2017 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. Since 1962, the Malheur Experiment Station has participated in the National 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.

A biophenometer to monitor degree-days and pyranometers to monitor total solar and photosynthetically active radiation were added in 1985. Starting in June 1997, the daily weather data and the monthly weather summaries have been posted on the Malheur Experiment Station web site 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 AgriMet 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 at www.usbr.gov/pn/agrimet and from links on the Malheur Experiment Station web page at www.cropinfo.net.

Materials and Methods

The ground under and around the weather stations was bare until October 17, 1997, when it was covered with turf grass. The grass is irrigated by subsurface drip irrigation. The manually observed 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. Crop 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). AgriMet calculates reference evapotranspiration (ET_0) for a theoretical 12- to 20-inch-tall crop of alfalfa assuming full cover for the whole season. Evapotranspiration for each crop 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 (crop cover). 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 using ET_0 and assuming a 15% reduction to account for cuttings.

Wind run is measured by the AgriMet weather station as total wind movement in miles over 24 hours at 9.8 ft 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.

2017 Weather

The total precipitation for 2017 (10.93 inches) was slightly higher than the 10-year and 74-year averages (10.09 inches) (Table 1). Precipitation for the months of January through April was higher than average.

Total snowfall for 2017 (31.5 inches) was higher than the 74-year average (17.7 inches) (Table 2). Contributing directly to the snow accumulation problems experienced over the winter of 2016-2017 were the higher than average snowfall and lower than average air temperature in December 2016 and January 2017. Snowfall in December 2016 was 19 inches and in January 2017 was 22 inches. From December 24, 2016 to February 15, 2017 there was a continuous minimum of 10 inches of snow on the ground. The highest snow depth of 28 inches occurred on January 19, 2017 and was the highest since records began in 1943. The average monthly maximum and minimum air temperatures for December of 2016 and January of 2017 were substantially lower than the 74-year average (Table 3). The lowest temperature for the year was -22°F on January 7.

The highest air temperature for 2017 was 102°F on both July 23 and 24. The average maximum air temperature in July and August was higher than average. The average minimum air temperature in July and August was substantially higher than average.

The average monthly maximum and minimum 4-inch soil temperatures were close to the 19-year and 50-year averages (Table 4).

Total monthly wind runs in 2017 were close to the 24-year average (Table 5). Total pan evaporation from May through October in 2017 was higher than the 69-year average (Table 6). Total accumulated reference evapotranspiration (ET_o) in 2017 was below the 25-year average (Table 7).

The year 2017 had 3337 growing degree-days (50 to 86°F), close to the 25-year average of 3300 (Table 8, Fig. 1). The year 2017 had a lower than average frost-free period (150 days) (Table 9). The last spring frost (≤32°F) occurred on May 13, 15 days later than the 41-year-average date of April 28; the first fall frost occurred on October 10, 2 days later than the 41-year-average date of October 8. Snow depth was the only record broken in 2017 (Table 10).

Acknowledgements

This work was supported by the National Oceanic and Atmospheric Administration, U.S. Bureau of Reclamation, Oregon State University, the Malheur County Education Service District and supported by Formula Grant nos. 2017-31100-06041 and 2017-31200-06041 from the USDA National Institute of Food and Agriculture.

