

PROJECT TITLE: Evaluation of the hulled wheats, einkorn, emmers and spelt, for yield and agronomic adaptation to Montana.

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OBJECTIVES:

The hulled wheat species will be evaluated for yield, human food and livestock feed nutritional quality and agronomic adaptation (lodging resistance and winter hardiness) to Montana.

RESULTS:

Einkorn: Table 1 compares the yield and agronomic traits of einkorn to spring oats, wheat and barley. Einkorn entries included PI accessions from the world collection in Aberdeen and PI accessions designated TM from Pierre Hucl, Canada. All einkorn accessions were significantly lower in yield compared to the traditional cereals. In contrast to 1998, many einkorn accessions produced yields equal to or higher than spring oats in 1996 and 1997.

Spring Emmer: The 1998 yield and agronomic traits of selected emmers are compared to spring wheat, barley and oats in Table 2. The trial also includes a spring triticale selection PGT-215 from Resource Seeds, two spring spelt selections, 1088 and 1094, from Dr. Kal Konzak, private breeder, Pulman, Washington, and four spring emmer selections from Bent Skovmand, Maize Center (CIMMYT), Mexico. The four emmers from (CIMMYT) were selected based on the potential for bread quality. The Bavaria dark and lite entries are selections from the original CDC Bavaria spring spelt, released by Pierre Hucl, Ag. Canada. The trial continued the on-going evaluation of two spring emmer plant introduction (PI) accessions from the world collections, PI 148 and PI 535. MonDak 1 and 2 emmers represent landrace selections presently grown in Montana North Dakota.

Winter spelt: Tables 3 and 4 compare winter spelt to Tiber hard red winter wheat. Yield on re-crop averaged 28 bushel less than on fallow. Spelt yields ranged from 4782 to 1904 lb/a on fallow compared to 2943 to 1529 lb/a on re-crop. The higher yielding spelt entries on both fallow and re-crop included the germplasm selection from Dr. Hal Lafever's program. The higher yielding entries also included the Dover Sindelar Montana landrace selection, and numerous accessions. In particular, the PI accessions 148159 and 355618

Braunshweise have been consistent high yielders and expressed winter hardiness over six years of evaluation. Both PI accessions have also been among the highest forage producers. Spring spelt: Table 5 compares the spring adapted winter spelts to spring oats, wheat, and barley. Lewis spring barley significantly out-yielded all spring spelt entries. While the spring oat and spring wheat yields were higher than the spelt entries, their yields were not significantly different from the majority of the spelt selections. The 1998 yield results are similar to the yield results observed in the previous three years.

SUMMARY:

Hulled wheats, einkorn, emmer and spelts, have been identified which produce yields equal to the traditional cereal crops, and which have agronomic traits compatible for cropping in Montana. Individual selections will be increased and released as varieties to be marketed as niche alternative cereal crops for livestock feed and human food.

FUTURE PLANS:

We will continue to evaluate the hulled wheat germplasm for adaptation to Montana cropping environments.

Table 1. 1998 Einkorn Variety Evaluation – Exp. Eink98. Central Agricultural Research Center. Moccasin, MT.

Entry	Variety/Line	Grain Yield (lbs/bu)	Heading Date (Julian) ^{1/}	Plant Height (in.)
2	Lewis Barley	3339	186	37
3	Newana Spring Wheat	2912	186	33
1	Otana Oats	2883	185	42
18	PI290511	2275	189	42
26	PI355526	2240	191	42
15	PI378469	2032	191	42
4	PI538723	2028	189	40
21	TM639	2018	190	43
16	PI266844	1988	189	41
11	PI182461	1984	192	43
8	PI94740	1976	189	43
25	TM168	1910	190	40
10	PI377662	1901	187	44
6	PI190947	1894	188	42
20	PI355544	1884	190	44
23	TM23	1878	188	42
5	PI362616	1874	188	43
7	PI355547	1848	190	43
19	PI355548	1839	190	42
13	PI355516	1785	190	43
9	PI182462	1725	190	42
22	TM24	1709	188	43
24	TM28	1707	189	42
12	PI272560	1620	191	42
14	PI264935	1598	189	42
17	CI13963	1390	188	45
Experimental Means		2009	188.9	41.8
F-Value for Var. (df = 25)		4.4**	4.0**	4.3**
CV 1: (s/Mean)*100		17.8	0.7	4.9
LSD (0.05)		586	2.3	3.3

