

Range Cattle Research and Education Center

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CLIMATOLOGICAL REPORT 2013  
Range Cattle Research and Education Center

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Weather conditions strongly influence agricultural operations from planting through harvesting. Knowledge of annual rainfall and temperature cycles, along with their extremes, help producers determine optimum times to prepare and plant seedbeds, fertilize pastures, apply herbicides, control water, and supplement cattle on pasture or range. Weather conditions influence forage seed germination, growth and development, palatability, and nutritive value.

This research report presents a summary of weather conditions observed during 2013 at the Range Cattle Research and Education Center (REC), Ona, Florida. The center is located  $81^{\circ} 56.406' W$  and  $27^{\circ} 23.733' N$  in south central Florida approximately 45 miles (72 km) east of the Gulf of Mexico and 100 miles (160 km) west of the Atlantic Ocean. Weather observations were collected with a Weather Watch 2000 (Campbell Scientific, Inc) from 1997 until 2005. Beginning in 2006, observations were collected using the Florida Automated Weather Network (FAWN). Accuracy of rainfall as measured by the Weather Watch 2000 or FAWN and was verified by comparing with rainfall measured using US Weather Service standard gauge. Measurements reported prior to 2006 were recorded at 0900 h; thus, data on a given day represented the previous 24-hour period. Beginning in 2006, measurements were recorded for an entire 24-h period beginning at midnight.

Daily observations of rainfall, temperature, and solar radiation are summarized in Table 1. These data are then compared to a 72-year summary of rainfall data and a 70-year summary of temperature data collected at this location. In addition, monthly evapotranspiration and freeze hazard information are reported.

**Table 1. Daily maximum and minimum temperature, precipitation, and solar radiation for 2013, Range Cattle REC.**

Day	January				February				March				April			
	Max °F	Min °F	Rain inch	S Rad MJ/m <sup>2</sup>	Max °F	Min °F	Rain inch	S Rad MJ/m <sup>2</sup>	Max °F	Min °F	Rain inch	S Rad MJ/m <sup>2</sup>	Max °F	Min °F	Rain inch	S Rad MJ/m <sup>2</sup>
1	78.22	50.41	0.00	13.11	69.28	38.54	0.00	21.27	60.08	52.38	0.00	6.75	84.49	56.21	0.00	11.38
2	81.41	53.53	0.00	13.12	73.42	41.40	0.00	19.92	58.62	40.51	0.00	12.82	87.93	58.21	0.00	26.56
3	80.98	58.21	0.01	11.40	71.82	42.55	0.00	18.39	55.87	34.72	0.00	19.47	87.66	59.76	0.02	21.15
4	65.12	58.78	0.01	3.68	71.89	36.20	0.00	20.67	69.67	30.52	0.00	26.52	71.04	64.15	1.97	3.69
5	78.48	57.72	0.01	12.07	79.14	40.35	0.00	20.20	77.49	33.97	0.00	26.07	75.60	58.71	0.07	17.01
