Range Cattle Research and Education Center   January 2020

Research Report RC-2020-1

CLIMATOLOGICAL REPORT 2019
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 2019 at the Range Cattle Research and Education Center (RCREC), Ona, Florida. The center is located 81° 56.406' W and 27° 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). 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 78-year summary of rainfall data and a 76-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 2019, Range Cattle REC.

	January				February				March				April			
Day	Max °F	Min °F	Rain inch	S Rad MJ/m²	Max °F	Min °F	Rain inch	S Rad MJ/m²	Max °F	Min °F	Rain inch	S Rad MJ/m²	Max °F	Min °F	Rain inch	S Rad MJ/m²
1	85.46	61.48	0.00	14.55	79.21	54.66	0.00	12.23	84.13	59.25	0.00	16.62	79.24	59.23	0.00	14.26
2	84.92	62.35	0.00	15.69	82.17	61.21	0.27	12.37	85.01	58.87	0.00	21.71	79.79	56.71	0.24	15.23
3	83.75	60.31	0.00	12.36	78.40	58.57	0.01	12.90	84.56	58.39	0.00	22.71	81.97	55.22	0.00	26.38
4	82.35	63.19	0.23	12.20	76.19	58.89	0.00	13.65	83.01	64.54	0.10	17.50	82.38	58.91	0.00	21.48
5	71.24	58.71	0.01	12.36	80.56	54.18	0.00	19.62	64.35	48.92	0.00	5.90	87.64	62.85	0.01	21.04
6	72.97	46.02	0.00	17.67	82.47	52.72	0.00	19.94	66.18	42.31	0.00	25.92	87.39	61.29	0.00	23.20
7	79.18	51.80	0.01	16.13	82.76	56.39	0.00	0.00	75.42	39.87	0.00	25.09	87.62	64.45	0.00	22.20
8	80.01	51.21	0.00	15.57	82.78	55.54	0.00	18.47	80.65	48.83	0.00	20.21	88.83	64.83	0.00	22.24
9	74.07	49.78	0.00	14.40	78.10	60.31	0.01	16.94	84.11	59.14	0.00	19.22	84.92	67.53	0.34	14.15
10	64.22	39.91	0.00	18.28	83.37	62.15	0.00	19.38	86.63	61.59	0.00	19.91	81.86	64.83	0.01	19.93
11	74.52	39.95	0.00	14.79	85.60	59.77	0.00	17.63	88.02	61.20	0.00	20.89	88.29	60.62	0.00	25.37
12	79.03	49.95	0.00	14.81	84.67	67.15	0.00	15.12	76.10	63.97	0.00	9.02	89.60	60.49	0.00	27.45
13	79.77	52.38	0.00	15.26	67.75	48.91	1.28	4.03	82.38	60.73	0.00	19.42	89.78	71.40	0.00	22.91
