# 1999 WEATHER REPORT

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

## 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-in depth was added in 1967. A biophenometer to monitor degree-days, and pyranometers to monitor 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.

On June 1, 1992, in cooperation with the U.S. Department of the Interior, Bureau of Reclamation, a fully automated weather station, connected 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-in and 20-in depths. Data is transmitted via satellite to the Boise computer every 4 hours and is used to calculate daily Malheur County crop water-use estimates. The Agrimet database can be accessed via computer modem or through the Internet at: www.pn.usbr.gov/agrimet and is linked to the Malheur Experiment Station web page at www.primenet.com/~mesosu.

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.primenet.com/~mesosu.

## Methods

The ground under and around the weather stations was bare, but it was covered with turf grass on October 17, 1997. The grass is irrigated with subsurface drip irrigation. The weather data is recorded each day at 8:00 a.m. All data pertains to the preceding 24-hour period except the 8:00 a.m. air temperature.

Evaporation is measured from April through October as inches of water evaporated from a standard 10-in deep by 4-ft diameter pan over 24 hours. Wind run is measured as

Evaporation is measured from April through October as inches of water evaporated from a standard 10-in deep by 4-ft diameter pan over 24 hours. Wind run is measured as total wind movement in miles over a 24 hour period measured at 24 inches above ground level. Weather data averages in the tables refer to the years preceding and up to, but not including, the current year.

## 1999 Weather

The spring was drier, cooler, and windier than normal. The months of March through May had total precipitation lower than the 10 year and 55 year averages (Table 1). The month of April was substantially cooler, with 52 percent fewer growing degree-days (50 to 86°F) than the 10-year average (Table 2 and Figure 1). The months of February through May had total wind runs higher than the 8-year average (Table 3). April had a 41 percent higher wind run than the 8-year average. Pan evaporation for April was 15 percent higher than the 10-year average (Table 4).

The summer was drier than normal. Only 0.09 inches of precipitation was recorded from July through September (Table 1). Although the spring was cooler than normal, the months of June through August had a total number of growing degree-days close to the normal. 1999 was similar to 1996 in the pattern of growing degree-day accumulation (Figure 1). Compared to 1996 and 1999, 1997 accumulated more growing degree-days in the spring and summer, and 1998 accumulated more growing degree-days in August and September. There were 55 percent fewer degree-days in the above optimal range (86 to 104°F) compared to the previous 9-year mean (Table 5).

Mean monthly maximum air temperatures were close to the 10-year and 53-year means (Table 6).

From March through October, the mean monthly maximum and minimum 4-in soil temperatures were lower than the 10-year and 31-year means (Table 7). The difference in soil temperature between 1999 and the mean probably is influenced by the installation of turf around the weather station in October of 1997. The soil remained warmer in winter and cooler in spring and summer. The last spring frost (≤32°F) occurred on May 11, 14 days later than the 22-year mean date of April 27; the first fall frost occurred on September 28, 7 days earlier than normal (Table 8).

The weather in 1999 did not exceed any record weather events recorded over the 54-year history for the Malheur Experiment Station (Table 9). The highest temperature for the year was 104°F on July 29 (Table 5). The lowest temperature for the year was 14°F on February 5 and 11. Total precipitation was 7.97 inches for the year, 27 percent lower than the 10-year station average and 23 percent lower than the 55-year station average (Table 1). Total pan-evaporation for April through October was 59.6 inches, close to the 10-year mean and higher than the 50-year mean (Table 4). Total snowfall for 1999 was 13.2 in, lower than the 10-year and 55-year means, respectively (Table 10).

Table 1. Monthly precipitation at the Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989-1999.