6	81.66	62.13	0.00	9.94	81.34	49.44	0.01	14.42	67.46	37.26	0.03	26.06	80.65	55.27	0.00	27.36
7	70.16	62.62	0.01	5.16	82.81	58.95	0.00	17.74	69.60	34.63	0.00	27.42	83.77	58.01	0.00	25.09
8	83.01	61.23	0.01	12.13	82.22	57.04	0.00	20.24	78.46	33.25	0.00	27.11	84.42	56.43	0.00	25.73
9	85.50	68.00	0.00	12.39	78.01	52.43	0.00	20.53	78.62	39.55	0.00	21.17	83.46	57.15	0.00	18.04
10	83.61	64.69	0.00	13.29	79.47	56.52	0.00	15.33	78.78	50.88	0.00	23.93	89.94	58.39	0.00	23.44
11	83.30	62.20	0.00	13.39	83.03	56.25	0.00	17.74	80.71	53.65	0.00	17.17	88.74	67.91	0.00	20.43
12	82.87	61.63	0.00	13.27	83.28	58.73	0.00	16.53	70.97	49.44	0.08	6.20	85.17	72.34	0.00	14.46
13	82.74	61.14	0.00	13.78	84.36	62.13	0.00	16.75	77.36	45.32	0.00	28.03	88.12	66.72	0.01	18.75
14	82.76	58.03	0.02	13.47	70.09	56.57	0.60	4.63	71.98	38.24	0.00	28.56	89.67	67.14	0.00	20.72
15	81.68	56.41	0.00	10.52	70.81	56.73	0.01	9.98	73.76	32.43	0.00	28.49	91.96	61.70	0.05	19.06
16	82.04	58.41	0.00	15.19	67.13	50.29	0.00	16.92	80.04	36.93	0.00	28.10	88.86	64.53	0.00	20.61
17	79.23	56.88	0.00	8.63	57.81	31.69	0.00	24.45	78.15	41.82	0.00	15.67	86.31	62.13	0.00	26.22
18	67.93	40.58	0.01	14.42	70.77	29.52	0.00	22.94	79.75	56.28	0.00	12.32	89.65	61.99	1.11	21.77
19	72.91	54.73	0.01	8.61	79.05	43.29	0.00	19.97	86.52	59.88	0.02	21.05	87.82	65.93	0.01	20.48
20	74.53	59.54	0.00	10.03	81.21	50.92	0.00	15.13	77.61	58.19	0.13	9.61	80.33	64.09	0.00	16.33
21	74.23	59.22	0.27	6.43	84.54	55.24	0.00	17.04	73.49	39.13	0.01	29.67	84.63	59.20	0.08	21.73
22	69.03	47.01	0.00	10.39	86.54	57.42	0.00	19.62	77.83	37.77	0.03	15.53	80.78	65.70	0.27	16.71
23	72.19	43.44	0.00	18.41	85.57	65.88	0.00	17.87	86.54	62.74	0.00	19.45	84.27	62.04	0.00	24.99
24	74.32	38.06	0.00	18.14	86.47	63.64	0.00	18.17	84.72	67.44	0.38	11.38	86.11	56.05	0.00	28.91
25	76.01	42.43	0.00	17.91	85.66	63.61	0.00	14.68	73.98	46.78	0.00	28.47	87.13	58.10	0.00	25.47
26	76.77	43.19	0.00	18.48	81.16	58.64	0.07	7.57	61.48	39.21	0.00	28.10	86.83	57.58	0.00	25.64
27	78.76	48.04	0.00	18.01	76.98	53.31	0.00	17.49	65.46	31.90	0.00	30.72	82.94	61.90	0.00	21.58
28	82.47	56.64	0.00	15.83	75.47	47.57	0.00	20.80	73.47	32.35	0.00	30.56	85.87	58.66	0.00	27.84
29	81.99	57.90	0.00	11.63					77.25	37.36	0.00	29.79	87.69	58.62	0.00	24.47
30	82.74	61.59	0.00	16.60					80.01	42.60	0.00	26.38	88.81	62.26	0.02	23.63
31	68.54	45.16	0.11	18.15					82.89	49.73	0.00	28.23				
<b>Avg</b>	77.91	55.15	0.02	12.82	77.83	51.24	0.02	17.39	74.47	43.45	0.02	22.28	85.36	61.23	0.12	21.31
<b>Max</b>	85.50	68.00	0.27	18.48	86.54	65.88	0.60	24.45	86.54	67.44	0.38	30.71	91.96	72.34	1.97	28.91
<b>Min</b>	65.12	38.06	0.00	3.68	57.81	29.52	0.00	4.63	55.87	30.52	0.00	6.20	71.04	55.27	0.00	3.69
<b>Total</b>			0.47	397.56			0.69	486.99			0.68	690.80			3.61	639.25

