

2008 WEATHER REPORT

Erik B. G. Feibert and Clinton C. Shock
Malheur Experiment Station
Oregon State University
Ontario, OR

Introduction

Air temperature and precipitation have been recorded daily at the Malheur Experiment Station since July 20, 1942. Installation of additional equipment in 1948 allowed for evaporation and wind measurements. A soil thermometer at 4-inch depth was added in 1967. A biophenometer, to monitor degree days, and pyranometers, to monitor total solar and photosynthetically active radiation, were added in 1985.

Since 1962, the Malheur Experiment Station has participated in the Cooperative Weather Station system of the National Weather Service. The daily readings from the station are reported to the National Weather Service forecast office in Boise, Idaho.

Starting in June 1997, the daily weather data and the monthly weather summaries have been posted on the Malheur Experiment Station web site on the internet at www.cropinfo.net.

On June 1, 1992, in cooperation with the U.S. Department of the Interior, Bureau of Reclamation, a fully automated weather station, linked by satellite to the Northwest Cooperative Agricultural Weather Network (AgriMet) computer in Boise, Idaho, began transmitting data from Malheur Experiment Station. The automated station continually monitors air temperature, relative humidity, dew point temperature, precipitation, wind run, wind speed, wind direction, solar radiation, and soil temperature at 8-inch and 20-inch depths. Data are transmitted via satellite to a computer in Boise every 4 hours and are used to calculate daily Malheur County crop water-use estimates. The AgriMet database can be accessed through the internet at www.usbr.gov/pn/agrimet and from links on the Malheur Experiment Station web page at www.cropinfo.net.

Methods

The ground under and around the weather stations was bare until October 17, 1997, when it was covered with turfgrass. The grass is irrigated with subsurface drip irrigation. The weather data are recorded each day at 8:00 a.m. Consequently, the data in the tables of daily observations refer to the previous 24 hours.

Evaporation is measured from April through October as inches of water evaporated from a standard class A pan (10 inches deep by 4-ft diameter) over 24 hours. Evapotranspiration (ET_c) for each crop is calculated by the AgriMet computer using data

from the AgriMet weather station and the Kimberly-Penman equation (Wright 1982). Reference evapotranspiration (ET_0) is calculated for a theoretical 12- to 20-inch-tall crop of alfalfa assuming full cover for the whole season. Evapotranspiration for all crops is calculated using ET_0 and crop coefficients for each crop. These crop coefficients vary throughout the growing season based on the plant growth stage. The crop coefficients are tied to the plant growth stage by three dates: start, full cover, and termination dates. Start dates are the beginning of vegetative growth in the spring for perennial crops or the emergence date for row crops. Full cover dates are typically when plants reach full foliage. Termination dates are defined by harvest, frost, or dormancy. Alfalfa mean ET_c is calculated for an alfalfa crop assuming a 15 percent reduction to account for cuttings.

Wind run is measured as total wind movement in miles over 24 hours at 24 inches above the ground. Weather data averages in the tables, except evapotranspiration, refer to the years preceding and up to, but not including, the current year.

2008 Weather

The total precipitation for 2008 (7.62 inches) was lower than the 10-year (10.21 inches) and 65-year (10.07 inches) averages (Table 1). Total snowfall for 2008 (26.0 inches) was higher than the 10-year (14.0 inches) and 65-year averages (18.2 inches) (Table 2).

The highest air temperature for 2008 was 100°F on June 30 and July 4 (Table 3). The lowest temperature for the year was -4°F on January 24.

March and April had fewer accumulated growing degree days (50° to 86°F) than the 22-year average (Table 4, Fig. 1). Growing degree days accumulated in March were 22 percent of average, and the lowest since 1991 when records began. Growing degree days accumulated in April were 57 percent of average. May, June, July, and August had total growing degree days close to average. The total number of degree days in the above-optimal range (86° to 104°F) in 2008 was close to the average (Table 5).

Total wind runs for May and June were 28 percent and 19 percent above the 17-year average (Table 6). Total pan-evaporation for May and June was 14 percent and 13 percent higher, respectively, than the 10-year average (Table 7). In 2008, total accumulated reference ET and ET_c for all crops except poplar were higher than the 16-year average (Table 8).

The average monthly maximum and minimum 4-inch soil temperatures from January through April were lower than the 10-year average (Table 9). Four-inch soil temperatures for the other months were close to the average.