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | inches | | | | | | | | | | | | |
| 1989 | 0.88 | 1.27 | 2.17 | 0.50 | 0.60 | 0.77 | 0.08 | 0.94 | 0.83 | 0.86 | 0.24 | 0.01 | 9.15 |
| 1990 | 0.44 | 0.35 | 0.72 | 1.52 | 1.70 | 0.36 | 0.04 | 0.61 | 0.00 | 0.49 | 0.69 | 0.29 | 7.21 |
| 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 |
| 10-yr avg | 1.41 | 0.78 | 1.03 | 1.16 | 1.57 | 0.82 | 0.47 | 0.28 | 0.35 | 0.74 | 1.13 | 1.17 | 10.91 |
| 55-yr avg | 1.35 | 0.93 | 0.96 | 0.82 | 1.10 | 0.79 | 0.27 | 0.41 | 0.51 | 0.70 | 1.20 | 1.35 | 10.39 |

Table 2. Cumulative monthly growing degree-days (50 to 86°F), Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1989-1999.

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1989 | 0 | 0 | 13 | 197 | 469 | 1,018 | 1,751 | 2,332 | 2,721 | 2,838 | 2,852 | 2,852 |
| 1990 | 2 | 9 | 88 | 327 | 588 | 1,085 | 1,819 | 2,454 | 3,039 | 3,077 | 3,077 | 3,077 |
| 1991 | 0 | 13 | 29 | 153 | 365 | 754 | 1,530 | 2,248 | 2,684 | 2,878 | 2,879 | 2,879 |
| 1992 | 0 | 13 | 119 | 321 | 803 | 1,377 | 2,016 | 2,720 | 3,105 | 3,279 | 3,283 | 3,283 |
| 1993 | 0 | 0 | 23 | 104 | 527 | 885 | 1,349 | 1,873 | 2,281 | 2,533 | 2,539 | 2,539 |
| 1994 | 0 | 2 | 94 | 283 | 652 | 1,175 | 1,969 | 2,743 | 3,252 | 3,396 | 3,398 | 3,398 |
| 1995 | 0 | 29 | 61 | 167 | 460 | 893 | 1,573 | 2,161 | 2,633 | 2,734 | 2,737 | 2,747 |
| 1996 | 0 | 5 | 58 | 193 | 436 | 929 | 1,687 | 2,345 | 2,709 | 2,903 | 2,921 | 2,923 |
| 1997 | 4 | 4 | 85 | 202 | 621 | 1,130 | 1,791 | 2,497 | 2,977 | 3,134 | 3,154 | 3,154 |
| 1998 | 0 | 2 | 54 | 166 | 400 | 805 | 1,607 | 2,356 | 2,871 | 3,022 | 3,038 | 3,042 |
| 1999 | 0 | 2 | 45 | 117 | 446 | 905 | 1,588 | 2,291 | 2,707 | 2,891 | 2,921 | 2,921 |
| 10-yr avg | 1 | 8 | 62 | 211 | 516 | 1,000 | 1,709 | 2,373 | 2,827 | 2,979 | 2,988 | 2,989 |