Table 1. Continued.

Day	May				June				July				August			
	Max °F	Min °F	Rain inch	S Rad MJ/m <sup>2</sup>	Max °F	Min °F	Rain inch	S Rad MJ/m <sup>2</sup>	Max °F	Min °F	Rain inch	S Rad MJ/m <sup>2</sup>	Max °F	Min °F	Rain inch	S Rad MJ/m <sup>2</sup>
1	76.95	66.83	0.76	4.32	87.71	71.24	1.65	13.85	81.45	71.19	1.72	5.97	93.07	71.33	0.07	24.12
2	76.15	65.26	0.02	8.80	83.55	71.40	0.01	18.71	86.81	71.64	0.80	13.54	91.63	71.94	1.00	20.20
3	84.33	63.01	0.02	23.46	82.62	69.89	0.90	9.56	87.51	71.47	0.11	16.52	90.50	73.00	0.10	12.46
4	81.72	60.98	0.00	23.36	82.96	71.08	0.01	11.25	87.58	70.14	0.27	14.47	88.54	73.81	0.06	17.37
5	78.30	53.29	0.00	31.20	83.84	72.12	0.23	9.47	82.24	71.69	0.53	15.43	91.47	73.81	0.06	19.26
6	78.58	52.03	0.00	25.34	77.88	71.08	2.60	4.04	90.34	71.60	0.00	27.06	92.16	73.08	0.27	22.20
7	79.12	46.99	0.00	28.66	84.79	70.20	0.00	14.49	90.28	72.34	0.00	26.32	91.67	73.94	0.00	21.55
8	82.22	51.98	0.00	26.43	88.09	70.38	0.56	10.28	90.84	72.21	0.00	23.31	91.63	73.98	0.00	24.61
9	87.39	49.98	0.00	30.37	90.30	70.86	0.00	20.40	89.56	69.42	0.00	25.70	91.11	72.45	0.02	18.35
10	90.84	62.01	0.00	26.57	92.35	70.54	0.01	21.47	88.14	69.21	0.01	22.43	92.61	71.49	0.01	24.37
11	89.29	63.28	0.00	22.28	90.75	70.18	0.00	20.82	86.81	70.36	0.70	16.87	93.40	72.10	0.00	25.73
12	88.39	67.08	0.00	23.84	93.38	69.03	0.00	24.47	85.89	69.71	0.18	18.39	93.13	72.72	0.00	25.60
13	85.44	60.22	0.00	19.92	89.40	68.77	0.00	15.00	83.68	70.75	0.87	10.38	94.78	70.72	0.48	27.30
14	85.23	49.35	0.00	32.48	88.63	69.57	0.00	23.99	87.21	69.76	0.24	14.63	93.63	73.58	0.01	26.85
15	85.19	51.96	0.00	31.00	90.48	68.50	0.00	18.89	90.27	72.10	0.02	23.36	88.03	72.39	0.03	15.00
16	87.13	53.13	0.00	32.38	92.14	72.05	0.00	23.67	87.22	72.01	0.66	14.81	93.85	72.68	1.36	20.65
17	90.05	58.71	0.00	26.87	93.63	70.36	0.00	29.76	87.89	70.23	0.03	15.67	92.03	72.39	0.00	18.45
18	94.78	64.29	0.00	28.01	91.08	71.46	0.00	24.51	85.44	69.64	0.99	13.63	91.99	74.12	0.35	17.66
19	94.08	61.02	0.00	27.27	91.04	69.82	0.84	19.96	90.28	70.14	0.22	15.95	93.63	72.03	0.03	21.80
20	92.46	64.36	0.85	23.93	91.62	69.24	0.57	20.19	91.58	70.99	0.11	18.74	91.69	71.02	0.01	20.87
21	87.08	64.15	0.09	18.11	90.66	67.10	0.01	20.21	88.97	71.38	1.02	14.87	91.09	74.16	0.21	17.48
22	88.57	64.87	0.03	20.40	91.02	68.18	0.00	26.45	91.36	72.10	0.00	22.76	91.51	71.74	1.95	17.28
23	91.58	62.96	0.00	28.39	89.67	70.11	0.04	19.46	89.94	73.13	0.00	23.79	93.79	73.60	0.15	24.77
24	94.17	63.27	0.00	26.34	90.84	70.34	0.00	27.31	89.06	73.27	0.00	23.95	92.73	72.72	0.60	22.16
25	89.42	65.01	0.00	28.24	92.59	70.21	0.00	26.06	87.78	75.13	0.00	12.72	87.46	72.41	0.23	10.04
26	86.36	54.09	0.00	28.59	90.19	69.04	1.07	12.98	90.19	73.08	1.45	17.84	90.68	73.15	0.28	23.02
27	88.52	59.81	0.00	30.89	92.50	66.67	0.01	25.55	93.34	73.94	0.00	25.41	88.34	70.90	0.05	21.11
28	87.87	66.18	0.00	22.51	89.47	69.71	0.00	16.57	90.48	71.58	0.01	16.78	90.23	69.73	0.14	16.57
29	86.16	68.04	0.00	20.82	89.38	72.27	0.08	20.16	92.79	71.40	0.17	24.65	90.73	71.15	0.00	22.87
30	83.66	68.79	0.02	21.31	86.25	72.09	1.30	12.99	92.10	71.98	0.04	25.55	90.77	72.88	0.00	15.65
31	85.06	69.75	0.10	15.83					91.42	73.74	0.41	16.76	91.02	70.88	0.01	24.09
<u>Avg</u>	86.33	60.41	0.06	24.45	88.96	70.11	0.33	18.75	88.66	71.52	0.34	18.65	91.58	72.45	0.24	20.63
<u>Max</u>	94.78	69.75	0.85	32.48	93.63	72.27	2.60	29.76	93.34	75.12	1.72	27.06	94.78	74.16	1.95	27.30
<u>Min</u>	76.15	46.99	0.00	4.32	77.88	66.67	0.00	4.04	81.45	69.21	0.00	5.97	87.46	69.73	0.00	10.04
<u>Total</u>			1.89	757.92			9.89	562.53			10.56	578.25		7.48	639.43	

Table 1. Continued.