The last spring frost ($\leq 32^\circ\text{F}$) occurred on May 2, 4 days later than the 32-year-average date of April 28; the first fall frost occurred on October 13, 7 days later than the 32-year-average date of October 6 (Table 10).

No local weather records were broken in 2008, but March had the fewest growing degree days since observations were first recorded in 1991 (Table 11).

References

Wright, J.L. 1982. New evapotranspiration crop coefficients. Journal of Irrigation and Drainage Division, American Society of Civil Engineers 108:57-74.

Table 1. Monthly precipitation at the Malheur Experiment Station, Oregon State University, Ontario, OR, 1991-2008.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
----- inches -----													
1991	0.59	0.44	0.88	0.81	1.89	1.09	0.01	0.04	0.35	1.01	1.71	0.43	9.25
1992	0.58	1.36	0.25	0.74	0.21	1.43	0.36	0.01	0.09	0.95	1.15	1.51	8.64
1993	2.35	1.02	2.41	2.55	0.70	1.55	0.18	0.50	0.00	0.80	0.64	0.60	13.30
1994	1.20	0.57	0.05	1.02	1.62	0.07	0.19	0.00	0.15	1.23	2.46	1.49	10.05
1995	2.67	0.28	1.58	1.16	1.41	1.60	1.10	0.13	0.07	0.57	0.88	2.56	14.01
1996	0.97	0.86	1.03	1.19	2.39	0.12	0.32	0.31	0.59	0.97	1.18	2.76	12.69
1997	2.13	0.17	0.25	0.66	0.67	0.86	1.40	0.28	0.40	0.43	1.02	0.94	9.21
1998	2.26	1.45	0.95	1.43	4.55	0.36	1.06	0.00	1.00	0.04	1.07	1.11	15.28
1999	1.64	2.50	0.59	0.23	0.28	1.02	0.00	0.09	0.00	0.40	0.49	0.73	7.97
2000	2.01	2.14	0.97	0.72	0.28	0.26	0.03	0.06	0.39	1.74	0.38	0.66	9.64
2001	1.15	0.41	1.11	0.70	0.37	0.64	0.32	0.00	0.10	0.68	1.33	1.00	7.78
2002	0.77	0.27	0.49	0.77	0.09	0.60	0.14	0.10	0.36	0.29	0.44	1.86	6.18
2003	1.46	0.48	0.99	1.12	1.52	0.24	0.36	0.11	0.15	0.02	0.86	1.47	8.78
2004	1.82	1.54	0.25	0.98	1.70	0.43	0.13	0.64	0.56	2.03	0.93	0.97	11.98
2005	0.41	0.12	1.66	0.80	2.94	1.02	0.22	0.06	0.14	1.38	1.58	3.92	14.25
2006	1.91	0.67	3.33	2.00	0.62	0.45	0.00	0.08	0.55	0.28	1.14	1.76	12.79
2007	0.07	0.95	0.12	0.82	0.47	0.63	0.03	0.15	0.92	0.68	1.07	1.56	7.47
2008	0.50	0.43	0.79	0.14	0.74	0.27	0.43	0.03	1.26	0.44	1.12	1.47	7.62
10-yr avg	1.35	1.05	1.05	0.96	1.28	0.57	0.23	0.13	0.42	0.75	0.93	1.50	10.21
65-yr avg	1.28	0.95	0.96	0.80	1.06	0.80	0.22	0.33	0.45	0.73	1.16	1.33	10.07

Table 2. Annual snowfall totals at the Malheur Experiment Station, Oregon State University, Ontario, OR, 1991-2008.

1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	10-yr avg	65-yr avg
----- inches -----																			
7.5	15.5	36.0	32.0	15.0	14.5	5.8	14.6	13.2	13.8	15.5	11.5	4.5	24.0	13.5	12.3	3.8	26.0	14.03	18.22

Table 3. Maximum and minimum air temperatures by month, Malheur Experiment Station, Oregon State University, Ontario, OR, 2008.