14	71.40	53.02	0.01	14.68	76.91	42.61	0.00	21.79	84.60	58.66	0.00	23.32	88.48	69.17	1.00	20.03
15	62.42	51.21	0.00	14.58	80.55	54.41	0.00	19.88	84.49	62.65	0.00	16.22	80.31	65.14	0.00	30.43
16	63.23	40.90	0.00	12.74	80.64	51.85	0.00	18.46	77.14	67.51	0.66	8.50	84.18	52.97	0.00	30.09
17	76.28	38.83	0.01	17.94	85.17	60.35	0.00	18.34	76.32	61.25	0.01	14.00	84.83	56.08	0.00	28.85
18	78.96	42.61	0.00	17.87	86.20	62.96	0.03	13.97	72.93	58.55	0.13	13.59	91.11	59.20	0.00	26.98
19	80.01	48.15	0.00	15.50	87.13	64.74	0.00	12.64	64.06	51.04	0.88	4.67	84.56	57.00	1.19	10.88
20	67.87	44.78	0.55	11.32	85.78	65.03	0.00	12.32	74.25	58.32	0.00	15.07	73.63	53.53	0.00	27.63
21	66.11	36.72	0.00	19.25	87.03	62.89	0.01	17.96	74.03	54.16	0.00	26.17	78.64	51.96	0.00	30.73
22	76.19	44.91	0.00	15.87	88.21	64.90	0.00	19.23	74.77	47.25	0.00	27.43	81.79	51.40	0.00	30.66
23	81.19	54.61	0.00	15.16	89.47	63.52	0.08	19.12	79.48	42.43	0.00	27.52	83.80	53.60	0.00	29.95
24	73.11	57.60	0.72	8.71	85.06	66.22	0.01	17.43	81.01	53.80	0.00	23.40	84.56	54.43	0.00	29.49
25	63.54	48.67	0.00	18.17	75.15	65.39	0.00	13.53	84.11	57.25	0.00	25.30	84.15	58.55	0.03	21.66
26	62.31	46.51	0.00	8.06	77.22	59.22	1.77	5.99	81.66	59.43	0.00	22.03	84.11	61.30	0.00	16.06
27	55.67	49.39	2.16	1.30	81.03	61.92	0.10	16.12	76.44	53.04	0.00	23.00	86.45	57.56	0.00	30.87
28	59.49	41.86	0.02	9.34	80.60	61.12	0.01	16.55	79.25	54.23	0.00	27.57	87.57	59.94	0.00	27.00
29	68.36	37.65	0.01	19.42					81.97	55.45	0.00	24.34	88.68	62.06	0.00	27.59
30	63.23	48.52	0.00	10.79					81.45	55.90	0.00	20.46	89.40	66.15	0.00	27.40
31	69.78	46.85	0.00	12.91					84.56	57.60	0.00	21.46				
Avg	72.60	49.60	0.12	14.12	81.79	59.19	0.12	15.02	79.13	56.00	0.06	19.62	84.86	59.94	0.09	24.07
Max	85.46	63.19	2.16	19.42	89.47	67.15	1.77	21.80	88.02	67.51	0.88	27.57	91.11	71.40	1.19	30.87
Min	55.67	36.72	0.00	1.30	67.75	42.61	0.00	0.00	64.06	39.87	0.00	4.67	73.63	51.40	0.00	10.88
Total			3.73	437.83			3.58	425.76			1.78	608.31			2.82	722.28