Day	September				October				November				December			
	Max °F	Min °F	Rain inch	S Rad MJ/m <sup>2</sup>	Max °F	Min °F	Rain inch	S Rad MJ/m <sup>2</sup>	Max °F	Min °F	Rain inch	S Rad MJ/m <sup>2</sup>	Max °F	Min °F	Rain inch	S Rad MJ/m <sup>2</sup>
1	90.07	70.43	0.02	12.50	89.44	69.53	0.00	21.11	86.88	62.62	0.00	15.38	74.14	59.43	0.00	8.03
2	88.66	71.87	0.51	10.59	88.63	69.85	0.00	18.09	77.99	60.94	0.13	5.62	69.73	58.46	0.00	4.85
3	89.01	70.86	0.14	14.45	89.24	69.21	0.00	19.38	77.68	58.03	0.00	18.77	77.95	59.16	0.02	11.61
4	91.15	72.99	0.07	17.72	89.26	70.74	0.00	18.56	79.93	54.75	0.00	13.16	82.18	57.85	0.00	10.35
5	92.05	72.43	0.00	18.66	89.65	68.97	0.00	19.42	82.72	64.51	0.01	10.75	83.52	58.68	0.00	13.78
6	93.45	73.96	0.00	21.80	89.65	69.85	0.00	16.87	85.06	66.33	0.00	13.85	84.87	61.81	0.00	12.36
7	90.36	71.15	0.00	22.52	83.77	69.98	0.42	10.10	81.91	63.93	0.00	11.06	85.24	58.26	0.00	14.49
8	91.27	69.57	0.00	22.99	85.69	71.20	0.00	19.14	80.53	63.36	0.00	15.60	84.11	61.16	0.00	12.27
9	91.18	71.31	0.00	22.75	81.77	66.38	0.00	6.40	82.47	62.47	0.00	12.59	85.08	60.44	0.00	12.68
10	90.88	72.18	0.00	24.48	86.09	64.45	0.00	18.36	83.03	64.33	0.00	12.12	84.56	55.26	0.00	13.39
11	88.36	72.03	0.02	20.00	86.56	63.28	0.00	5.11	83.26	64.96	0.00	12.67	83.05	61.30	0.00	13.90
12	89.38	70.38	3.12	15.09	79.02	63.88	0.00	19.69	80.83	62.29	0.00	10.29	73.08	51.98	0.00	9.17
13	89.65	69.03	0.02	19.71	86.58	63.90	0.00	17.66	68.52	53.02	0.00	11.70	77.05	48.87	0.00	14.61
14	94.05	71.11	0.05	22.90	86.14	63.16	0.00	18.57	77.41	50.81	0.00	15.10	84.25	56.75	0.00	11.54
15	91.71	72.14	0.14	16.73	85.57	65.12	0.00	18.73	76.19	57.27	0.01	6.84	75.69	60.85	0.00	7.54
16	89.22	70.84	0.00	17.73	86.77	67.42	0.00	15.86	76.68	68.00	0.02	5.12	67.84	44.21	0.00	14.84
17	89.38	70.86	0.32	17.17	90.21	66.33	0.00	19.66	85.69	67.12	0.00	11.79	76.93	42.14	0.00	15.53
18	87.33	71.98	0.04	18.57	89.24	67.77	0.00	17.85	86.79	63.68	0.00	12.96	73.58	38.03	0.00	16.05
19	87.85	72.19	0.00	17.71	90.09	70.54	0.00	16.52	81.91	64.58	0.03	8.30	77.36	39.84	0.00	15.41
20	88.11	69.49	0.00	20.17	90.25	69.62	0.02	12.86	84.78	63.03	0.00	11.19	82.40	52.99	0.00	12.78
21	88.95	66.56	0.00	20.83	89.65	73.56	0.00	15.17	84.29	67.51	0.00	9.69	85.57	64.54	0.00	12.35
22	89.29	71.13	0.03	18.26	88.66	68.59	0.03	15.33	83.73	62.74	0.00	13.41	85.23	66.69	0.00	11.68
23	82.45	72.57	0.82	5.08	81.86	62.56	0.03	11.69	85.93	59.16	0.00	14.24	85.39	62.44	0.00	12.09
24	75.02	72.86	1.17	1.23	73.15	59.14	0.00	7.74	72.10	62.06	0.00	5.92	74.23	50.47	0.00	11.27
25	81.84	70.47	0.86	6.09	81.64	57.49	0.00	19.19	77.13	61.68	0.00	12.36	77.36	49.60	0.00	12.41
26	89.47	71.60	0.14	20.13	81.77	56.30	0.00	19.94	83.17	66.09	0.36	8.54	80.62	54.77	0.00	10.14
27	85.57	68.14	0.00	16.67	80.69	53.65	0.00	19.91	73.71	46.36	0.34	10.76	78.78	60.04	0.00	9.04
28	88.14	69.78	0.00	17.19	84.81	54.43	0.00	19.26	67.24	36.67	0.00	17.36	79.72	64.11	0.00	7.81
29	89.08	68.47	0.00	22.28	85.03	59.94	0.00	17.95	72.18	50.59	0.00	12.50	78.91	59.95	0.05	5.07
30	90.25	67.62	0.00	21.65	84.74	63.09	0.00	15.05	75.27	53.71	0.00	8.66	64.80	56.86	0.00	2.81
31					86.76	60.64	0.00	15.91					69.06	57.63	0.00	7.05
<u>Avg</u>	88.77	70.87	0.25	17.45	85.88	65.18	0.02	16.36	79.83	60.09	0.03	11.61	78.78	55.95	0.00	11.19
<u>Max</u>	94.05	73.96	3.12	24.48	90.25	73.56	0.42	21.11	86.88	68.00	0.36	18.77	85.57	66.69	0.05	16.05
<u>Min</u>	75.02	66.56	0.00	1.23	73.15	53.65	0.00	5.11	67.24	36.67	0.00	5.12	64.80	38.03	0.00	2.81
<u>Total</u>			7.47	523.63			0.50	507.08			0.90	348.31			0.07	346.92

