

Spring Cereal Forage Applied Water Use

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Introduction

When years of drought continue, year after year, irrigation water availability is a huge issue. Forage production decreases dramatically, and livestock may need to be sold prematurely. Emergency feed production from cereal species can be a partial solution to producing emergency feed. If winter cereals were not planted in the Fall to help with maintaining or increasing forage needed for livestock; spring cereals can be planted to utilize any winter through early summer precipitation, along with limited irrigation water.

The following oat, barley, wheat, rye, and triticale spring cereal data are from the 1990-1993 cereal species and variety trials planted at the Central Oregon Ag Research Center at Powell Butte, Oregon. Materials and methods are provided in (Bohle et.al, 2002). The irrigation records accessed had solid set spacing dimensions, nozzle size, nozzle pressure, along with the number of hours the system was run for each event; inches-per-hour of water applied was able to be calculated. The hours were converted to inches per irrigation episode.

Harvest dates, at late boot or soft dough growth stage, were then used to subtract irrigation events back 6-9 days to previous irrigation events to allow a suitable time for the dry down of the foliage and soil so harvest could occur. Yield was divided by total inches of water applied to document applied water use to determine yield per inch of water applied.

Table 1 is a partial calendar of “day of year” dates. The data tables (tables 2-7) are sorted from least amount of water applied to most water applied. Yield, harvest date, water applied, and DM yield (pounds and tons/inch) per inch of water applied are presented in the tables.

Because of the way the irrigation system was set up at the Powell Butte site, extra lines sometimes needed to be run on different trials to reduce the pressure on the lines, so extra water was added in some years. *Due to the lack of an on-site weather station, rain and snow precipitation is not considered as part of the water use by the cereals, so is not added into the total water usage by the cereals.* The amount of irrigation water applied could be dramatically different in the late spring to early summer, annually, depending upon precipitation events. There have been years where there was absolutely no moisture in the soil at planting time, to years where there was enough winter, spring, and early summer moisture to harvest a large amount of forage with little to no additional irrigation water applied for a late spring harvest of perennial forage (one rare year).

If limited irrigation water availability quantity is known, this information can aid a producer in choosing which species and variety would be the best choice to plant to produce forage (although some of these varieties are not now currently available).

Bohle, M. Ballerstedt, P., Dovel, R., Karow, R., and Hannaway, D. (2002) Spring cereal forage varieties for central Oregon. Central Oregon Ag Research Center Annual Report. Oregon State University Ag Experiment Station. Special Report 1046. 27 pages.

https://agsci.oregonstate.edu/sites/agscid7/files/coarec/publications/02_spring_cereal_forage.pdf

Table 1. Day of year (doy) from January 1 starting with April 1 to September 1 and spring cereal forage planting date day of year, 1990 - 1993.

Year	Apr. 1	Planting Date (doy)	May 1	Jun. 1	Jul. 1	Aug. 1	Sep. 1
1990	91	96	121	152	182	213	244
1991	91	113	121	152	182	213	244
1992	92	97	122	153	183	214	245
1993	91	125	121	152	183	213	244

doy – day of year from January 1.

Table 2. Spring cereal forage trial yield, harvest date, water applied, yield (pounds and tons) per inch of water applied at COAREC, Powell Butte, Oregon in 1990. (Planted April 6, doy - 96)

Variety	Species	DM Yield (t/ac)	Harvest Date (doy)	Water Applied (in)	DM Yield per inch of Water Applied (lb/in)	DM Yield per inch of Water Applied (ton/in)
Soft Dough Harvest						
Haybet	Barley	5.81	198	20.96	554	0.28
Whitford	Barley	4.80	198	20.96	458	0.23
Westford	Barley	5.84	202	20.96	557	0.28
Koldbar	Barley	5.58	202	22.28	501	0.25
Belford	Barley	4.40	204	23.60	373	0.19
Cayuse	Oat	6.06	207	23.60	514	0.26
Kanota	Oat	5.49	207	23.60	465	0.23
Swan	Oat	6.28	209	24.76	507	0.25
Otana	Oat	6.85	210	24.76	553	0.28
Monida	Oat	7.11	211	25.75	552	0.28
Karl	Triticale	7.04	212	25.75	547	0.27
Sierra	Oat	5.33	212	25.75	414	0.21
Juan	Triticale	7.25	213	25.75	563	0.28
Twin	SWSW	6.13	213	25.75	476	0.24
Dirkwin	SWSW	6.00	213	25.75	466	0.23