	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	Max	Min																						
	°F																							
Highest	49	34	52	36	63	37	82	46	96	62	100	70	100	67	99	65	89	55	85	52	66	45	56	38
Lowest	18	-4	34	14	47	21	46	21	54	31	63	41	82	49	75	43	63	39	51	26	35	20	18	2
2008 avg	33	17	42	27	52	30	60	33	74	47	82	53	93	59	91	56	79	46	66	38	51	32	38	20
10-yr avg	38	25	45	27	56	33	64	39	72	46	82	52	94	61	91	57	80	47	66	38	48	30	38	25
65-yr avg	35	20	43	25	55	31	64	37	74	45	82	52	92	58	90	56	79	46	66	36	48	28	37	22

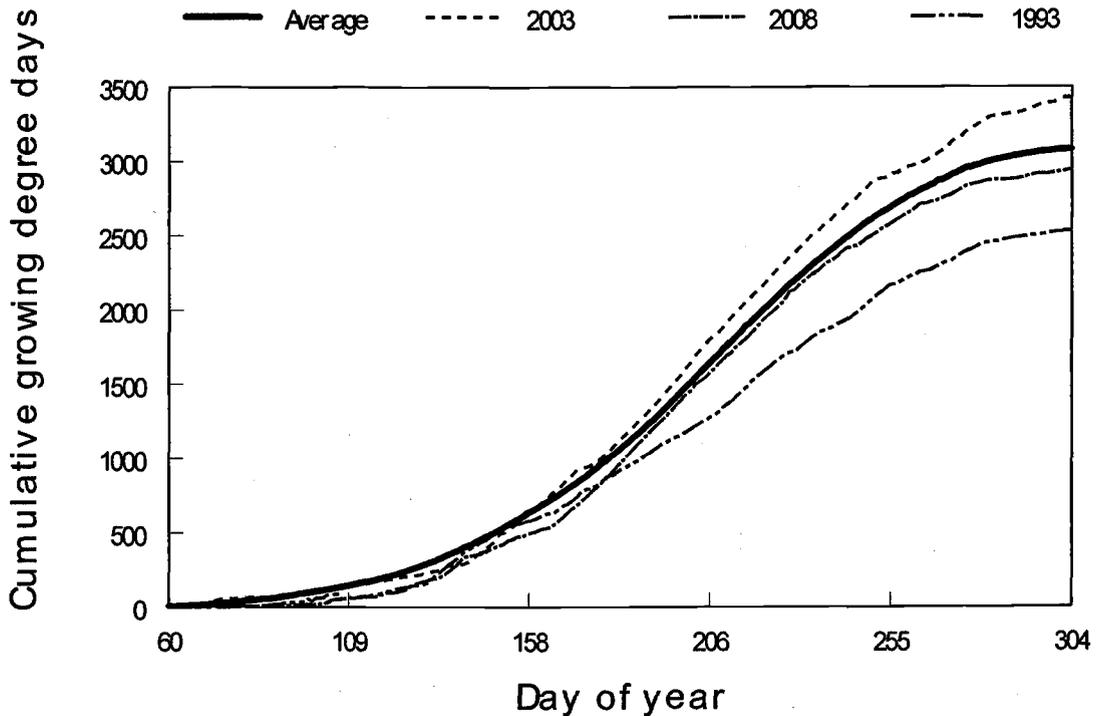


Figure 1. Cumulative growing degree days (50-86°F) over time for years with lowest (1993) and highest (2003) totals compared to 2008 and to 18-year average (1990-2007), Malheur Experiment Station, Oregon State University, Ontario, OR.

Table 4. Monthly total growing degree days (50-86°F), Malheur Experiment Station, Oregon State University, Ontario, OR, 1991-2008.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1991	0	13	16	124	212	389	776	718	436	194	1	0	2,879
1992	0	13	106	202	482	574	639	704	385	174	4	0	3,283
1993	0	0	23	81	423	358	464	524	408	252	6	0	2,539
1994	0	2	92	189	369	523	794	774	509	144	2	0	3,398
1995	0	29	32	106	293	433	680	588	472	101	3	10	2,747
1996	0	5	53	135	243	446	805	658	364	194	18	2	2,923
1997	4	0	81	117	419	509	661	706	481	157	20	0	3,154
1998	0	2	52	112	68	571	802	749	515	151	16	4	3,042
1999	0	2	43	72	329	459	683	703	416	184	30	0	2,921
2000	0	4	36	194	342	536	751	743	368	133	2	0	3,109
2001	0	0	63	126	401	488	715	761	472	155	27	0	3,208
2002	0	2	32	137	319	562	805	621	437	142	14	2	3,073
2003	0	4	72	112	319	594	846	754	448	281	11	2	3,443
2004	0	0	115	187	311	607	776	680	365	180	4	0	3,225
2005	0	7	59	126	286	419	749	733	383	133	4	0	2,899
2006	0	4	22	131	364	599	866	668	394	151	31	0	3,230
2007	0	7	99	146	405	551	871	682	398	115	20	0	3,294
2008	0	0	13	86	333	504	774	700	387	144	16	2	2,959
22-year avg	0	6	58	150	327	520	743	687	426	168	13	1	3,099

Table 5. Monthly total degree days in the above-ideal (86-104°F) range, Malheur Experiment Station, Oregon State University, Ontario, OR, 1991-2008.