Table 1. Continued.

	May				June				July				August			
Day	Max °F	Min °F	Rain inch	S Rad MJ/m²	Max °F	Min °F	Rain inch	S Rad MJ/m²	Max °F	Min °F	Rain inch	S Rad MJ/m²	Max °F	Min °F	Rain inch	S Rad MJ/m²
1	86.56	65.79	0.11	22.71	91.09	72.25	0.01	25.49	94.82	70.39	0.00	28.36	90.75	71.53	0.06	18.69
2	85.23	69.80	1.63	15.13	92.30	67.95	0.00	28.18	93.40	71.64	0.46	19.50	87.73	72.27	0.00	19.18
3	87.89	68.92	0.00	25.01	94.23	67.57	0.00	28.37	95.45	71.98	0.00	24.88	90.79	72.93	1.14	18.44
4	90.48	65.17	0.00	26.31	96.46	70.75	0.02	26.72	95.29	72.50	0.00	23.64	88.95	73.69	0.01	17.59
5	86.88	69.03	0.08	20.05	94.33	70.27	0.12	22.46	95.20	73.90	0.00	26.04	88.99	73.11	0.63	12.30
6	88.92	69.33	0.00	22.26	90.48	70.74	0.00	19.30	93.15	72.70	0.39	22.46	91.11	72.28	0.17	18.38
7	90.86	69.15	0.00	21.49	87.60	73.80	0.00	12.22	87.35	71.98	0.01	16.21	87.78	72.05	0.59	10.32
8	88.88	67.42	0.00	24.79	91.18	73.18	0.32	17.21	84.27	72.63	0.01	16.74	92.14	71.67	0.01	22.71
9	91.18	67.42	1.19	22.45	87.01	72.12	1.33	17.66	86.76	75.13	0.31	12.32	84.90	74.89	0.40	13.83
10	88.86	67.51	0.43	20.59	87.53	70.57	0.50	15.33	88.93	72.46	0.07	18.71	87.60	75.31	0.10	17.51
11	91.35	69.22	0.00	26.86	89.53	70.32	0.11	22.30	87.53	72.77	0.15	15.50	90.64	76.14	0.58	17.71
12	89.56	68.47	0.00	23.47	91.36	70.48	0.00	23.97	89.42	72.81	0.00	16.04	87.37	76.39	0.24	13.29
13	87.47	71.47	0.10	16.15	88.03	71.49	0.50	16.30	93.58	71.47	0.00	18.69	90.03	76.44	0.29	11.58
14	82.33	67.33	0.00	11.91	85.17	69.58	0.01	15.14	94.64	73.00	0.00	26.93	88.88	76.41	0.38	9.55
15	87.30	67.75	0.00	20.35	92.79	70.00	0.03	21.44	95.11	70.63	0.00	24.56	87.40	74.97	0.95	15.21
16	87.49	66.92	0.00	26.25	87.26	72.72	0.70	7.54	96.06	72.34	0.00	27.13	83.37	73.90	0.01	13.72
17	87.93	61.32	0.00	28.43	86.88	70.34	0.01	18.65	95.90	71.20	1.54	28.04	89.33	73.58	0.00	23.80
18	90.05	60.31	0.00	31.01	88.99	72.16	0.20	18.25	94.75	70.38	0.00	24.59	93.29	71.80	0.00	22.44
19	92.97	63.81	0.00	30.26	90.14	70.75	1.30	18.51	95.50	71.44	0.01	28.69	91.99	73.36	0.00	20.22
20	93.38	67.39	0.00	29.15	93.11	70.93	0.00	28.46	93.51	71.78	0.00	21.28	90.68	73.38	0.00	18.42
21	92.73	66.65	0.00	28.18	94.03	73.00	0.00	28.63	91.63	70.83	0.11	14.29	92.43	72.90	0.07	23.95
22	91.11	66.92	0.00	28.02	93.81	71.10	0.00	22.84	93.04	69.73	0.01	22.98	93.18	73.09	0.01	22.65
23	90.45	64.36	0.00	28.32	94.95	70.38	0.00	28.27	88.30	69.28	0.70	12.44	90.84	74.21	0.00	19.07
24	90.93	62.53	0.00	30.86	94.37	71.53	0.02	28.88	88.99	71.55	0.16	16.72	94.32	74.50	0.00	24.14
25	91.71	63.73	0.00	29.68	97.68	70.43	0.01	27.01	86.27	73.45	0.23	13.16	94.53	74.17	0.12	26.12
26	92.84	66.34	0.00	28.44	97.45	69.12	0.01	27.73	88.95	70.84	0.57	13.67	92.71	76.12	0.00	17.64
27	94.78	66.04	0.00	27.81	94.89	70.30	0.00	27.98	91.09	70.39	0.00	24.42	92.86	72.63	0.02	19.24
28	94.51	65.19	0.00	30.18	92.57	70.30	0.03	27.98	93.16	72.52	0.00	20.78	90.25	74.61	0.06	18.10
29	93.78	63.39	0.00	31.18	87.69	70.52	0.13	12.47	94.33	71.42	0.00	22.11	93.15	73.60	0.30	22.28
30	97.38	67.53	0.00	31.18	92.48	70.30	0.02	18.03	93.63	71.62	0.00	28.38	91.74	75.07	0.01	17.03
31	95.67	73.04	0.47	24.39					95.61	70.79	0.34	23.49	92.05	74.82	0.00	18.61
Avg	90.37	66.75	0.12	25.25	91.47	70.88	0.17	21.59	92.11	71.79	0.16	21.06	90.38	73.92	0.19	18.18
Max	97.38	73.04	1.63	31.18	97.68	73.80	1.33	28.88	96.06	75.13	1.54	28.69	94.53	76.44	1.14	26.12
Min	82.33	60.31	0.00	11.91	85.17	67.57	0.00	7.54	84.27	69.28	0.00	12.32	83.37	71.53	0.00	9.55
Total			4.01	783.02			5.38	647.77			5.07	652.91			6.15	563.88

Table 1. Continued.

