

## 2005 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](http://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](http://www.usbr.gov/pn/agrimet) and is linked to the Malheur Experiment Station web page at [www.cropinfo.net](http://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-inch-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.

## 2005 Weather

The total precipitation for 2005 (14.25 inches) was higher than the 10-year (10.38 inches) and 60-year (10.19 inches) averages (Table 1). Precipitation in May (2.94 inches) was over twice as high as the 10-year and 60-year averages and was the third highest since observations began in 1943 (1st: 4.55 inches in May 1998, 2nd: 3.09 inches May 1953). The months of October, November, and December had precipitation higher than average. Precipitation in December (3.92 inches) was over twice as high as the 10-year and 60-year averages and was the highest since observations began in 1943. Total snowfall for 2005 (14 inches) was lower than the 10-year (14.0 inches) and 62-year averages (18.2 inches) (Table 2).

The highest temperature for 2005 was 101°F on August 6 and 7 (Table 3). The lowest temperature for the year was -2°F on December 18. The average maximum and minimum air temperatures for December were substantially lower than the 10-year and 60-year averages.

The months of April, May, and June had a lower number of growing degree days (50° to 86°F) than the 19-year average (Table 4, Fig. 1). June had 19 percent fewer growing degree days than the 19-year average. The total number of degree days in the above-optimal range in 2005 was close to the average (Table 5).

All months, except April, had total wind runs lower than the 10-year and 57-year averages (Table 6). Total pan-evaporation for 2005 was close to the 10-year and 56-year averages (Table 7). Total accumulated  $ET_c$  for all crops in 2005 was close to the 14-year average (Table 8).

The average monthly maximum and minimum 4-inch soil temperatures in 2005 were close to the 10-year and 37-year averages (Table 9).

The last spring frost ( $\leq 32^{\circ}\text{F}$ ) occurred on April 15, 13 days earlier than the 29-year average date of April 28; the first fall frost occurred on October 6, 1 day later than the 29-year average date of October 5 (Table 10).

No other weather records were broken in 2005 (Table 11).

### References

Wright, J.L. 1982. New evapotranspiration crop coefficients. J. Irrig. Drain. Div., ASCE 108:57-74.

Table 1. Monthly precipitation at the Malheur Experiment Station, Oregon State University, Ontario, OR, 1991-2005.

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
10-yr avg	1.69	1.01	0.82	0.90	1.33	0.61	0.49	0.17	0.36	0.72	0.88	1.41	10.38
60-yr avg	1.36	0.96	0.93	0.81	1.05	0.76	0.25	0.38	0.48	0.72	1.15	1.32	10.19

Table 2. Annual snowfall totals at the Malheur Experiment Station, Oregon State University, Ontario, OR, 1991-2005.

1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	10-yr avg	62-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	14.0	18.2

Table 3. Monthly air temperature, Malheur Experiment Station, Oregon State University, Ontario, OR, 2005.

	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
	°F																							
Highest	50	33	58	34	72	47	79	56	89	57	98	61	100	68	101	67	91	58	82	50	59	41	41	33
Lowest	26	12	36	15	50	24	51	27	56	36	67	38	68	41	77	46	59	34	53	32	28	17	20	-2
2005 avg	37	25	47	25	59	34	64	40	72	47	78	50	93	58	92	57	79	46	65	40	45	29	31	18
10-yr avg	38	25	45	27	57	33	64	38	73	46	82	52	92	59	91	55	81	47	66	37	50	30	39	26
60-yr avg	35	20	43	25	55	31	64	37	74	45	82	52	92	58	90	56	80	46	66	36.5	48	28	37	22