^{1/} Number of days from Jan. 1 (190 = July 9)

** Denotes Statistical Significance at P<= 0.01

Planted: 4/22/1998

Harvested: Information not available.

Fertilizer: 90# N as Urea broadcast and incorporated.

Growing Season Precipitation (April – July): 9.35” – 90 year avg.: 8.69”

<u>April</u>	<u>May</u>	<u>June</u>	<u>July</u>
0.59”	1.89”	4.79”	2.08

Table 2. Performance of selected spring emmer lines in comparison to spring oats, barley and wheat grown under dryland conditions – Exp. 98SE. Central Agricultural Research Center. Moccasin, MT. 1998.

Variety/Line	Grain Yield (bu/a)	Test Weight (lbs/bu)	Heading Date (Julian ^{1/})	Plant Height (in.)	Lodging Score (0-9)
Lewis	3290	-	182	37	1.0
Newana	2991	-	186	34	0.0
PI148	2931	31.0	180	36	3.0
Bread 3	2844	33.7	181	37	1.3
Spelt 1088	2831	30.6	181	38	0.0
Trit PG T-215	2702	49.0	188	41	0.0
Otana Oats	2543	-	186	45	1.3
Spelt 1094	2292	23.0	185	41	0.7
Bread 2	2263	32.9	189	38	4.0
Bavaria Dark	2138	25.9	192	50	2.7
PI535	2120	28.8	193	45	1.0
Bavaria Lite	2053	29.5	193	46	4.3
Bread 4	1925	26.3	186	41	4.0
Mondak 2	1847	30.3	190	43	2.0
Mondak 1	1728	29.8	191	41	4.0
Bread 1	1702	20.8	189	40	8.7
Experimental Means	2388	30.1	186.9	40.8	2.4
F-Value for Var. (df = 15)	6.5**	23.1**	169.3**	19.2**	17.0**
CV 1: (S/Mean)*100	14.2	7.2	0.3	4.0	40.2
LSD (0.05)	563	3.7	1.0	2.7	1.6

^{1/} Number of days from Jan. 1 (185 = July 4).

** Denotes Statistical Significance at P ≤ 0.01.

Planted: 4/22/1998 on fallow ground.

Harvested: not available

Fertilizer: 90# N as Urea broadcast and incorporated.

Growing Season Precipitation (April – July): 9.35" – 90 year avg.: 8.69"

<u>April</u>	<u>May</u>	<u>June</u>	<u>July</u>
0.59"	1.89"	4.79"	2.08"

Table 3. Evaluation of Winter Spelt lines grown on fallow ground – Exp. WSPL.
Central Agricultural Research Center. Moccasin, MT. 1998