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, 1990-2017.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
							inches						
1990	0.44	0.35	0.72	1.52	1.7	0.36	0.04	0.61	0	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
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	7.81
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
2009	0.65	0.43	0.86	0.13	1.47	2.27	0.09	1.39	0.02	1.24	0.63	1.82	11.00
2010	2.13	1.19	0.59	1.21	1.18	1.95	0.02	0.86	0.19	1.16	1.09	4.19	15.76
2011	1.05	0.42	2.97	0.44	2.61	0.81	0.19	0.02	0.08	1.59	0.57	0.45	11.20
2012	1.65	0.49	1.36	1.03	0.77	0.45	0.00	0.04	0.1	0.83	1.13	1.25	9.10
2013	0.58	0.34	0.32	0.19	0.37	0.80	0.00	0.11	2.39	0.44	0.90	0.59	7.03
2014	0.69	1.58	1.22	0.92	0.45	0.24	0.02	0.28	0.62	0.52	1.46	3.04	11.04
2015	0.64	0.74	0.77	0.67	1.80	0.18	0.51	0.05	0.50	1.13	1.29	3.21	11.49
2016	0.98	0.38	0.98	0.88	0.95	0.25	0.98	0.01	0.13	0.75	0.58	2.11	8.98
2017	3.02	1.61	1.61	1.27	1.02	0.62	0.00	0.00	0.49	0.45	0.00	0.84	10.93
10-yr avg	0.89	0.70	1.00	0.64	1.08	0.79	0.23	0.29	0.62	0.88	0.98	1.97	10.07
74-yr avg	1.25	0.92	0.95	0.79	1.05	0.80	0.23	0.33	0.47	0.74	1.14	1.42	10.09

Table 2. Annual snowfall totals (inches) at the Malheur Experiment Station, Oregon State University, Ontario, OR, 1943-2017. Average annual snowfall (1943-2016) is 17.7 inches.

			1943	1944	1945	1946	1947	1948	1949
			24.7	10.3	19.0	8.2	9.1	14.6	9.6
1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
23.9	32.4	22.3	7.5	10.4	40.3	15.6	26.4	9.8	12.1
1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
21.2	9.7	14.8	13.3	32.6	19.6	6.3	11.9	14.9	24.8
1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
13.5	17.1	23.7	19.2	20.3	27.3	21.3	21.3	9.3	31.0
1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
11.5	14.5	32.7	35.4	21.0	33.4	13.0	15.5	34.8	25.1
1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
5.7	7.5	15.5	36.0	32.0	15.0	14.5	5.8	14.6	13.2
2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
13.75	15.50	11.50	4.50	24.00	13.50	12.30	3.75	26.00	13.75
2010	2011	2012	2013	2014	2015	2016	2017		
28.0	1.0	4.0	14.0	22.5	14.0	24.5	31.5		

Table 3. Maximum and minimum air temperatures by month, Malheur Experiment Station, Oregon State University, Ontario, OR, 2017.

Month		Highest	Lowest	2017 avg	74-yr avg
		---------- °F ----------			
Jan	Max	44	6	26	35
	Min	32	-22	9	19
Feb	Max	49	28	39	43
	Min	35	11	25	25
Mar	Max	72	41	56	55
	Min	48	22	37	31
Apr	Max	72	51	61	64
	Min	50	29	38	37
May	Max	93	52	73	74
	Min	58	32	46	45
Jun	Max	97	65	83	82
	Min	65	45	56	52
Jul	Max	102	89	96	92
	Min	73	57	64	58
Aug	Max	83	83	93	90
	Min	51	51	60	56
Sep	Max	97	61	80	80
	Min	63	37	50	46
Oct	Max	72	47	63	65
	Min	48	27	35	37
Nov	Max	43	43	49	48
	Min	23	23	32	28
Dec	Max	46	23	35	37
	Min	31	10	22	22

Table 4. Monthly soil temperature at 4-inch depth, Malheur Experiment Station, Oregon State University, Ontario, OR, 2017.

	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 ----------																							
2017 avg	33	33	34	33	43	42	49	47	58	53	67	63	73	70	73	70	66	63	54	51	45	44	35	34
Highest	34	34	34	34	48	47	53	50	66	59	73	69	75	72	75	72	72	69	61	59	51	48	40	39
Lowest	32	29	32	31	34	32	46	44	51	48	60	59	69	63	71	68	58	55	49	46	41	40	32	30
19-yr avg	33	32	36	35	43	41	50	46	60	55	68	62	74	68	72	67	65	61	55	52	43	42	35	34
50-yr avg	33	32	37	34	49	40	59	47	71	57	79	66	87	73	85	72	75	63	60	51	44	40	34	33

[a]1998-2016 average. Ground covered with turf in 1997.