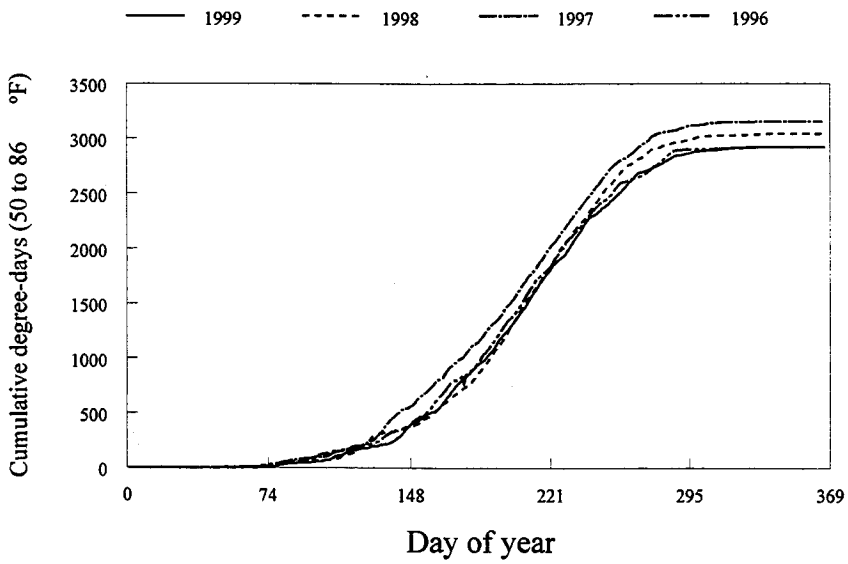


Figure 1. Cumulative degree-days (50 to 86°F) over time for years 1996 to 1999, Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1999.

Table 3. Daily wind-run totals and monthly totals, Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1999.

| Daily | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | miles | | | | | | | | | | | |
| Max. | 183 | 200 | 260 | 246 | 159 | 141 | 104 | 133 | 158 | 173 | 117 | 156 |
| Min. | 27 | 21 | 29 | 41 | 36 | 28 | 23 | 27 | 22 | 20 | 20 | 13 |
| Average | 64 | 90 | 84 | 111 | 96 | 65 | 61 | 64 | 62 | 57 | 47 | 57 |
| Annual total | miles | | | | | | | | | | | |
| 1998 | 1,916 | 2,426 | 2,602 | 3,343 | 2,976 | 1,951 | 1,889 | 1,927 | 1,874 | 1,771 | 1,410 | 1,754 |
| 8-yr average | 1,564 | 1,668 | 2,356 | 2,380 | 2,232 | 1,960 | 1,760 | 1,632 | 1,568 | 1,838 | 1,673 | 1,738 |
| 50-yr average | | | | 2,113 | 1,891 | 1,539 | 1,452 | 1,299 | 1,230 | 1,269 | | |

Table 4. Pan-evaporation totals. Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1999.

| Totals | April | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|
| Daily | inches | | | | | | | |
| Mean | 0.23 | 0.3 | 0.29 | 0.39 | 0.31 | 0.28 | 0.15 | |
| Max. | 0.45 | 0.57 | 0.46 | 0.61 | 0.54 | 0.43 | 0.35 | |
| Min. | 0.05 | 0.16 | 0.07 | 0.27 | 0.15 | 0.16 | 0.06 | |
| Annual | inches | | | | | | | |
| 1999 | 6.87 | 9.34 | 8.73 | 12.08 | 9.56 | 8.31 | 4.73 | 59.62 |
| 10-yr avg | 6.00 | 8.72 | 9.52 | 11.48 | 10.41 | 7.54 | 4.33 | 59.12 |
| 50-yr avg | 5.54 | 7.59 | 8.82 | 11.07 | 9.56 | 6.22 | 3.16 | 51.32 |

Table 5. Monthly degree-days (86 to 104°F), Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990-1999.

| Year | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|
| 1990 | 0 | 0 | 13 | 56 | 41 | 14 | 0 | 124 |
| 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 |
| 9-yr avg | 0 | 2 | 7 | 40 | 36 | 7 | 0 | 92 |

Table 6. Monthly air temperature, Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1999.

| | 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 | | | | | | | | | | | | | | | | | | | | | | | |
| Max. | 50 | 35 | 61 | 41 | 70 | 40 | 80 | 44 | 92 | 57 | 97 | 63 | 104 | 68 | 97 | 67 | 90 | 61 | 81 | 54 | 68 | 42 | 56 | 35 |
| Min. | 31 | 17 | 32 | 14 | 44 | 24 | 41 | 19 | 54 | 29 | 58 | 39 | 73 | 42 | 74 | 40 | 63 | 31 | 50 | 25 | 41 | 20 | 22 | 15 |
| 1999 avg | 41 | 28 | 42 | 28 | 56 | 32 | 62 | 35 | 71 | 43 | 80 | 51 | 90 | 55 | 91 | 56 | 80 | 45 | 69 | 37 | 55 | 33 | 37 | 25 |
| 10-yr avg | 36 | 21 | 43 | 23 | 56 | 32 | 65 | 38 | 74 | 46 | 81 | 52 | 90 | 57 | 90 | 54 | 82 | 47 | 66 | 35 | 48 | 27 | 38 | 20 |
| 53-yr avg | 35 | 20 | 43 | 25 | 55 | 31 | 64 | 37 | 74 | 45 | 82 | 52 | 91 | 57 | 90 | 55 | 80 | 46 | 65 | 36 | 48 | 28 | 37 | 22 |