## Rainfall

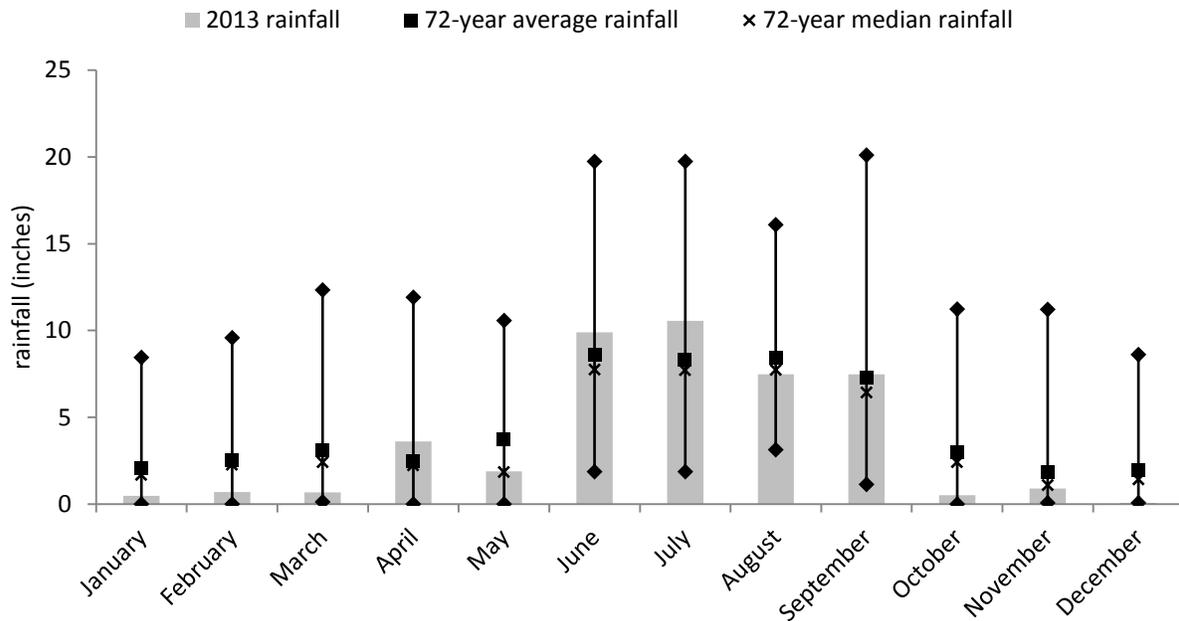
Daily rainfall equaled or exceeded 1 inch on twelve separate occasions, with daily rainfall exceeding 2 inches on two of these occasions (Table 1). The single greatest daily rain event was 12 September when 3.12 inches were recorded. Annual rainfall for 2013 totaled 44.21 inches, which was 8.82 inches less than the 72-year average of 53.03 inches (Table 2). The lowest annual total on record was observed in 2000 when 32.02 inches were measured, and the greatest annual rainfall total observed was in 1959 when 78.82 inches were recorded. Nine months of 2013 saw rainfall that fell below the 72-year average. Rainfall was one or more inches less than the 72-year average in January, February, May, and December and two or more inches less than the 72-year average in March and October. Total rainfall was more than two inches greater than the 72-year average in July and more than one inch greater in April and June. Monthly rainfall during 2013 is graphically compared to historical mean, median, maximum, and minimum rainfall in Figure 1.