1990 Irrigation: 30 x 40 feet solid set spacing, 9/64-inch Rainbird nozzles, 55 PSI at Nozzle, 0.36-inches per hour application rate. Season First irrigation: April 13; Last irrigation: August 15.

Table 3. Spring cereal forage trial yield, harvest date, water applied, yield (pounds and tons) per inch of water applied at COAREC, Powell Butte, Oregon in 1991. (Planted April 22, doy - 113)

Variety	Species	DM Yield (t/ac)	Harvest Date (doy)	Water Applied (in)	DM Yield per inch of Water Applied (lb/in)	DM Yield per inch of Water Applied (ton/in)
Late Boot Harvest						
Gazelle	Rye	2.46	177	9.78	503	0.25
Common	Rye	2.13	183	10.07	423	0.21
Karl	Triticale	1.64	183	10.07	326	0.16
Alamos 83	Triticale	1.40	183	10.07	278	0.14
Eronga 83	Triticale	1.99	184	10.07	395	0.20
Juan	Triticale	2.19	186	10.07	435	0.22
Grace	Triticale	2.01	186	10.07	399	0.20
Soft Dough Harvest						
Belford	Barley	4.16	204	17.6	473	0.24
Koldbar	Barley	4.09	204	17.6	465	0.23
Haybet	Barley	4.04	204	17.6	459	0.23
Unkown	Barley	3.83	204	17.6	435	0.22
Westford	Barley	3.29	204	17.6	374	0.19
Whitford	Barley	3.21	204	17.6	365	0.18
Monida	Oat	4.96	214	23.12	429	0.21
Montezuma	Oat	4.82	214	23.12	417	0.21
Swan	Oat	4.61	214	23.12	399	0.20
Kanota	Oat	4.40	214	23.12	381	0.19
Cayuse	Oat	3.54	214	23.12	306	0.15
Otana	Oat	5.47	215	23.12	473	0.24
Sierra	Oat	3.67	215	23.12	317	0.16
Riel	Oat	4.81	216	23.12	416	0.21
Park	Oat	4.10	216	23.12	355	0.18
Texas Red	Oat	4.85	217	23.12	420	0.21
Grizzley	Oat	3.95	217	23.12	342	0.17
Dirkwin	SWSW	5.50	221	25.88	425	0.21
Twin	SWSW	5.41	221	25.88	418	0.21
Stampede	Oat	4.13	221	25.88	319	0.16
Winter Grey	Oat	4.07	221	25.88	315	0.16

1991 Irrigation: 40 x 40 feet solid set spacing, 9/64-inch Rainbird nozzles, 40 PSI at nozzle, 0.23-inches per hour application rate. Season First irrigation: April 18; Last irrigation: September 20.

Table 4. Spring cereal forage late boot harvest yield, harvest date, water applied, yield (pounds and tons) per inch of water applied at COAREC, Powell Butte, Oregon in 1992. (Planted April 6, doy - 97)

