29	8.5	1.5
Intrigue	chewing	none	616	1356	986	30	35	3.5	7.8
Intrigue	fescue	yes	437	482	460	32	31	6.5	4.3
Radar	chewing	none	874	1412	1143	29	34	4.0	7.8
Radar	fescue	yes	582	762	672	26	32	7.0	5.3
MNHD	Hard	none	829	1300	1065	24	26	8.0	6.0
MNHD	fescue	yes	246	56	151	31	22	9.0	1.3

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table 23.

2017 Kernza Intermediate Wheatgrass Planting Date Trial*
Magnusson Research farm-F4

All harvested 8-23-2019
 2018-19 Data

Planting regime ¹	Yield ² #/acre			Harvest Ht.(in.)
	2018	2019	Mean	
Fall - fallow plant	559	696	627	61
Fall - wheat stubble plant	335	607	471	56
Spring - with wheat	671	631	651	59
LSD @5% level	148	NS	107	NS
CV(%)	12	9	8	4

Experimental Design: RCB with 3 reps

Plot size= 20'x 180'

*-Kernza variety= C4-2016Rosemount

¹-Spring planting with Linkert spring wheat @120#/acre 5/19/2017.

Fall planting into wheat stubble-8/25/2017

Fall planting into fallow ground -9/2/2017

Seeding Rate=10#/acre on all treatments

²-Grain yield in #/acre. Visually estimated 80% hulled seed and 10% ergot

³-Live plant counts/ft.2

table 24.

**2019 Tall Fescue Growth Regulator/Fungicide Trial
Drew Parsley Farm-North of Williams**

Treatment	Rate-adjutant	Seed Yield-	Harvest	RC ³
		#/acre	Ht.(In.)	22-Jul
1 Apogee+Quilt	8oz.+12oz.25%NIS+2.5%AMS	1277	25	396
2 Apogee	8oz.+25%NIS+2.5%AMS	1115	22	368
3 Palisade EC	1.5pt+.25%NIS	1055	22	435
4 Apogee	8oz.+25%NIS+3gal-28%N	1139	24	362
5 Palisade EC	1.5pt+.25%NIS+3gal AMS	990	21	406
6 Quilt Xcel	12oz+.25%NIS	1244	28	360
7 Priaxor	6oz+.25%NIS	1368	28	400
8 Folicur	5oz+.25%NIS	1148	27	409
9 Quilt Xcel+Warrior	12oz+2oz+.25%NIS	1331	28	310
10 No Fungicide		1217	28	326
LSD @5% level		273	2	84
CV(%)		15	6	15

Experimental Design:RCB with 3 reps

Add Quilt Xcel to trts 2-5 6/26/2019

Growth regs applied 6/13/2019. 1:30pm 65F NW 4-8mph

Fungicides applied 6/26/2019 2:00pm 80F wsw 8-12mph fully headed , early pollen shedding

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table 25.

**2019 Spring Fertilizer Applications to Tall Fescue
Drew Parsley Farm-North of Williams**

UM added	Fertilizer	N source	Total N application	Add sulfur AMS-#/ac	Yield	Harvest	RCI ³	
					#/acre	Ht.(In.)	Lodging ²	22-Jul
1	140-0-0-20s	urea	140	20#AMS	NA¹	29	1.3	389
2	140-0-0-20s	am nitrate	140	20#AMS	1344	34	1.0	504
3	55-0-0-60s	0	60	60#AMS	999	32	1.0	345
4	180-0-0-60s	urea	180	60#AMS	1192	34	2.0	521
5	180-0-0-60s	am nitrate	180	60#AMS	1270	34	2.3	555
6	140-0-0	urea	140	0	862	29	1.0	338
7	140-0-0	am nitrate	140	0	1014	31	1.3	490
8	180-0-0	urea	180	0	1398	32	1.0	488
9	180-0-0	am nitrate	180	0	1344	32	2.3	567
10	0	0	0	0	613	26	1.0	251
LSD @5% level					381	4	0.7	202
CV(%)					19	6	30	26

Experimental Design:RCB with 3 reps

¹-No harvest samples taken on 2 of the 3 plots

²-Lodging-1=none;9=flat

³-RCI-Relative chlorophyll index-higher number=more chlorophyll

Management of both trials=

Best management practices incorporated in both trials other than treatments

Planted under barley 5/2018

Fall fertilizer added = 30-50-60-12s to both trials 10/2018

Spring fertilizer to growth regulator/fungicide trial-110-0-0

Variety-Titanium

table 26.