|	September				October				November				December			
Day	Max °F	Min °F	Rain inch	S Rad MJ/m²	Max °F	Min °F	Rain inch	S Rad MJ/m²	Max °F	Min °F	Rain inch	S Rad MJ/m²	Max °F	Min °F	Rain inch	S Rad MJ/m²
1	84.67	74.46	0.23	15.73	89.42	71.37	0.00	19.30	86.31	67.91	0.00	11.23	81.32	53.55	0.00	13.48
2	91.78	76.01	0.03	17.78	90.46	69.35	0.00	19.77	90.07	66.52	0.00	14.84	66.36	45.12	0.06	13.28
3	89.85	74.61	0.04	19.48	90.37	68.43	0.00	20.88	79.29	65.61	0.00	13.08	64.98	38.60	0.00	16.97
4	90.81	75.60	0.00	17.34	91.26	65.05	0.00	22.04	86.43	67.89	0.00	10.74	70.00	43.23	0.00	16.37
5	93.58	76.53	0.00	22.44	87.60	68.14	0.00	16.87	89.15	67.33	0.00	16.33	70.52	41.09	0.00	14.76
6	93.58	76.10	0.32	23.51	88.74	69.30	0.12	16.67	87.17	69.28	0.08	13.40	77.31	38.92	0.00	15.97
7	92.50	72.54	0.01	25.86	90.63	73.42	0.01	18.90	89.47	69.39	0.01	16.59	76.82	42.95	0.00	12.03
8	93.27	67.57	0.00	23.14	90.93	73.17	0.00	16.11	87.55	65.48	0.00	13.89	82.13	50.67	0.00	14.63
9	95.49	73.83	0.01	22.14	86.43	70.81	0.10	10.48	77.95	64.56	0.13	12.54	83.70	52.95	0.00	15.81
10	93.51	74.21	0.01	25.08	87.82	71.13	0.01	19.11	80.94	57.61	0.00	18.58	86.05	56.91	0.00	11.87
11	92.44	73.29	0.00	23.40	89.22	68.20	0.00	19.83	83.70	57.16	0.00	18.60	87.03	64.18	0.03	11.18
12	92.50	73.51	0.00	22.11	85.05	66.83	0.00	12.47	83.97	57.16	0.00	16.12	75.29	65.46	0.01	7.09
13	88.54	76.46	0.08	15.23	89.51	64.17	0.00	20.07	74.23	57.45	0.00	10.85	77.07	64.90	0.00	5.84
14	89.40	75.02	0.02	17.64	91.04	67.59	0.00	19.20	80.13	62.08	0.00	7.77	78.67	69.58	0.01	11.46
15	92.80	74.91	0.04	19.04	89.78	68.09	0.00	18.84	78.69	63.10	0.15	6.30	78.48	42.13	0.00	16.09
16	92.70	72.61	0.01	22.09	89.56	69.06	0.51	19.54	65.52	52.03	0.00	7.91	86.54	55.85	0.00	15.51
17	94.53	70.14	0.00	24.56	87.08	69.26	0.01	16.17	56.01	50.63	0.00	3.24	84.63	66.49	0.41	9.29
18	91.67	68.18	0.06	20.08	81.59	68.94	0.03	5.48	74.28	49.48	0.00	14.26	68.79	49.42	0.11	2.53
19	87.78	69.39	0.01	23.58	86.54	73.42	2.48	12.78	74.61	48.94	0.00	16.31	71.33	45.50	0.00	11.57
20	84.02	69.55	0.02	12.37	89.11	72.99	0.00	17.67	76.89	42.57	0.00	15.49	75.16	57.67	0.00	7.37
21	87.76	67.69	0.00	21.55	90.54	74.16	0.00	17.32	79.30	43.21	0.00	17.46	74.55	62.65	0.05	7.16
22	88.57	67.26	0.00	25.36	90.54	70.66	0.00	16.47	82.36	50.72	0.00	15.76	71.33	64.99	0.73	2.93
23	88.56	64.87	0.00	22.19	86.45	69.96	0.00	19.35	82.51	53.46	0.00	15.21	75.07	63.91	0.45	11.54
24	88.90	63.09	0.00	23.58	90.21	70.03	0.00	17.54	75.06	67.35	0.66	16.33	65.62	52.09	0.01	7.29
25	90.66	62.82	0.00	24.47	90.91	72.30	0.01	17.28	71.98	47.82	0.00	16.23	80.49	61.43	0.00	11.22
26	90.88	64.33	0.00	22.15	89.37	72.93	0.00	15.45	77.00	47.16	0.00	16.72	78.42	59.23	0.00	10.05
27	90.37	65.16	0.00	23.19	91.09	71.11	0.00	14.18	81.99	46.76	0.00	16.21	80.51	67.26	0.01	8.61
28	92.88	68.79	0.00	21.42	91.45	69.64	0.02	16.81	82.45	52.21	0.00	13.38	77.97	68.67	0.16	7.20
29	90.46	70.21	0.00	20.17	91.42	71.28	0.08	15.12	82.35	48.96	0.00	16.73	83.23	68.90	0.46	9.88
30	91.99	71.51	0.00	19.41	90.64	71.08	0.00	17.37	83.50	52.90	0.00	16.37	79.56	69.62	0.11	5.35
31					90.54	69.17	0.00	17.78					70.03	57.18	0.00	13.10
Avg	90.88	71.00	0.03	21.20	89.20	70.03	0.11	17.00	80.02	57.10	0.03	13.95	76.74	56.16	0.08	10.88
Max	95.49	76.53	0.32	25.86	91.45	74.16	2.48	22.04	90.07	69.39	0.66	18.60	87.03	69.62	0.73	16.97
Min	84.02	62.82	0.00	12.37	81.59	64.17	0.00	5.48	56.01	42.87	0.00	3.24	64.98	38.60	0.00	2.53
Total			0.89	636.23			3.38	527.02			1.03	418.63			2.61	337.58

