

2007 WEATHER REPORT

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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 the Boise computer 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.

2007 Weather

The total precipitation for 2007 (7.47 inches) was lower than the 10-year (10.41 inches) and 64-year (10.11 inches) averages (Table 1). Total snowfall for 2007 (3.8 inches) was lower than the 10-year (14.0 inches) and 64-year averages (18.2 inches) (Table 2).

The highest air temperature for 2007 was 105°F on July 7 (Table 3). The lowest temperature for the year was 6°F on January 15.

The months of February, March, May, June, and July had a higher number of growing degree days (50° to 86°F) than the 21-year average (Table 4, Fig. 1). Compared to 2003, which had the highest total growing degree days and compared to the average, the pattern of growing degree day accumulation in 2007 showed a higher accumulation earlier in the season (Fig. 1). The total number of degree days in the above-optimal range (86° to 104°F) in 2007 was higher than the average (Table 5).

Monthly total wind runs were close to the 10-year and 59-year averages (Table 6). Windy weather in late March had peak wind gusts of 34, 45, 37, and 42 mph on March 25, 26, 27, and 28, respectively. This windy weather event was associated with displacement of planted onion and sugar beet seed. Total pan-evaporation for April, May, June, and July was higher than the 10-year and 59-year averages (Table 7). Total accumulated reference ET and ET_c for onions and dry beans in 2007 were the highest since data collection started in 1992 (Table 8).

The average monthly maximum and minimum 4-inch soil temperatures in 2007 were close to the 10-year and 40-year averages (Table 9).

The last spring frost ($\leq 32^\circ\text{F}$) occurred on May 4, 6 days later than the 31-year-average date of April 28; the first fall frost occurred on October 11, 5 days later than the 31-year-average date of October 6 (Table 10).

The year 2007 had the highest reference evapotranspiration since 1992, when the AgriMet station was installed at the Malheur Experiment Station (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, 1991-2007.

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
10-yr avg	1.46	0.99	0.83	0.86	1.48	0.56	0.40	0.17	0.37	0.80	0.95	1.54	10.41
64-yr avg	1.29	0.96	0.93	0.78	1.08	0.80	0.23	0.34	0.44	0.74	1.16	1.32	10.11

Table 2. Annual snowfall totals at the Malheur Experiment Station, Oregon State University, Ontario, OR, 1991-2007.

1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	10-yr avg	64-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	14.0	18.2

Table 3. Monthly air temperature, Malheur Experiment Station, Oregon State University, Ontario, OR, 2007.

	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	Max	Min																						
	°F																							
Highest	48	29	59	37	73	47	85	50	90	56	98	65	105	70	99	63	96	62	82	48	65	47	60	44
Lowest	25	6	37	11	40	24	51	24	56	32	61	45	87	54	70	50	60	33	48	28	38	18	29	11
2007 avg	38	18	48	29	61	35	65	38	77	47	84	54	98	65	90	56	80	47	63	37	51	28	39	25
10-yr avg	38	25	45	27	56	33	64	38	73	46	82	52	93	60	91	56	81	47	67	38	49	30	38	25
64-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