Variety/Line	Grain Yield (lbs/a)	Lodging Score (0-9)	Heading Date (Julian ^{1/})	Plant Height (in.)
1023-89-25	4782	1.0	172	44
SAVA	4557	1.0	166	39
PI347888-69Z6-405W	4517	0.7	168	34
PI355618 BRAUNSHWE	4381	1.7	181	51
SINDELAR WHITE	4276	3.3	179	51
27290RA,R3-18	4194	1.0	170	44
MAVERICK	4178	1.3	165	41
CHAMP	4105	1.7	174	49
PI348157-69Z6320-6	4101	8.3	177	49
TIBER	4093	0.3	164	39
PI348337-69Z6508-B	4051	1.0	174	52
SAM	3929	0.3	171	39
WK85031-1	3872	2.0	168	42
PI348159 GER	3866	6.0	178	52
SINDELAR MIX	3852	4.7	180	52
SAMMY	3832	0.0	165	38
ROQUIN	3825	2.3	176	48
TORA	3815	0.0	172	37
SP949	3794	8.7	174	47
PI348145 GER	3689	3.7	178	48
PI348148 GER	3669	2.0	177	51
WK86025-28	3664	0.7	168	43
GR900	3605	1.3	175	49
PI355647 STRICKHOF	3585	2.0	175	50
PI355650 SPELTA 44	3584	1.3	177	53
PI347871	3565	1.7	180	52
PI348234 GER	3545	4.0	185	46
ALT-GOLD	3473	2.0	176	52
PI148180 BROWN	3437	5.3	180	50
PI355646 ROTHENBURG	3364	1.3	176	50
PI348297 GER	3317	2.0	182	50
PI348180	3269	2.3	176	53

(Continued)

Table 3. Evaluation of Winter Spelt lines (fallow, grain) – Exp. WSPL (Continued).

Variety/Line	Grain Yield (lbs/a)	Lodging Score (0-9)	Heading Date (Julian ^{1/})	Plant Height (in.)
PI355613	3217	1.3	179	52
SINDELAR DARK	3208	2.3	175	50
PI347878 SWIT	3189	2.3	181	52
PI355613 GER	3052	1.3	178	51
PI348264	3044	3.7	176	48
OBERKULMER	2965	1.7	176	53
PI355605 VOCNWALDE	2941	2.0	177	51
PI348131 GER	2926	2.0	179	54
PI355609 BANGERTER	2881	1.7	172	50
CANADA BULK	2736	1.3	178	52
PI355644 BATTING NI	2620	2.0	174	52
PI355703 FORAGE	1904	5.3	180	57
Experimental Means	3602	2.3	175.1	48.2
F-Value for Var. (df = 43)	3.8**	10.7**	13.9**	14.4**
CV 1: (S/Mean)*100	14.2	44.4	1.3	5.0
LSD (0.05)	832	1.7	3.7	3.9

^{1/} Number of days from Jan. 1 (170 = June 19).

** Denotes Statistical Significance at $P \leq 0.01$.

Planted: 9/24/1997

Harvested: information not available.

Fertilizer: 90# N as Urea, pre-plant incorporated.

Growing Season Precipitation (April – July): 9.35" – 90 year avg.: 8.69"

<u>April</u>	<u>May</u>	<u>June</u>	<u>July</u>
0.59"	1.89"	4.79"	2.08"

Table 4. Evaluation of Winter Spelt lines on re-crop ground – Exp. WSPL. Central Agricultural Research Center. Moccasin, MT. 1998.

Variety/Line	Grain Yield (lbs/a)	Heading Date (Julian ^{1/2})	Plant Height (in.)
PI348159 GER	2943	180	41
PI348145 GER	2942	181	38
PI348157-69Z6320-6	2668	180	42
PI355605 VOCNWALDE	2664	179	43
SP949	2628	179	41
MAVERICK	2626	168	38
PI148180 BROWN	2610	181	42
1023-89-25	2576	173	39
PI355618 BRAUNSHWE	2565	182	43
PI347871	2553	181	42
SINDELAR MIX	2527	182	46
PI348337-69Z6508-B	2499	180	42
WK85031-1	2492	169	38
PI348234 GER	2471	183	38
WK86025-28	2460	171	39
TIBER	2403	168	37
CHAMP	2280	175	40
SAVA	2277	170	37
SINDELAR DARK	2263	176	42
PI355650 SPELTA 44	2239	179	46
PI347878 SWIT	2238	180	41
27290RA,R3-18	2237	172	38
GR900	2228	178	42
PI348148 GER	2228	179	41
PI355613 GER	2227	180	44
SINDELAR WHITE	2226	181	45
TORA	2141	174	33
PI348264	2124	179	42
PI355644 BATTING NI	2115	177	44
CANADA BULK	2104	179	40
PI347888-69Z6-405W	2100	172	25
ALT-GOLD	2092	178	42
ROQUIN	2072	178	41
SAMMY	2053	167	32
SAM	2020	176	37
PI355647 STRICKHOF	2005	177	44

(Continued)

Table 4. Evaluation of Winter Spelt lines (re-crop, grain) – Exp. WSPL (Continued).