Rainfall

        Daily rainfall equaled or exceeded 1 inch on 14 separate occasions, with a daily total rainfall maximum of 2.48 inches on 19 October (Table 1). Annual rainfall for 2019 totaled 40.43 inches, which was 12.66 inches lower than the 78-year average of 52.97 inches (Table 2). Only 0.89 inches of rainfall fell during September, which is a new record low rainfall for the month. 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. Record low rainfall was recorded during the month of September with 0.89 inches recorded. Six months of rainfall was below normal. Monthly rainfall during 2019 is graphically compared to historical mean, median, maximum, and minimum rainfall in Figure 1.

Table 2. Summary of rainfall by months. Range Cattle REC, 2019.

| Month | 1942 to 2019 | | 2019 | | |
	Maximum / month	Minimum / month	78-year average†	Total	Difference from 78-year average
	--inches*--				
January	8.45	0.03	2.17	3.73	1.58
February	9.59	0.02	2.46	3.58	1.13
March	12.34	0.13	2.96	1.78	- 1.20
April	11.91	0.00	2.43	2.82	0.40
May	13.55	0.00	3.81	4.01	0.21
June	18.99	2.79	8.58	5.38	- 3.24
July	19.74	1.87	8.29	5.07	- 3.26
August	16.10	3.13	8.33	6.15	- 2.21
September	20.11	0.89	7.24	0.89	- 6.44
October	11.23	0.00	2.89	3.38	0.50
November	11.22	0.07	1.84	1.03	- 0.82
December	8.61	0.07	1.97	2.61	0.65
Year total			*52.97*	*40.43*	*-12.66*

*Inches x 2.54 = cm.

† Since rainfall records began in July 1942, means for January to June are 77-year means.
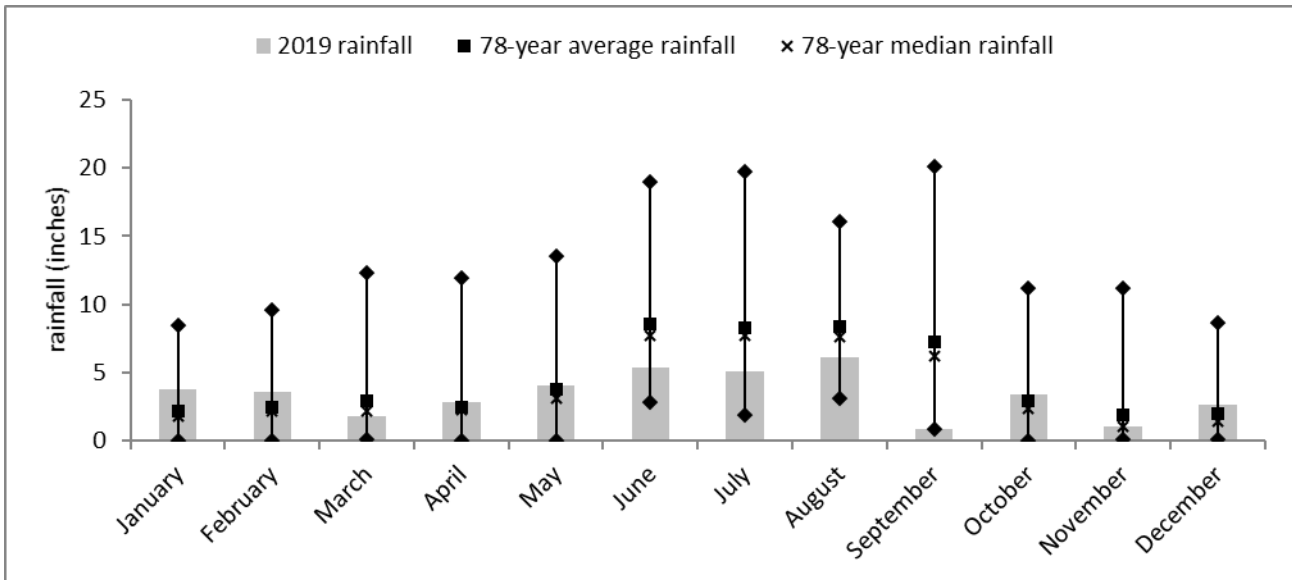
Figure 1. Monthly rainfall at the Range Cattle REC during 2019 relative to historical average, median, minimum, and maximum monthly rainfall. Current rainfall is indicated by the gray bars, historical average and median rainfall are indicated by squares (■) and "X's" (x), respectively. Historical high and low rainfall are indicated by diamonds (♦).