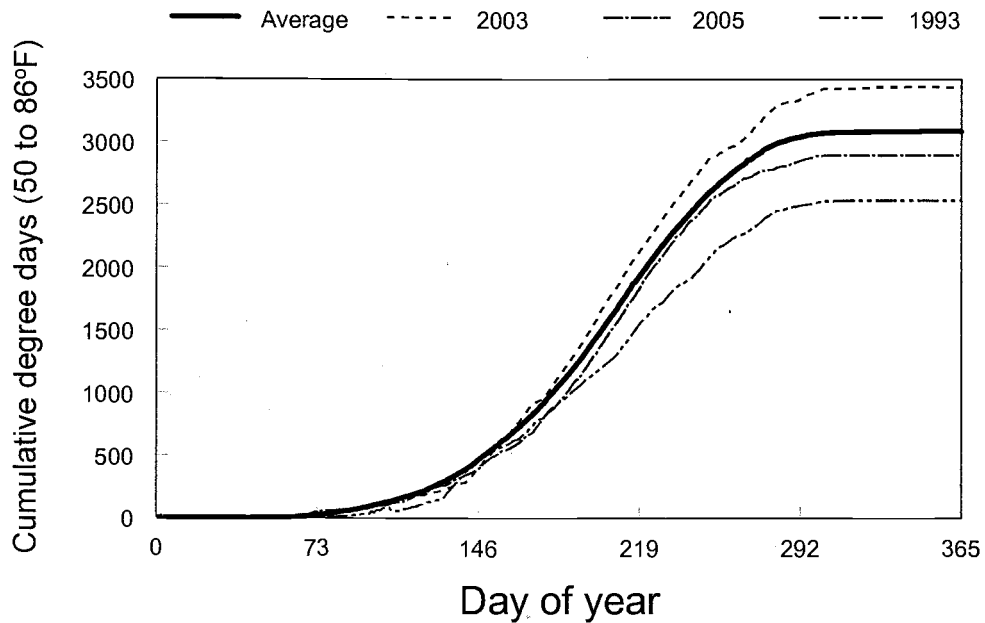


Figure 1. Cumulative growing degree days (50-86°F) over time for selected years compared to 15-year average, Malheur Experiment Station, Oregon State University, Ontario, OR.

Table 4. Monthly total growing degree days (50-86°F), Malheur Experiment Station, Oregon State University, Ontario, OR, 1991-2005.

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
19-year avg	0	5	57	152	323	519	730	686	432	173	12	1	3,092

Table 5. Monthly total degree days in the above-ideal (86 -104°F) range, Malheur Experiment Station, Oregon State University, Ontario, OR, 1991-2005.

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
15-yr avg	0	2	8	41	34	6	0	90

Table 6. Wind-run daily totals and monthly totals, Malheur Experiment Station, Oregon State University, Ontario, OR, 2005.

Daily	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	----- miles -----											
Mean	28	13	59	74	42	43	41	41	41	23	39	24
Max	175	42	181	189	104	112	106	139	144	80	125	100
Min	0	4	8	18	11	14	6	12	13	2	5	0
Annual total	----- miles -----											
2005	863	358	1,831	2,214	1,295	1,296	1,264	1,276	1,242	724	1,173	754
10-yr average	1,521	1,813	2,375	2,415	2,230	1,897	1,701	1,602	1,524	1,655	1,549	1,756
57-yr average				2,152	1,926	1,568	1,470	1,327	1,255	1,284		

Table 7. Pan-evaporation totals, Malheur Experiment Station, Oregon State University, Ontario, OR, 2005.

Totals	April	May	Jun	Jul	Aug	Sep	Oct	Total
Daily	----- inches -----							
Mean	0.20	0.22	0.31	0.40	0.36	0.24	0.12	
Max	0.44	0.37	0.50	0.61	0.53	0.35	0.23	
Min	0.08	0.11	0.08	0.09	0.26	0.13	0.00	
Annual	----- inches -----							
2005	5.73	6.91	9.32	12.49	11.22	7.25	3.68	56.6
10-yr avg	6.08	8.39	9.83	11.48	10.42	7.17	4.38	58.3
56-yr avg	5.64	7.72	8.98	11.17	9.64	6.32	3.29	51.8

Table 8. Total accumulated reference evapotranspiration (ET<sub>0</sub>) and crop evapotranspiration (ET<sub>c</sub>) (acre-inches/acre), Malheur Experiment Station, Oregon State University, Ontario, OR, 1992-2005.

Year	ET <sub>0</sub>	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	44.0
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
Average	55.1	41.8	24.1	26.1	34.1	29.0	27.2	20.8	27.5	24.0	37.4	45.1
mm	1,400.5	1,060.9	612.5	662.4	865.6	737.4	690.5	529.1	698.1	609.6	949.6	1,145.5

Table 9. Monthly soil temperature at 4-inch depth, Malheur Experiment Station, Oregon State University, Ontario, OR, 2005.

	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
Highest	37	35	42	39	50	45	60	54	70	63	74	69	79	72	79	72	70	64	63	56	49	47	34	33
Lowest	30	26	33	32	42	38	44	40	55	50	62	56	68	61	67	60	57	52	49	40	34	33	26	25
2005 avg	32	31	37	35	46	42	51	46	62	56	68	61	75	67	74	67	65	59	55	51	41	40	30	29
10-yr avg	35	34	38	35	46	41	55	47	64	56	73	63	79	69	77	69	69	63	57	52	44	42	37	35
38-yr avg	33	32	38	34	50	41	61	47	72	58	81	66	88	74	86	73	76	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, 1990-2005.

Year	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
1976-2003 Avg	April 28	October 5	160

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

Record event	Measurement	Date
----- Since 1943 -----		
Greatest annual precipitation	16.87 inches	1983
Greatest monthly precipitation	4.55 inches	May 1998
Greatest 24-hour precipitation	1.52 inches	Sep 14, 1959
Greatest annual snowfall	40 inches	1955
Greatest 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	58.8 inches	2002