Variety	Species	DM Yield (t/ac)	Harvest Date (doy)	Water Applied (in)	DM Yield per inch of Water Applied (lb/in)	DM Yield per inch of Water Applied (ton/in)
Late Boot Harvest						
Gazelle	Rye	2.56	156	9.59	534	0.27
Bedortha	Rye	2.06	158	9.59	430	0.21
Chopper	Barley	3.28	159	9.59	684	0.34
Wiemer	Barley	2.97	159	9.59	619	0.31
Montezuma	Oat	2.58	159	9.59	538	0.27
Arnzt	Rye	1.83	159	9.59	382	0.19
Common	Rye	1.82	159	9.59	380	0.19
Karl	Triticale	3.28	161	10.67	615	0.31
Alamos 83	Triticale	1.79	161	10.67	336	0.17
Belford	Barley	3.24	162	10.67	607	0.30
Eronga 83	Triticale	2.02	162	10.67	379	0.19
Fortuna	HRSW	3.70	168	13.73	539	0.27
Mondia	Oat	3.62	168	13.76	526	0.26
Juan	Triticale	2.53	168	13.73	369	0.18
Glenman	HRSW	3.08	169	13.73	449	0.22
Grace	Triticale	2.90	169	13.73	422	0.21
Westford	Barley	4.68	170	14.81	632	0.32
Lew	HRSW	3.50	170	14.81	473	0.24
Trical 2700	Triticale	3.47	170	14.81	469	0.23
Dirkwin	SWSW	2.71	170	13.73	395	0.20
Riel	Oat	3.29	171	14.81	444	0.22
Texas Red	Oat	3.89	173	14.81	525	0.26
Grizzley	Oat	4.11	175	16.25	506	0.25
Winter Grey	Oat	4.65	183	17.33	537	0.27
Stampede	Oat	4.34	189	18.77	462	0.23

1992 Irrigation: 30 x 40 feet solid set spacing, 9/64-inch Rainbird nozzles, 55 PSI at nozzle, 0.36-inches per hour application rate. Season First irrigation: April 20; Last irrigation: August 6.

Table 5. Spring cereal forage soft dough harvest yield, harvest date, water applied, yield (pounds and tons) per inch of water applied at COAREC, Powell Butte, Oregon in 1992. (Planted April 6, doy - 97)

Variety	Species	DM Yield (t/ac)	Harvest Date (doy)	Water Applied (in)	DM Yield per inch of Water Applied (lb/in)	DM Yield per inch of Water Applied (ton/in)
Soft Dough Harvest						
Chopper	Barley	6.19	183	17.33	714	0.36
Westford	Barley	7.20	184	17.33	831	0.42
Belford	Barley	6.37	184	17.33	735	0.37
Montezuma	Oat	5.94	184	17.33	686	0.34
Wiemer	Barley	5.25	184	17.33	606	0.30
Monida	Oat	8.09	199	19.85	815	0.41
Texas Red	Oat	8.03	199	19.85	809	0.40
Grizzley	Oat	7.91	199	19.85	797	0.40
Fortuna	HRSW	7.87	199	19.85	793	0.40
Riel	Oat	7.70	199	19.85	776	0.39
Lew	HRSW	7.80	209	22.01	709	0.35
Stampede	Oat	8.40	212	23.09	728	0.36
Winter Grey	Oat	6.74	212	23.09	584	0.29
Karl	Triticale	8.42	216	24.17	697	0.35
Glenman	HRSW	8.13	216	24.17	673	0.34
Alamos 83	Triticale	7.81	216	24.17	646	0.32
Dirkwin	SWSW	7.62	216	24.17	631	0.32
Grace	Triticale	10.52	217	25.25	833	0.42
Juan	Triticale	11.79	218	25.25	934	0.47
Trical 2700	Triticale	10.49	218	25.25	831	0.42
Bedortha	Rye	7.62	218	25.25	604	0.30
Eronga 83	Triticale	10.30	219	25.25	816	0.41
Arnzt	Rye	8.39	219	25.25	665	0.33
Common	Rye	8.07	219	25.25	639	0.32
Gazelle	Rye	7.24	219	25.25	573	0.29

1992 Irrigation: 30 x 40 feet solid set spacing, 9/64-inch Rainbird nozzles, 55 PSI at nozzle, 0.23-inches per hour application rate. Season First irrigation: April 20; Last irrigation: August 6.