Year	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
1991	0	0	2	41	36	4	0	83
1992	0	5	20	23	54	2	0	104
1993	0	4	4	2	11	5	0	26
1994	0	2	16	68	54	7	0	147
1995	0	0	4	23	22	7	0	56
1996	0	0	5	54	32	4	0	95
1997	0	4	0	27	31	5	0	67
1998	0	0	0	63	45	14	0	122
1999	0	1	2	21	16	1	0	41
2000	0	0	7	41	43	4	0	95
2001	0	5	7	25	45	4	0	86
2002	0	0	14	54	11	5	0	85
2003	0	5	9	74	36	5	0	130
2004	0	0	18	43	31	2	0	94
2005	0	0	4	43	36	4	0	86
2006	0	5	13	81	23	5	0	128
2007	0	0	14	79	29	5	0	128
2008	0	3.6	9	41.4	30.6	0	0	84.6
18-yr avg	0	2	8	45	33	5	0	94

Table 6. Daily wind-run and monthly totals, Malheur Experiment Station, Oregon State University, Ontario, OR, 2008.

Daily	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	----- miles/day -----											
Mean	53	65	61	72	89	74	51	45	33	41	25	42
Max.	237	288	165	210	303	212	141	173	193	235	132	155
Min.	2	4	11	16	18	23	17	6	7	3	0	3
Monthly total	----- miles/month -----											
2008	1,654	1,872	1,878	2,174	2,768	2,213	1,567	1,409	987	1,268	755	1,303
17-yr average	1,457	1,670	2,342	2,412	2,163	1,867	1,688	1,550	1,460	1,601	1,485	1,648
60-yr average				2,165	1,922	1,575	1,478	1,326	1,250	1,287		

Table 7. Daily pan-evaporation and monthly totals, Malheur Experiment Station, Oregon State University, Ontario, OR, 2008.

Totals	April	May	Jun	Jul	Aug	Sep	Oct	Total
	----- inches/day -----							
Daily								
Mean	0.22	0.31	0.37	0.41	0.35	0.23	0.13	
Max.	0.44	0.50	0.65	0.65	0.55	0.47	0.27	
Min.	0.11	0.16	0.08	0.27	0.23	0.07	0.04	
Monthly	----- inches/month -----							
2008	6.07	9.67	11.24	12.83	10.79	6.75	4.06	61.41
10-yr avg	6.18	8.45	9.99	12.10	10.54	7.07	4.32	58.27
60-yr avg	5.66	7.76	9.03	11.26	9.69	6.36	3.33	51.78

Table 8. Total accumulated reference evapotranspiration (ET₀) and crop evapotranspiration (ET_c) (acre-inches/acre), Malheur Experiment Station, Oregon State University, Ontario, OR, 1992-2008.

Year	ET ₀	Alfalfa (mean)	Winter grain	Spring grain	Sugar beets	Onions	Potatoes	Dry beans	Field corn	Poplar		
										1st year	2nd year	3rd year +
1992	53.7	44.4	26.9	27.9	36.1	30.3	28.8	21.3	29.8			
1993	51.9	36.4	21.3	22.7	29.3	24.1	22.8	17.9	23.7			
1994	57.6	40.6	21.3	22.6	34.5	29.5	28.2	21.1	27.7			
1995	49.6	37.1	18.9	22.2	29.0	26.7	23.6	16.7	23.7			
1996	52.8	39.8	22.3	24.1	32.9	27.2	26.3	19.5	25.7			
1997	55.2	41.5	23.8	25.3	33.4	28.0	26.6	19.7	25.1			
1998	55.0	40.7	21.3	23.9	32.4	28.2	26.2	21.0	27.9	23.9	37.1	44
1999	58.6	43.9	25.0	26.4	33.7	28.9	26.5	21.7	28.5	24.3	37.8	45.5
2000	58.7	45.5	26.0	25.7	38.3	32.0	29.5	24.1	30.6	24.9	38.9	47.1
2001	57.9	43.8	25.5	27.2	34.8	30.3	27.4	21.4	29.1	23.7	37.0	44.7
2002	58.8	41.7	25.9	28.7	35.2	30.4	27.7	21.9	27.8	23.6	36.7	44.4
2003	54.2	44.1	27.5	31.7	39.1	31.6	31.9	22.4	29.3	24.3	37.9	45.9
2004	52.8	43.5	27.8	30.6	34.3	30.2	27.9	22.1	28.4	23.3	36.3	44.1
2005	53.8	44.5	26.5	27.0	36.0	32.8	30.2	20.0	29.2	24.3	37.8	45.3
2006	57.7	47.8	24.3	30.2	38.4	32.4	30.9	22.4	29.6	26.2	40.8	49.3
2007	59.0	47.2	27.6	26.7	38.9	33.7	29.7	24.5	30.5	25.7	40.1	48.6
2008	58.0	46.4	28.1	30.4	36.4	32.7	30.0	24.0	30.4	23.3	36.5	44.5
Average	55.5	42.7	24.5	26.5	34.8	29.9	27.7	21.2	28.0	24.4	38.1	45.9
mm	1,409	1,084	622	673	883	758	703	539	710	620	967	1,166