Evapotranspiration

Evapotranspiration is the total amount of water transferred from the earth to the atmosphere. Monthly evaporation in 2019 was 2.37 inches greater than the 14-year average (Table 3). Evapotranspiration exceeded rainfall in March through May and September through November in 2019 (Figure 2). It is quite normal for evapotranspiration to exceed rainfall in January, February, and December, but above average rainfall prevented this occurrence. Evapotranspiration exceeded rainfall by 4.46 inches in 2019, which is likely due to the below normal rainfall recorded from June through September.
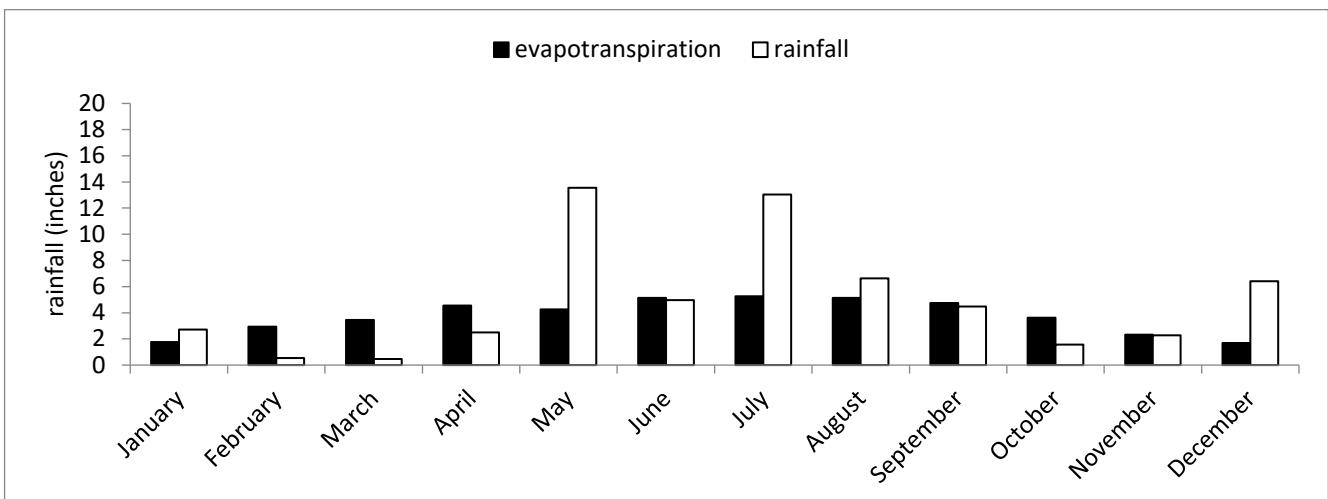
Figure 2. Comparison of monthly evapotranspiration and rainfall at the Range Cattle REC during 2019.

Solar Radiation

Total solar radiation for 2019 was 6761.25 MJ. Daily solar radiation is shown in Table 1, and 2019 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 2019 (722.28 MJ) to produce approximately 10,329 lb/A of plant dry matter.

Table 3. Monthly solar radiation and evapotranspiration at the Range Cattle REC in 2019.