Table 6. Spring cereal forage late boot harvest yield, harvest date, water applied, yield (pounds and tons) per inch of water applied at COAREC, Powell Butte, Oregon in 1993. (Planted May 4, doy - 125)

Variety	Species	DM Yield (t/ac)	Harvest Date (doy)	Water Applied (in)	DM Yield per inch of Water Applied (lb/in)	DM Yield per inch of Water Applied (ton/in)
Late Boot Harvest						
Montezuma	Oat	2.15	179	9.84	437	0.22
Gazelle	Rye	1.89	179	9.84	384	0.19
Swan	Oat	1.88	179	9.84	382	0.19
Faust	Barley	2.01	181	9.84	409	0.20
Alberta	Barley	1.67	183	9.84	339	0.17
Haybet	Barley	2.51	186	10.56	475	0.24
Eureka	Barley	2.06	186	10.56	390	0.20
Fortuna	HRSW	1.98	186	10.56	375	0.19
Nepal	Barley	1.93	186	10.56	366	0.18
Meloy	Barley	1.64	186	10.56	311	0.16
Glenman	HRSW	1.57	187	10.56	297	0.15
Cayuse	Oat	3.28	188	10.56	621	0.31
Magnum II	Oat	2.88	188	10.56	545	0.27
Ajay	Oat	2.79	188	10.56	528	0.26
Belford	Barley	2.09	188	10.56	396	0.20
Lew	HRSW	1.85	188	10.56	350	0.18
Florida 201	Triticale	1.73	188	10.56	328	0.16
Eronga 83	Triticale	1.70	188	10.56	322	0.16
Frank	Triticale	1.68	188	10.56	318	0.16
Otana	Oat	3.15	189	10.56	597	0.30
Mondia	Oat	3.08	189	10.56	583	0.29
Dirkwin	SWSW	2.28	189	10.56	432	0.22
Twin	SWSW	2.35	190	10.56	445	0.22
Juan	Triticale	1.94	190	10.56	367	0.18
Rid Awn	Barley	2.08	191	12.90	322	0.16
Ensiler	Oat	3.35	192	12.90	519	0.26
Park	Oat	3.18	192	12.90	493	0.25
Westford	Barley	3.15	195	13.80	457	0.23
Trical 2700	Triticale	2.57	195	13.80	372	0.19
Magnum	Oat	4.54	202	14.70	618	0.31
Stampede	Oat	4.36	205	14.70	593	0.30
Whitman	Triticale	2.60	206	14.70	354	0.18

1993 Irrigation: 30 x 40 feet solid set spacing, 9/64-inch Rainbird nozzles, 55 PSI at nozzle, 0.23-inches per hour application rate. Season First irrigation: May 12; Last irrigation: September 10.

Table 7. Spring cereal forage soft dough harvest yield, harvest date, water applied, yield (pounds and tons) per inch of water applied at COAREC, Powell Butte, Oregon in 1992. Planted May 4, doy - 125)

Variety	Species	DM Yield (t/ac)	Harvest Date (doy)	Water Applied (in)	DM Yield per inch of Water Applied (lb/in)	DM Yield per inch of Water Applied (ton/in)
Soft Dough Harvest						
Montezuma	Oat	6.19	209	14.70	842	0.42
Swan	Oat	5.53	209	14.70	752	0.38
Faust	Barley	4.88	209	14.70	664	0.33
Alberta	Barley	4.34	209	14.70	590	0.30
Eureka	Barley	5.59	213	14.70	761	0.38
Meloy	Barley	5.51	213	14.70	750	0.37
Haybet	Barley	5.26	213	14.70	716	0.36
Nepal	Barley	5.03	213	14.70	684	0.34
Cayuse	Oat	6.98	214	14.70	950	0.47
Ajay	Oat	6.74	214	14.70	917	0.46
Rid Awn	Barley	5.62	216	16.14	696	0.35
Ensiler	Oat	7.63	217	16.14	945	0.47
Magnum II	Oat	7.45	217	16.14	923	0.46
Mondia	Oat	7.37	217	16.14	913	0.46
Park	Oat	7.27	217	16.14	901	0.45
Otana	Oat	6.70	217	16.14	830	0.42
Westford	Barley	6.66	217	16.14	825	0.41
Belford	Barley	6.03	217	16.14	747	0.37
Magnum	Oat	7.66	225	17.22	890	0.44
Stampede	Oat	6.87	225	17.22	798	0.40
Fortuna	HRSW	6.40	225	17.22	743	0.37
Gazelle	Rye	7.60	228	18.30	831	0.42
Twin	SWSW	6.32	230	19.74	640	0.32
Dirkwin	SWSW	6.62	231	19.74	671	0.34
Glenman	HRSW	6.10	231	19.74	618	0.31
Lew	HRSW	6.00	231	19.74	608	0.30
Eronga 83	Triticale	9.37	242	19.74	949	0.47
Frank	Triticale	8.78	242	19.74	890	0.44
Florida 201	Triticale	8.60	242	19.74	871	0.44
Juan	Triticale	9.25	244	19.74	937	0.47
Trical 2700	Triticale	9.03	249	19.74	915	0.46