Variety/Line	Grain Yield (lbs/a)	Heading Date (Julian ^{1/})	Plant Height (in.)
PI355613	1992	180	42
PI348131 GER	1874	180	43
PI355646 ROTHENBURG	1856	179	45
OBERKULMER	1829	178	45
PI348180	1809	178	44
PI348297 GER	1682	182	44
PI355703 FORAGE	1663	184	46
PI355609 BANGERTER	1529	178	43
Experimental Means	2253	177.3	40.8
F-Value for Var. (df = 43)	4.0**	12.8**	8.3**
CV 1: (S/Mean)*100	12.5	1.2	5.9
LSD (0.05)	456	3.4	3.9

1/ Number of days from Jan. 1 (170 = June 19).

** Denotes Statistical Significance at $P \leq 0.01$.

Planted: 9/24/1997

Harvested: Information not available.

Fertilizer: 60# N

Growing Season Precipitation (April – July): 9.35" – 90 year avg.: 8.69"

<u>April</u>	<u>May</u>	<u>June</u>	<u>July</u>
0.59"	1.89"	4.79"	2.08"

Table 5. 1998 Spring Spelt Evaluation – Exp. SSPL98. Central Agricultural Research Center.
Moccasin, MT. 1998.

Entry	Variety/Line	Grain Yield (lbs/a)	Heading Date (Julian) ^{1/}	Plant Height (in.)	Lodging Score (0-9)
2	Lewis Barley	3067	183	36	1.3
1	Otana Oats	2472	186	45	1.3
3	Newana Spring Wheat	2368	186	33	0.0
22	PI348633	2070	193	52	2.3
19	PI348498	1876	193	52	1.7
20	PI348593	1843	192	50	1.0
23	PI348766	1805	192	51	1.3
16	PI348688	1763	192	50	1.7
17	PI348760	1752	193	48	2.3
14	PI348450	1744	192	48	1.0
5	PI348756	1733	190	49	1.7
25	PI348444	1638	191	49	2.0
12	PI348436	1634	194	47	2.3
21	PI348763	1598	193	50	2.7
26	PI348671	1582	192	49	2.0
15	PI348755	1572	194	48	1.7
6	PI355580 – Awnless	1548	195	48	1.3
18	PI348486	1546	192	49	2.7
8	PI348769	1493	191	49	1.7
7	PI190962 - Awnless	1460	195	48	1.3
10	PI348778	1443	193	46	2.7
11	PI348582	1441	193	50	1.7
13	PI348636	1437	193	47	1.7
28	PI348733	1367	194	47	2.7
24	PI348757	1331	192	49	1.3
9	PI348571	1326	190	50	1.3
27	PI348680	1246	194	45	1.7
4	BAVARIA	1170	194	44	4.0
Experimental Means		1690	191.9	47.5	1.8
F- Value for Var. (df = 27)		1.9*	60.5**	9.3**	3.6**
CV 1: (S/Mean)*100		30.1	0.3	5.0	37.7
LSD (0.05)		832	0.98	3.9	1.1

^{1/} Number of days from Jan. 1 (190 = July 9)

** Denotes Statistical Significance at P<= 0.01.

* Denotes Statistical Significance at P<= 0.05.

Planted: 4/22/1998

Harvested: Information not available.

Fertilizer: 60# N as Urea broadcast and incorporated.

Growing Season Precipitation (April – July): 9.35” – 90 year avg.: 8.69”