**Table 2.** Summary of rainfall by months. Range Cattle REC, 2013.

Month	1942 to 2013		72-year average†	2013	Difference from 72-year average
	Maximum / month	Minimum / month		Total	
	-----inches-----				
January	8.45	0.03	2.08	0.47	-1.61
February	9.59	0.02	2.49	0.69	-1.80
March	12.34	0.13	3.08	0.68	-2.40
April	11.91	0.00	2.47	3.61	1.36
May	10.58	0.00	3.70	1.89	-1.81
June	18.99	2.79	8.60	9.89	1.29
July	19.74	1.87	8.33	10.56	2.23
August	16.10	3.13	8.40	7.48	-0.92
September	20.11	1.14	7.30	7.47	0.17
October	11.23	0.00	2.98	0.50	-2.48
November	11.22	0.07	1.86	0.90	-0.96
December	8.61	0.07	1.96	0.07	-1.89
<i>Year total</i>			53.39	44.21	-8.82

\*Inches x 2.54 = cm.

† Since rainfall records began in July 1942, means for January to June are 69-year means.



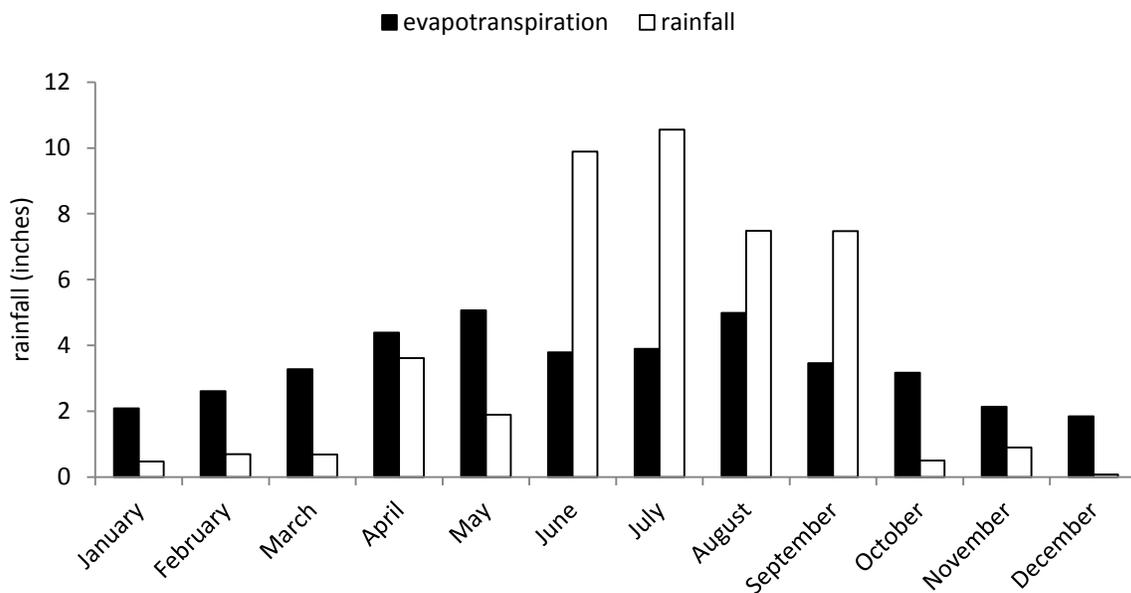
**Figure 1.** Monthly rainfall at the Range Cattle REC during 2013 relative to historical average, median, minimum, and maximum monthly rainfall. Current rainfall is indicated by the gray bars, historical average and median rainfall are indicated by squares (■) and “X’s” (x), respectively. Historical high and low rainfall are indicated by diamonds (◆).

## Evapotranspiration

Evapotranspiration is the total amount of water transferred from the earth to the atmosphere. Monthly evaporation was greater than the nine-year average during January, February, April, August, October, November, and December (Table 3). Evapotranspiration exceeded rainfall in January through May, November, and December during 2013 (Figure 2). Historically, evapotranspiration generally exceeds rainfall in January to May and October to December, which are months with limited rainfall. Rainfall exceeded evapotranspiration by 4.14 inches for the entire year.

**Table 3.** Monthly solar radiation and evapotranspiration at the Range Cattle REC during 2013.

Month	2005-2013	2013	2006-2013	2013
	Evapotranspiration		Solar radiation	
	-----inches-----		-----MJ/m <sup>2</sup> -----	
January	1.96	2.09	427.63	397.56
February	2.38	2.61	456.71	486.99
March	3.35	3.28	665.12	690.80
April	4.36	4.39	735.47	639.25
May	5.18	5.06	786.20	757.92
June	4.58	3.79	669.20	562.53
July	4.70	3.89	624.84	578.25
August	4.40	4.99	558.89	639.43
September	3.76	3.46	508.81	523.63
October	2.99	3.17	477.90	507.08
November	1.89	2.13	378.27	348.31
December	1.43	1.84	371.66	346.92
<i>Year total</i>		<i>40.07</i>		<i>6478.66</i>

**Figure 2.** Comparison of monthly evaporation and transpiration at the Range Cattle REC during 2013.

## Solar Radiation

Total solar radiation for 2013 was 6478.66 MJ. Daily solar radiation is shown in Table 1, and 2013 total monthly solar radiation can be seen in Table 3. If soil water, temperature, and fertility are not limiting and vegetative cover is complete, 1 MJ results in about 14.3 lb/A of plant dry matter. Theoretically, enough solar radiation was received in April 2013 (639.25 MJ) to produce approximately 9,141 lb/A of plant dry matter.