Table 5. Daily and monthly wind-run, Malheur Experiment Station, Oregon State University, Ontario, OR, 2017.

Daily	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	---------- miles/day ----------											
Mean	88	119	126	164	140	121	102	91	101	100	95	77
Max	427	477	443	367	445	288	186	191	256	228	223	253
Min	31	59	63	51	59	61	62	54	47	42	32	23
Monthly total	---------- miles/month ----------											
2017	2741	3333	3903	4917	4337	3628	3168	2816	3029	3102	2850	2401
24-yr average	2828	3198	4210	4618	4182	3668	3356	3273	3162	3286	3010	3284

Table 6. Daily and monthly pan-evaporation, Malheur Experiment Station, Oregon State University, Ontario, OR, 2017.

Totals	April	May	Jun	Jul	Aug	Sep	Oct	Total
Daily	---------- inches/day ----------							
Mean	0.19	0.26	0.33	0.41	0.33	0.22	0.13	
Max	0.32	0.54	0.61	0.56	0.48	0.36	0.31	
Min	0.04	0.07	0.15	0.24	0.20	0.06	0.00	
Monthly	---------- inches/month ----------							
2017	5.64	8.13	9.99	12.69	10.11	6.74	4.08	57.38
69-yr avg	5.79	7.91	9.21	11.44	9.80	6.44	3.41	54.00

Table 7. Total accumulated reference evapotranspiration (ET_o) and estimated crop evapotranspiration (ET_c) (acre-inches/acre) for various crops, Malheur Experiment Station, Oregon State University, Ontario, OR, 1992-2017.

										Poplar		
Year	ET_o	Alfalfa (Mean)	Winter Grain	Spring Grain	Sugar Beet	Onion	Potato	Dry Bean	Field corn	Yr. 1	Yr. 2	Yr. 3 +
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
2006	57.7	47.9	24.4	31.4	38.5	33.8	29.4	23.9	29.6	26.3	41.0	49.3
2007	59.0	47.2	27.6	26.7	38.9	33.7	29.7	24.5	31.9	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
2009	58.1	42.5	26.3	28.4	34.7	28.4	27.6	20.3	26.7	22.6	35.2	42.7
2010	51.5	41.9	21.0	26.8	33.4	28.9	27.7	21.1	26.7	22.2	34.5	41.4
2011	51.0	41.9	23.3	25.8	34.4	29.2	27.5	22.8	28.0	23.6	36.8	44.5
2012	57.3	45.3	23.6	27.6	36.4	31.5	31.6	24.0	31.2	25.3	39.4	47.4
2013	59.3	47.8	28.9	30.9	39.2	34.9	32.5	25.9	33.4	25.8	40.2	48.7
2014	59.2	49.0	29.7	32.6	37.5	35.0	34.5	26.6	35.1	26.1	40.8	49.6
2015	61.6	50.3	27.1	29.8	36.2	33.8	32.9	24.7	34.0	25.4	39.5	47.6
2016	60.0	49.7	28.0	31.3	37.0	34.0	31.5	23.4	34.6	26.3	41.1	49.9
2017	53.8	51.7	25.6	27.9	36.2	30.6	29.5	23.9	31.2	23.8	37.1	44.8
Avg												
inch	56.1	43.9	25.1	27.5	35.3	30.6	28.7	22.1	29.1	24.5	38.1	46.1
mm	1426	1115	638	699	896	778	730	561	740	621	969	1170

Table 8. Monthly total growing degree-days (50-86°F), Malheur Experiment Station, Oregon State University, Ontario, OR, 1993-2017.