Month	2006-2019	2019	2006-2019	2019
	Evapotranspiration		Solar radiation	
	--------inches--------		--------MJ/m^2--------	
January	1.88	1.82	414.25	437.83
February	2.48	2.79	456.54	425.76
March	3.39	3.53	644.28	608.31
April	4.38	4.48	710.69	722.28
May	5.23	5.57	769.59	783.02
June	4.92	5.10	662.92	647.77
July	4.91	4.87	648.24	652.91
August	4.58	4.55	587.26	563.88
September	3.98	4.61	533.45	636.24
October	3.20	3.66	502.01	527.02
November	2.01	2.16	399.48	418.63
December	1.56	1.75	370.65	337.59
Total	*42.52*	*44.89*	*6699.40*	*6761.25*

Temperature

  The highest temperature observed during 2019 was 97.68 °F on 25 June (Table 1). Monthly average-high temperatures exceeded the 76-year average in all months except January, March, and August (Table 4). Monthly average low temperatures were above the 76-year average in all months except January and September (Table 5). Daily average low temperatures did not fall to 32 °F, and the lowest temperature of 36.72 °F was recorded on 21 January (Table 1). Scattered frost begins to occur when air temperature drops to 35 °F; minimal frost, if any, occurred in 2019. Overall, mean low temperature for 2019 was 2.4 degrees greater than the 76-year mean.

Table 4. Summary of maximum temperature* during 2019 by month, Range Cattle REC.

Month	Shelter†					Ground level‡	
	1944-2019 Avg. high	2019 Avg. high	1944-2019 Extreme high	Year	2019 Extreme high	2019 Avg. high	Extreme high
	-------------------------------°F-------------------------------					----------°F----------	
January	73.2	72.6	90.0	1982	85.5	65.8	72.9
February	75.3	81.8	91.0	1962	89.5	71.2	75.9
March	79.1	79.1	94.0	1946	88.0	72.7	75.6
April	83.6	84.9	97.0	1945	91.1	77.9	81.3
May	88.1	90.4	103.0	1945	97.4	83.8	90.7
June	90.1	91.5	103.0	1945	97.7	85.8	89.9
July	90.9	92.1	101.0	1972	96.1	85.9	89.4
August	91.1	90.4	98.0	several	94.5	85.6	88.2
September	89.6	90.9	96.2	several	95.5	85.4	88.5
October	85.1	89.2	96.5	2015	91.5	82.5	84.5
November	79.3	80.0	94.0	1990	90.1	74.8	81.2
December	74.6	76.7	89.0	1945	87.0	70.5	74.7
Average	*83.3*	*85.0*				*78.5*	

*°C = (°F − 32) x 0.555

† Prior to 2006, 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 2019 by month, Range Cattle REC.

| Month	Shelter†					Ground level‡	
	1944-2019	2019	1944-2019		2019	2019	
	Avg.	Avg.	Extreme		Extreme	Avg.	Extreme
	low	low	low	Year	low	low	low
	---------------------------------ºF---------------------------------					----------ºF----------	
January	49.1	49.6	18.0	1981	36.7	60.7	54.3
February	50.8	59.2	23.8	2009	42.6	65.6	59.3
March	54.2	56.0	26.0	1980	39.9	66.7	60.4
April	58.1	59.9	34.0	1971	51.4	70.7	66.8
May	63.4	66.8	43.0	1945	60.3	76.4	73.5
June	69.1	70.9	52.0	1984	67.6	79.6	77.2
July	71.3	71.8	62.0	several	69.3	80.0	78.2
August	72.0	73.9	61.0	1977	71.5	80.3	77.9
September	71.2	71.0	51.0	1962	62.8	79.4	76.1
October	64.9	70.0	37.5	2008	64.2	77.5	75.3
November	56.9	57.1	25.0	1970	42.9	69.5	62.3
December	51.7	56.2	20.0	1962	38.6	65.3	58.4
Average	*61.1*	*63.5*				*72.6*	