## Temperature

The highest temperature observed during 2013 was 94.78 °F on May 18 and August 13 (Table 1). Monthly average-high shelter temperatures exceeded the 72-year average in January, February, April, August, October, November, and December (Table 4). Monthly average-low shelter temperatures were below the 72-year average in March, May, and September (Table 5). Daily-low shelter temperatures at or below 32 °F were observed on four days in 2013, with two events in February, and two in March (Table 1). The extreme low temperature for 2013 occurred on 18 February when shelter temperature reached 29.52 °F. Scattered frost begins when air temperature drops to 35 °F. Air temperatures at or below 35°F were observed five additional days in 2013, resulting in widespread or scattered frost across the landscape (data not shown). Mean low temperatures were lower than the 72-year means in March, May, and September (Table 5). Overall, mean low temperature for 2013 was 0.5 °F greater than the 72-year mean.

**Table 4.** Summary of maximum temperature\* during 2013 by month, Range Cattle REC.

Month	Shelter†					Ground level‡	
	1944-2013 Avg. high	2013 Avg. high	1944-2013 Extreme high	1944-2013 Year	2013 Extreme high	2013 Avg. high	2013 Extreme high
-----°F-----							
January	73.3	77.9	90.0	1982	85.5	68.2	71.5
February	75.1	77.8	91.0	1962	86.5	68.4	74.4
March	79.0	74.5	94.0	1946	86.5	68.8	73.8
April	83.4	85.4	97.0	1945	92.0	77.5	80.7
May	88.1	86.3	103.0	1945	94.8	81.8	87.5
June	90.1	89.0	103.0	1945	93.6	84.5	89.5
July	90.8	88.7	101.0	1972	93.3	84.3	90.3
August	91.1	91.6	98.0	several	94.8	86.2	91.5
September	89.5	88.8	96.2	several	94.1	92.6	86.5
October	84.9	85.9	95.0	several	90.3	79.1	81.8
November	79.2	79.8	94.0	1990	86.9	74.3	77.3
December	74.3	78.8	89.0	1945	85.6	71.2	73.6
<i>Average</i>	83.2	83.7				78.3	

\*°C = (°F – 32) x 0.555

† Air temperature is measured using a thermometer in an instrument shelter designed to protect meteorological equipment from exposure to direct sunlight, precipitation, and condensations, while allowing for adequate ventilation so that the instruments measure environmental parameters accurately.

‡ Ground level temperature is measured with a soil probe, which measures the temperature 4 inches below the soil surface.

**Table 5.** Summary of minimum temperature\* for 2013 by month, Range Cattle REC.

Month	Shelter†					Ground level‡	
	1944-2013 Avg. low	2013 Avg. low	1944-2013 Extreme low	1944-2013 Year	2013 Extreme low	2013 Avg. low      Extreme low	
-----°F-----					-----°F-----		
January	49.1	55.1	18.0	1981	38.1	64.0	58.0
February	50.5	51.2	23.8	2009	29.5	63.1	52.3
March	54.2	43.4	26.0	1980	30.5	62.1	56.2
April	58.0	61.2	34.0	1971	55.3	71.3	66.7
May	63.3	60.4	43.0	1945	47.0	74.2	69.1
June	69.0	70.1	52.0	1984	66.7	78.2	74.1
July	71.3	71.5	62.0	several	69.2	78.6	76.4
August	71.9	72.4	61.0	1977	69.7	81.0	79.5
September	71.1	70.9	51.0	1962	66.6	79.3	76.9
October	64.7	65.2	37.5	2008	53.7	75.8	71.0
November	56.8	60.1	25.0	1970	36.7	71.2	64.2
December	51.3	55.6	20.0	1962	38.0	67.6	61.7
<i>Average</i>	<i>60.9</i>	<i>61.4</i>				<i>72.2</i>	