Whitman	Triticale	6.75	249	19.74	684	0.34
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1993 Irrigation: 30 x 40 feet solid set spacing, 9/64-inch Rainbird nozzles, 55 PSI at nozzle, 0.23-inches per hour application rate. Season First irrigation: May 12; Last irrigation: September 10.

Table 8. Spring cereal forage regrowth from late boot harvest yield, harvest date, days after late boot harvest, DM yield (pounds and tons/acre) per day of regrowth at COAREC, Powell Butte, Oregon in 1992. (Planted May 4, doy -125)

Variety	Species	DM Yield (t/ac)	Harvest Date (doy)	Days After Late Boot Harvest (days)	DM Yield per day of regrowth (lb/day)	DM Yield per day of regrowth (ton/day)
Regrowth From Late Boot Harvest						
Montezuma	Oat	2.55	237	35	146	0.07
Swan	Oat	2.49	237	32	156	0.08
Meloy	Barley	1.05	237	46	46	0.02
Belford	Barley	0.96	237	51	38	0.02
Faust	Barley	0.88	237	51	35	0.02
Westford	Barley	0.82	237	58	28	0.01
Alberta	Barley	0.62	237	49	25	0.01
Nepal	Barley	0.60	237	49	24	0.01
Eureka	Barley	0.57	237	54	21	0.01
Haybet	Barley	0.69	239	51	27	0.01
Rid Awn	Barley	1.08	241	62	35	0.02
Monida	Oat	2.42	243	51	95	0.05
Ajay	Oat	2.33	243	51	91	0.05
Otana	Oat	2.25	243	54	83	0.04
Cayuse	Oat	1.93	243	54	71	0.04
Magnum II	Oat	1.54	243	55	56	0.03
Park	Oat	1.37	243	48	57	0.03
Ensiler	Oat	1.24	247	57	44	0.02
Gazelle	Rye	1.82	249	61	60	0.03
Glenman	HRSW	1.47	249	43	68	0.03
Dirkwin	SWSW	1.06	249	61	35	0.02
Twin	SWSW	0.96	249	68	28	0.01
Lew	HRSW	0.94	249	63	30	0.01
Fortuna	HRSW	0.85	249	70	24	0.01
Florida 201	Triticale	2.40	255	67	72	0.04
Eronga 83	Triticale	2.13	255	60	71	0.04
Frank	Triticale	1.30	255	69	38	0.02
Whitman	Triticale	1.14	255	66	35	0.02
Juan	Triticale	0.92	255	65	28	0.01
Trical 2700	Triticale	0.67	255	67	20	0.01
Stampede	Oat	0.46	255	69	13	0.01

Magnum	Oat	0.33	255	68	10	0.00
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1993 Irrigation: 30 x 40 feet solid set spacing, 9/64-inch Rainbird nozzles, 55 PSI at nozzle, 0.23-inches per hour application rate. Season - First irrigation: May 12; Last irrigation: September 10.