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
1993	0	0	58	139	451	371	473	556	459	239	17	4	2768
1994	0	5	172	242	398	507	712	695	523	195	7	0	3456
1995	2	60	77	155	330	443	646	566	469	170	16	12	2945
1996	0	19	103	188	286	490	662	614	377	216	37	11	3004
1997	3	10	122	167	447	508	632	665	489	215	35	0	3293
1998	0	4	95	175	268	436	737	690	529	220	40	5	3198
1999	0	9	81	175	320	467	629	651	458	268	69	1	3127
2000	1	13	79	277	380	541	702	684	421	202	8	0	3309
2001	0	0	122	176	433	502	680	712	507	231	62	0	3424
2002	0	4	76	202	375	564	749	620	457	230	37	11	3325
2003	1	11	134	164	370	580	782	714	479	338	27	8	3610
2004	0	0	189	264	322	535	727	657	410	238	7	1	3349
2005	0	19	126	193	342	446	692	685	435	215	6	0	3158
2006	0	18	48	204	406	597	791	647	446	219	60	4	3441
2007	0	20	183	220	441	543	796	644	442	184	50	6	3528
2008	0	2	39	144	389	512	713	665	452	228	36	6	3186
2009	1	7	66	209	415	509	702	644	523	130	34	0	3239
2010	1	5	92	159	248	467	671	605	470	271	50	0	3037
2011	0	11	46	106	272	423	676	699	531	221	11	4	2999
2012	1	8	129	253	353	484	751	694	512	222	56	12	3475
2013	0	8	130	226	407	549	745	717	491	201	18	7	3498
2014	0	22	116	227	424	544	779	685	503	293	36	17	3647
2015	7	71	190	241	427	674	716	700	461	347	33	9	3876
2016	0	42	129	305	405	576	680	683	443	227	78	0	3570
2017	0	0	114	169	380	533	766	706	461	189	19	0	3337
Avg 1993-2016	1	15	108	200	371	511	702	662	470	230	34	5	3300

Table 9. Last and first frost (32°F) dates and number of frost-free days, Malheur Experiment Station, Oregon State University, Ontario, OR, 1990-2017.

Year	Date of last frost Spring	Date of first frost Fall	Total frost-free days
1990	8-May	7-Oct	152
1991	30-Apr	4-Oct	157
1992	24-Apr	14-Sep	143
1993	20-Apr	11-Oct	174
1994	15-Apr	6-Oct	174
1995	16-Apr	22-Sep	159
1996	6-May	23-Sep	140
1997	3-May	8-Oct	158
1998	18-Apr	17-Oct	182
1999	11-May	28-Sep	140
2000	12-May	24-Sep	135
2001	29-Apr	10-Oct	164
2002	8-May	12-Oct	157
2003	19-May	11-Oct	145
2004	16-Apr	24-Oct	191
2005	15-Apr	6-Oct	174
2006	19-Apr	0ct 22	186
2007	4-May	11-Oct	160
2008	2-May	13-Oct	164
2009	13-May	1-Oct	141
2010	7-May	12-Oct	158
2011	4-May	25-Oct	174
2012	29-Apr	4-Oct	158
2013	23-May	5-Oct	135
2014	29-Apr	22-Oct	176
2015	15-Apr	27-Oct	195
2016	28-Mar	12-Oct	198
2017	13-May	10-Oct	150
avg 1976-2016	28-Apr	8-Oct	162

Table 10. 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 June precipitation	2.27 inches	June 2009
Highest December precipitation	4.19 inches	Dec 2010
Highest 24-hour precipitation	1.52 inches	Sep 14, 1959
Highest annual snowfall	40 inches	1955
Greatest snow depth	28 inches	Jan 17, 2017
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. ≥100°F	18 days	2013
Lowest air temperature	-26°F	Jan 21 and 22, 1962
Total days with minimum air temp. ≤0°F	35 days	1985
Longest frost-free period	198 days	2016
---------- Since 1967 ----------		
Lowest soil temperature at 4-inch depth	12°F	Dec 24, 25, and 26, 1990
---------- Since 1993 ----------		
Most yearly growing degree-days	3876 degree-days	2015
Fewest yearly growing degree-days	2768 degree-days	1993
Fewest growing degree-days in March	39	2008
Fewest growing degree-days in April	106	2011
Most growing degree-days in April	305	2016
---------- Since 1992 ----------		
Highest reference evapotranspiration	61.6 inches	2015