Table 7. Monthly 4 inches soil temperature, Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1999.

| | 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 | | | | | | | | | | | | | | | | | | | | | | | |
| Max. | 37 | 37 | 42 | 38 | 48 | 43 | 55 | 51 | 66 | 61 | 74 | 66 | 76 | 70 | 78 | 69 | 68 | 63 | 58 | 55 | 49 | 47 | 44 | 42 |
| Min. | 29 | 29 | 32 | 30 | 37 | 35 | 41 | 37 | 49 | 47 | 56 | 55 | 67 | 62 | 67 | 59 | 57 | 52 | 48 | 45 | 39 | 38 | 31 | 26 |
| 1999 mean | 33 | 33 | 35 | 33 | 42 | 39 | 49 | 44 | 56 | 52 | 67 | 62 | 72 | 66 | 72 | 66 | 65 | 60 | 54 | 50 | 45 | 43 | 36 | 34 |
| 10-yr mean | 34 | 33 | 39 | 35 | 50 | 42 | 61 | 49 | 72 | 58 | 79 | 66 | 87 | 73 | 85 | 73 | 77 | 66 | 61 | 52 | 45 | 40 | 35 | 33 |
| 31-yr mean | 33 | 32 | 38 | 34 | 50 | 41 | 62 | 48 | 74 | 58 | 82 | 67 | 90 | 74 | 88 | 74 | 77 | 64 | 61 | 51 | 44 | 39 | 34 | 33 |

Table 8. Last and first frost (≤32°F) dates and number of frost-free days, Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1990-1999.

| 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 | 139 |
| 1997 | May 3 | Oct 8 | 158 |
| 1998 | Apr 18 | Oct 17 | 182 |
| 1999 | May 11 | Sep 28 | 140 |
| 1976-1998 Average | April 27 | October 5 | 161 |

Table 9. Record weather events through 1999 at the Malheur Experiment Station, Oregon State University, Ontario, Oregon.

| Record event | Measurement | Date |
|---|---|---|
| Greatest annual precipitation | 16.87 in | 1983 |
| Greatest monthly precipitation | 4.55 in | May 1998 |
| Greatest 24-hour precipitation | 1.52 in | Sep 14, 1959 |
| Greatest annual snowfall | 40 in | 1955 |
| Greatest 24-hour snowfall | 10 in | Nov 30, 1975 |
| Earliest snowfall | 1 in | Oct 25, 1970 |
| Highest air temperature | 108°F | Aug 4, 1961 |
| Total days with max. air temp. ≥ 100°F | 17 days | 1971 |
| Lowest air temperature | -26°F | Jan 21 and 22, 1962 |
| Total days with min. air temp. ≤ 0°F | 35 days | 1985 |
| Lowest 4-in soil temperature | 12°F | Dec 24, 25, and 26, 1990 |

Table 10. Annual snowfall totals at the Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1988-1999.

| 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 10-yr avg | 55-yr avg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| inches | | | | | | | | | | | | | |
| 34.8 | 25.1 | 5.7 | 7.5 | 15.5 | 36.0 | 32.0 | 15.0 | 14.5 | 5.8 | 14.6 | 13.2 | 17.2 | 18.8 |