[*]ºC = (ºF − 32) x 0.555

† Prior to 2006, 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 3. The spring freeze hazard estimates the likelihood of temperatures reaching below the critical temperature <u>after</u> a selected date, while the fall freeze hazard estimates the likelihood of experiencing the <u>first</u> attainment of a critical temperature <u>before</u> a selected date. Based on records from 1964 to 2017, 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 30% chance of a frost (assuming 35 ºF) occurring before the 1st of March (Figure 4C). A grower has a significant likelihood of experiencing three frosts over ten years after the 1st of March; however, the likelihood drops to approximately 10% by March 20th.
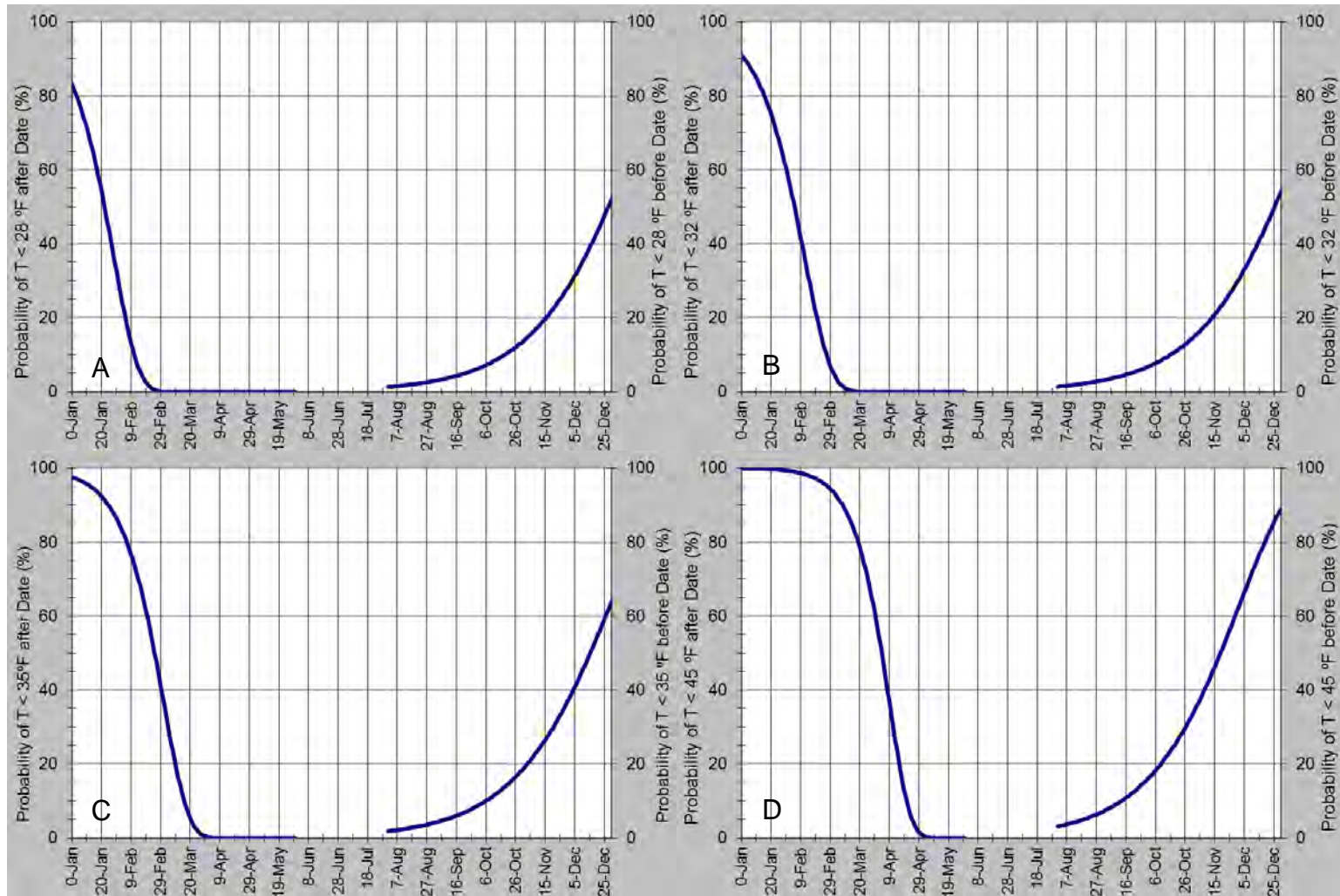
Figure 3. Spring and fall freeze hazard showing temperature probabilities after a given spring date and before a given fall date. Trend lines for temperature probabilities <28 °F (A), <32 °F (B), <35 °F (C), and <45 °F (D). Graphs were constructed using minimum temperature data from 1960 – 2010 using FRISKNH as developed by R. Snyder and J. Paulo de Melo-Abreu.