**2019 P & K Long Term Fertility Rotation Trial on Spring Wheat and Soybeans
Magnusson Research Farm- Roseau,Mn**

Wheat-2019

Added ¹ P & K	Yield ² Bu/Acre	Test		
		Wt./Bu	Protein ³	Ht.(in.)
1 0-20-0	85.0	60.3	15.3	30
2 0-40-0	86.3	60.3	15.3	30
3 0-60-0	87.3	60.2	15.1	30
4 0-80-0	85.3	60.3	15.1	30
5 0-100-0	92.8	60.2	15.2	29
6 0-0-20	81.3	60.0	15.4	30
7 0-0-40	81.5	60.0	15.4	29
8 0-0-60	83.3	60.0	15.5	30
9 0-0-80	81.3	60.3	15.7	30
10 0-0-100	82.5	60.1	15.7	30
11 0-20-20	89.0	60.1	15.3	30
12 0-40-40	86.5	60.1	15.2	30
13 0-60-60	85.3	60.2	15.1	30
14 0-80-80	77.5	60.0	15.3	30
15 0-100-100	87.8	60.3	15.2	29
16 0-0-0	82.3	60.2	15.3	31
LSD @5%level	8.6	0.3	0.2	1.4
LSD @10%level	7.2	0.2	0.2	1.2
CV(%)	7.2	0.3	1.1	3.3

Linkert wheat seeded @ 120#/acre 5/11/2019
160-0-0 applied and incorporated in final seedbed prep.

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Soybeans

	Yield ² Bu/Acre	Test			
		Wt./Bu	Protein ³	Oil ³	Ht.(in.)
1 0-20-0	65.3	57.4	36.7	20.4	28
2 0-40-0	62.0	57.5	37.1	20.4	28
3 0-60-0	61.5	57.2	37.4	20.5	28
4 0-80-0	61.0	57.5	36.9	19.6	28
5 0-100-0	63.8	57.1	37.8	20.3	28
6 0-0-20	61.8	57.3	37.0	20.4	28
7 0-0-40	63.5	57.5	37.0	20.4	29
8 0-0-60	67.5	57.5	36.9	20.2	28
9 0-0-80	61.5	57.5	37.0	20.0	28
10 0-0-100	68.0	57.4	37.0	20.3	27
11 0-20-20	67.8	57.3	36.9	20.3	30
12 0-40-40	64.3	57.5	36.7	20.0	28
13 0-60-60	64.3	57.4	37.0	20.5	28
14 0-80-80	62.3	57.5	37.2	20.3	28
15 0-100-100	68.5	57.3	37.4	20.2	30
16 0-0-0	61.7	57.3	36.9	19.9	28
LSD @5%level	7.7(ns)	0.4	NS	NS	NS
LSD @10%level	6.4	0.3	0.8	0.8	2.1
CV(%)	8.5	0.5	1.8	2.3	6

Experimental Design: RCB with 4 reps
All plots us best management practices(BPM)
Asgrow AG005X8 soybeans seeded @ 225,000/acre 5/17/2019
Added¹ - 0-46-0 super phosphate and 0-0-60 potash used for P and K sources
Yield² - Bushels per acre corrected to 12%moisture for wheat and 13%moisture for soybean
Protein and Oil³ -on dry matter basis
Plot size= 6' x 15' Harvest area= 5' x 12'

5/7/2019	PH	% OM	Olsen P ppm	NH4OAc-K ppm	SO4-S #/ac	Zn ppm	nitrates #/acre	Sol salts
Soil tests-0-6"								
F7SE(wheat in 2019)	8.2	2.8	6	154	14	0.27	9	0.23
F7NW(soybean in 2019)	7.8	2.8	23	166	34	0.38	NA	0.4