Table 9. Monthly soil temperature at 4-inch depth, Malheur Experiment Station, Oregon State University, Ontario, OR, 2008.

	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	Max	Min																						
	°F																							
2008 avg	30	29	32	30	42	39	48	43	61	56	69	62	75	70	72	67	64	61	54	51	44	43	35	33
Highest	32	31	40	36	45	42	58	50	70	64	79	73	80	73	78	72	67	69	63	61	51	50	47	45
Lowest	25	21	29	27	38	36	42	37	50	46	60	56	72	67	67	62	61	58	48	44	38	36	29	26
10-yr avg	34	33	36	35	44	41	51	47	61	55	69	62	75	68	73	67	66	61	55	51	43	41	35	34
41-yr avg	33	32	37	34	49	41	60	47	72	58	80	66	88	74	86	73	75	63	60	51	44	39	34	33

Table 10. Last and first frost ($\leq 32^{\circ}\text{F}$) dates and number of frost-free days, Malheur Experiment Station, Oregon State University, Ontario, OR, 1990-2008.

	Date of last frost	Date of first frost	Total frost-free days
	Spring	Fall	
1990	May 8	Oct 7	152
1991	Apr 30	Oct 4	157
1992	Apr 24	Sep 14	143
1993	Apr 20	Oct 11	174
1994	Apr 15	Oct 6	174
1995	Apr 16	Sep 22	159
1996	May 6	Sep 23	140
1997	May 3	Oct 8	158
1998	Apr 18	Oct 17	182
1999	May 11	Sep 28	140
2000	May 12	Sep 24	135
2001	Apr 29	Oct 10	164
2002	May 8	Oct 12	157
2003	May 19	Oct 11	145
2004	April 16	Oct 24	191
2005	April 15	Oct 6	174
2006	April 19	Oct 22	186
2007	May 4	Oct 11	160
2008	May 2	Oct 13	164
1976-2007 Avg	April 28	Oct 6	161

Table 11. Record weather events at the Malheur Experiment Station, Oregon State University, Ontario, OR.

Record event	Measurement	Date
----- Since 1943 -----		
Highest annual precipitation	16.87 inches	1983
Lowest annual precipitation	5.16 inches	1949
Highest monthly precipitation	4.55 inches	May 1998
Highest 24-hour precipitation	1.52 inches	Sep 14, 1959
Highest annual snowfall	40 inches	1955
Highest 24-hour snowfall	10 inches	Nov 30, 1975
Earliest snowfall	1 inch	Oct 25, 1970
Highest air temperature	110°F	July 22, 2003
Total days with maximum air temp. $\geq 100^\circ\text{F}$	17 days	1971
Lowest air temperature	-26°F	Jan 21 and 22, 1962
Total days with minimum air temp. $\leq 0^\circ\text{F}$	35 days	1985
----- Since 1967 -----		
Lowest soil temperature at 4-inch depth	12°F	Dec 24, 25, and 26, 1990
----- Since 1986 -----		
Highest yearly growing degree days	3,446 degree days	1988
Lowest yearly growing degree days	2,539 degree days	1993
----- Since 1991/1992 -----		
Fewest growing degree days in March	13	2008
Highest reference evapotranspiration	59.0 inches	2007