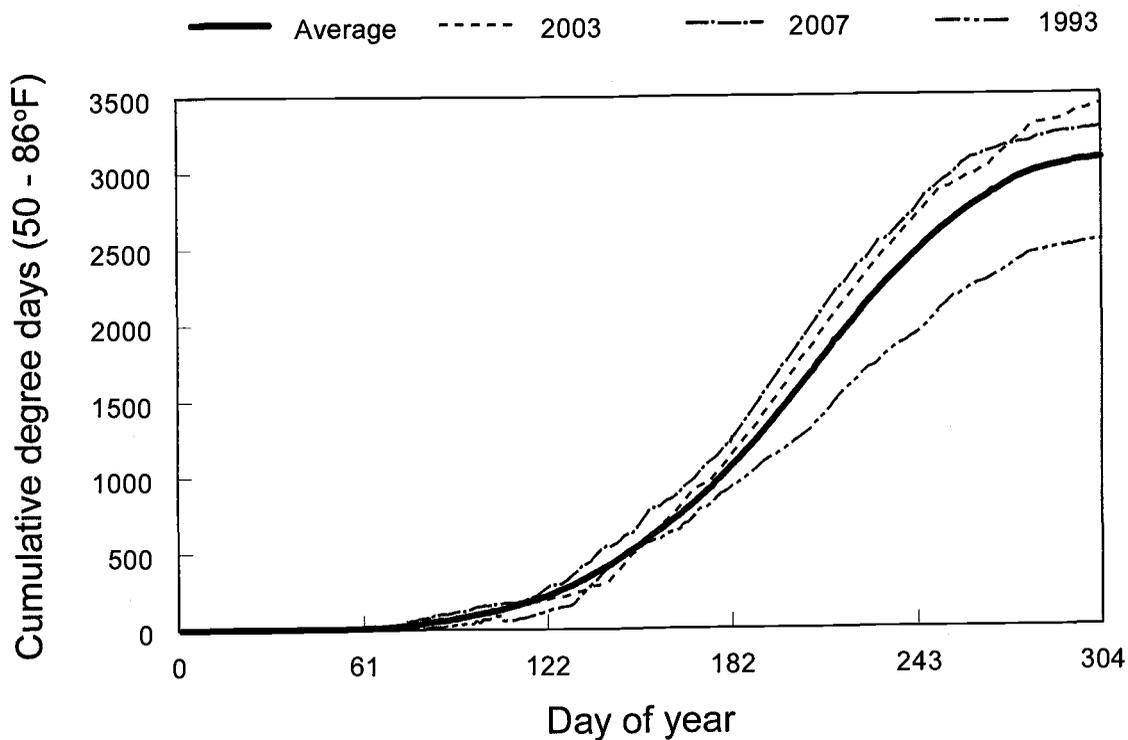


Figure 1. Cumulative growing degree days (50-86°F) over time for years with lowest (1993) and highest (2003) totals compared to 2007 and to 17-year average (1990-2006), Malheur Experiment Station, Oregon State University, Ontario, OR.

Table 4. Monthly total growing degree days (50-86°F), Malheur Experiment Station, Oregon State University, Ontario, OR, 1991-2007.

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
21-year avg	0	5	56	150	321	514	731	688	430	171	12	1	3,089

Table 5. Monthly total degree days in the above-ideal (86-104°F) range, Malheur Experiment Station, Oregon State University, Ontario, OR, 1991-2007.

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
17-yr avg	0	2	8	41	34	5	0	90

Table 6. Wind-run daily totals and monthly totals, Malheur Experiment Station, Oregon State University, Ontario, OR, 2007.

Daily	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	----- miles -----											
Mean	39	51	63	81	69	57	54	38	38	55	25	55
Max.	153	208	293	210	171	160	118	90	108	224	137	251
Min.	7	9	15	16	19	17	20	8	5	6	2	1
Annual total	----- miles -----											
2007	1,212	1,441	1,959	2,425	2,138	1,720	1,689	1,167	1,145	1,709	742	1,705
10-yr average	1,454	1,774	2,415	2,474	2,064	1,856	1,642	1,554	1,430	1,561	1,478	1,628
59-yr average				2,160	1,919	1,573	1,474	1,328	1,252	1,280		

Table 7. Pan-evaporation totals, Malheur Experiment Station, Oregon State University, Ontario, OR, 2007.

Totals	April	May	Jun	Jul	Aug	Sep	Oct	Total
Daily	----- inches -----							
Mean	0.22	0.32	0.35	0.42	0.34	0.23	0.14	
Max.	0.39	0.47	0.52	0.61	0.52	0.43	0.35	
Min.	0.03	0.13	0.06	0.26	0.07	0.06	0.00	
Annual	----- inches -----							
2007	6.54	10.04	10.49	13.13	10.47	6.91	4.23	61.8
10-yr avg	6.14	8.32	9.99	11.89	10.58	7.11	4.43	58.2
59-yr avg	5.65	7.73	9.01	11.23	9.68	6.35	3.32	51.8

Table 8. Total accumulated reference evapotranspiration (ET₀) and crop evapotranspiration (ET_c) (acre-inches/acre), Malheur Experiment Station, Oregon State University, Ontario, OR, 1992-2007.

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
Average	55.2	42.4	24.3	26.5	34.5	29.6	27.5	21.0	27.8	24.3	37.8	45.6
mm	1,402.6	1,075.9	617.1	672.9	876.3	751.9	699.4	532.9	705.7	616.8	960.8	1,158.0

Table 9. Monthly soil temperature at 4-inch depth, Malheur Experiment Station, Oregon State University, Ontario, OR, 2007.

	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	Max	Min																						
2007 avg	31	30	35	34	46	42	52	47	64	57	71	63	78	70	75	67	67	61	54	49	43	40	35	34
Highest	33	32	43	40	52	48	61	53	70	62	76	68	81	75	78	71	75	70	58	53	48	45	41	40
Lowest	29	28	29	29	36	35	47	43	54	48	62	56	74	64	67	61	56	51	49	44	35	34	31	31
10-yr avg	34	33	37	35	45	41	52	47	62	56	70	63	76	68	74	68	67	62	55	52	43	42	36	34
40-yr avg	33	32	37	34	50	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, 1990-2007.

	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
1976-2006 Avg	April 28	October 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 1992 -----		
Highest reference evapotranspiration	59.0 inches	2007