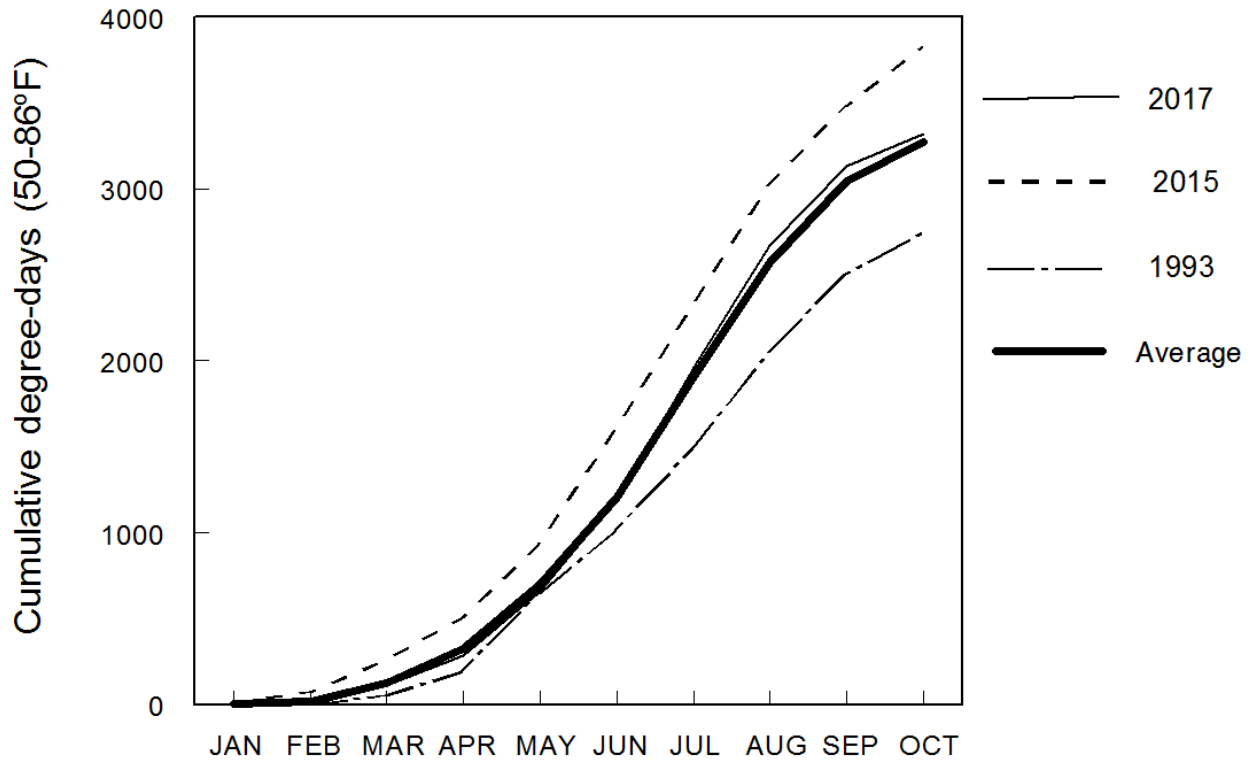

Figure 1. Cumulative growing degree-days (50-86°F) over time for 2017 compared to the years with lowest (1993) and highest (2015) totals since 1993 and to the 24-year average (1993-2016), Malheur Experiment Station, Oregon State University, Ontario, OR.