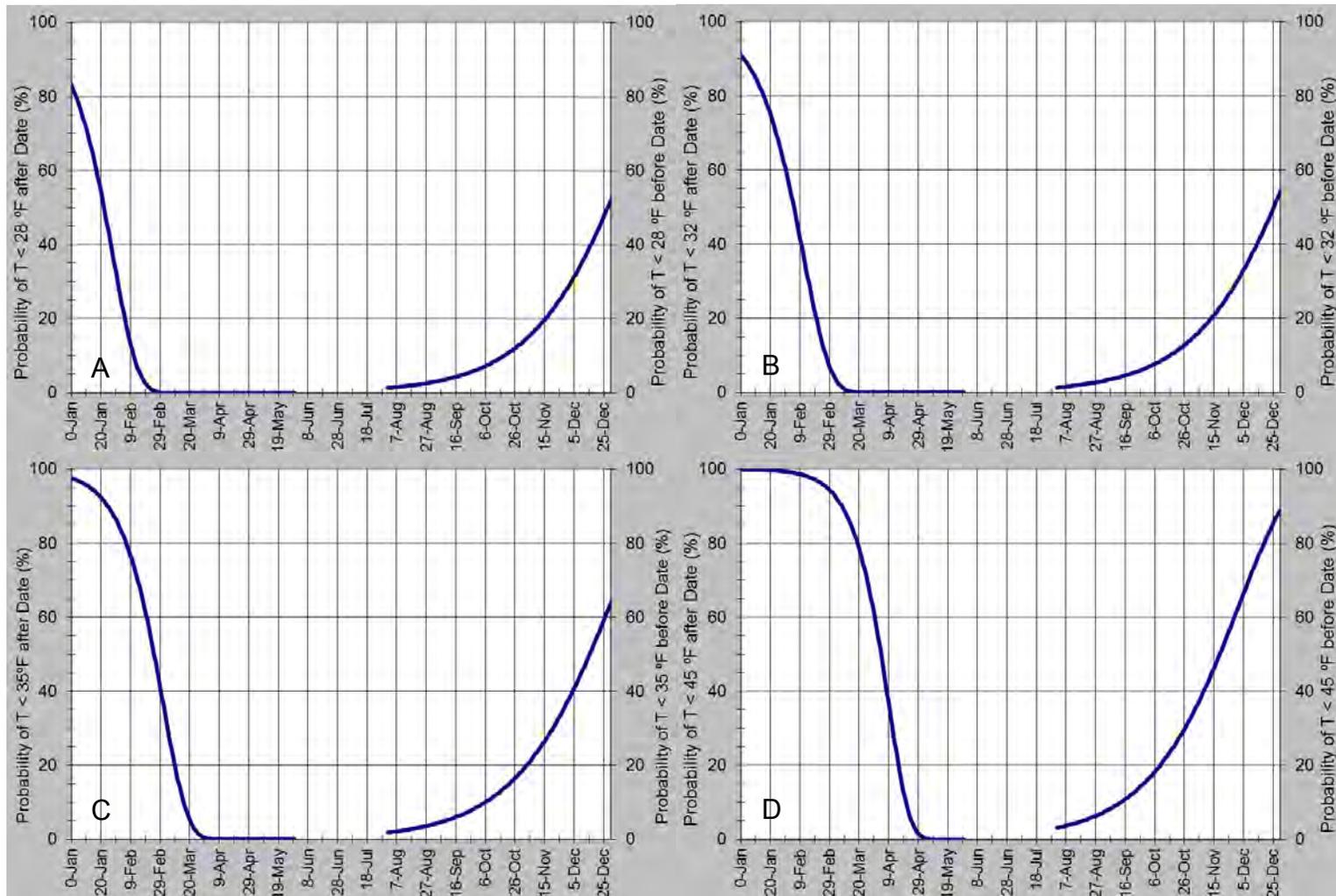
\*°C = (°F – 32) x 0.555

† Air temperature is measured using a thermometer in an instrument shelter designed to protect meteorological equipment from exposure to direct sunlight, precipitation, and condensations, while allowing for adequate ventilation so that the instruments measure environmental parameters accurately.

‡ Ground level temperature is measured with a soil probe, which measures the temperature 4 inches below the soil surface.

### Freeze hazard

The fall and spring freeze hazards for the Range Cattle REC are shown in Figure 4. The spring freeze hazard estimates the likelihood of temperatures reaching below the critical temperature after a selected date, while the fall freeze hazard estimates the likelihood of experiencing the first attainment of a critical temperature before a selected date. Based on records from 1964 to 2013, these data will not predict what will occur in a given year, but what can be expected over a period of years. In an example using the spring freeze hazard, one should expect approximately a 50% chance of a frost (assuming 35 °F) occurring after the 1<sup>st</sup> of March (Figure 4C). A grower has a significant likelihood of experiencing five frosts over ten years after the 1<sup>st</sup> of March; however, the likelihood drops to approximately 10% by March 20<sup>th</sup>.



**Figure 4.** Spring and fall freeze hazard showing temperature probabilities after a given spring date and before a given fall date. Trend lines for temperature probabilities <28 °F (A), <32 °F (B), <35 °F (C), and <45 °F (D). Graphs were constructed using minimum temperature data from 1960 – 2010 using FRISKNH as developed by R. Snyder and J. Paulo de Melo-Abreu and can be accessed at <http://biomet.ucdavis.edu/frost-protection.html>