

Range Cattle Research and Education Center

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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 seed germination, forage growth, palatability, and nutritive value.

This research report presents a summary of rainfall, air temperature, evapo-transpiration, and solar radiation for 2010 obtained at the Range Cattle Research and Education Center (REC), Ona, Florida, and is compared to a 69-year summary of rainfall data and a 68-year summary of temperature data collected from this location. 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.

Rainfall

Annual rainfall for 2010 totaled 49.15 inches (Table 1), which was 4.41 inches (8.2%) less than the 69-year average of 53.56 inches (Table 1). The lowest annual total was observed in 2000 when 32.02 inches were measured, and the greatest annual rainfall total on record was in 1959 when 78.82 inches were recorded.

Characterized by a particularly wet spring, 2010 monthly rainfall totals exceeded the 69-year average for March, April, May, August, and November (Figure 1; Table 1). Rainfall deficits exceeding two inches were recorded in June, July, September, and

October. Above normal spring rainfall provided some growth of forages for hay, resulting in a fairly good hay crop.

Daily rainfall equaled or exceeded 1 inch on 20 separate occasions in 2010. Four of these rain events exceeded 2 inches (Table 2). The single greatest daily rain event was 1 August when 3.20 inches were recorded.

Table 1. Summary of rainfall by months. Range Cattle REC, 2010.

Month	1942 to 2010		69-year average†	2010	Difference from 69-year average
	Maximum / month	Minimum / month		Total	
	-----inches-----				
January	8.45	0.03	2.12	2.02	-0.10
February	9.59	0.02	2.58	2.48	-0.10
March	12.34	0.13	3.12	5.94	2.82
April	11.91	0.00	2.48	2.88	0.40
May	10.58	0.00	3.80	6.28	2.48
June	18.99	2.79	8.62	4.65	-3.97
July	19.74	1.87	8.32	5.74	-2.58
August	16.10	3.13	8.39	11.95	3.56
September	20.11	1.14	7.23	3.60	-3.63
October	11.23	0.00	2.97	0.00	-2.97
November	11.22	0.07	1.91	2.77	0.86
December	8.61	0.16	2.02	0.84	-1.18
Year total			53.56	49.15	-4.41

*Inches x 2.54 = cm.

† Since rainfall records began in July 1942, means for January to June are 68-year means.

Evapo-transpiration

Evapo-transpiration is the total amount of water transferred from the earth to the atmosphere. Evapo-transpiration exceeded rainfall in April, June, September, October, and December during 2010 (Figure 2). Evapo-transpiration generally exceeds rainfall in January to May and October to December, which are months with limited rainfall. Rainfall exceeded evapo-transpiration by 5.82 inches for the entire year.

Table 2. Daily maximum and minimum temperature, precipitation, and solar radiation for 2010, Range Cattle REC.

Day	January				February				March				April			
	Max °F	Min °F	Rain inches	MJ/ m ²	Max °F	Min °F	Rain inches	MJ/ m ²	Max °F	Min °F	Rain inches	MJ/ m ²	Max °F	Min °F	Rain inches	MJ/ m ²
1	66.4	47.25	0.99	2.742	64.98	51.57	0.05	2.957	72.48	36.41	0.00	25.81	82.38	49.60	0.00	27.80
2	59.2	38.64	0.00	11.45	69.73	54.18	0.06	3.552	73.31	43.85	0.12	11.79	83.05	54.32	0.00	28.34
3	45.99	36.58	0.00	5.402	65.28	52.23	0.00	13.79	57.22	39.19	0.00	16.09	85.21	54.07	0.00	25.21
4	54.81	31.60	0.00	11.10	77.47	50.13	0.00	16.86	58.15	35.29	0.00	26.70	54.25	55.96	0.00	28.19
5	49.37	29.46	0.00	10.58	78.64	61.21	1.03	5.418	63.63	32.65	0.00	26.71	83.61	56.77	0.00	28.58
6	52.27	28.12	0.00	11.14	67.53	55.04	0.00	15.43	67.35	34.80	0.00	27.37	82.89	56.64	0.00	28.38
7	62.11	26.79	0.00	11.44	59.14	41.03	0.00	16.72	71.58	33.72	0.00	27.75	84.42	54.52	0.00	27.05
8	68.9	35.36	0.00	6.755	64.83	37.09	0.00	16.56	74.23	38.38	0.00	2.540	83.75	61.12	0.00	20.06
9	46.67	30.27	0.31	2.173	72.79	49.73	0.06	6.668	74.11	45.63	0.00	1.439	78.64	67.98	0.01	16.69
10	46.31	28.51	0.00	10.59	59.02	42.17	0.00	23.04	80.28	49.86	0.00	20.57	82.35	58.93	0.00	25.83
11	54.07	25.15	0.00	11.36	59.86	36.98	0.00	19.79	80.94	63.36	0.03	7.680	80.87	63.23	0.00	15.36
12	62.6	24.57	0.04	11.46	59.65	47.07	1.02	2.462	66.58	61.57	2.46	2.091	81.95	61.27	0.00	24.53
13	63.27	29.84	0.00	18.54	54.03	63.72	0.00	14.27	71.08	54.09	0.00	26.34	84.16	60.96	0.00	26.89
14	71.82	38.56	0.00	17.59	57.16	33.58	0.00	16.11	71.10	51.87	0.00	23.58	81.54	60.46	0.00	29.16
15	77	49.10	0.00	14.56	71.64	34.28	0.00	21.15	72.72	49.15	0.00	24.93	81.07	59.95	0.00	20.76
16	79.38	62.17	0.13	7.882	58.60	40.41	0.00	23.66	70.21	49.10	0.00	22.75	80.62	60.35	0.00	25.77
17	76.24	56.05	0.0	13.66	59.47	37.00	0.00	22.07	69.28	53.94	0.00	17.21	78.51	60.51	0.00	13.98
18	70.14	48.79	0.00	17.03	60.80	35.92	0.00	24.27	66.38	46.33	0.00	25.93	73.11	63.10	0.34	5.849
19	71.69	46.44	0.00	18.31	63.53	38.52	0.00	15.58	72.93	45.23	0.00	24.48	81.93	62.31	0.49	23.23
20	75.47	45.01	0.00	15.71	71.35	48.63	0.00	15.68	77.34	47.30	0.00	27.82	82.35	61.36	0.01	22.74
21	81.95	57.20	0.00	12.34	77.59	48.61	0.00	17.56	72.57	56.05	1.04	3.352	81.09	71.51	0.00	22.67
22	77.95	63.97	0.03	8.196	79.45	59.76	0.00	11.99	70.30	55.33	0.01	21.14	84.36	55.02	0.00	28.79
23	78.62	56.91	0.00	12.66	79.79	59.95	0.00	11.90	70.09	50.23	0.00	28.47	85.77	56.07	0.00	28.33
24	83.40	65.55	0.00	9.426	71.85	52.02	0.04	7.592	78.12	43.94	0.00	25.70	88.34	63.16	0.00	27.60
25	75.58	46.49	0.51	16.20	59.38	35.46	0.00	25.58	79.59	54.61	0.42	20.45	83.82	68.43	0.00	14.72
26	69.75	42.88	0.00	20.43	65.16	31.89	0.00	26.22	78.21	55.00	0.09	17.71	82.42	62.20	2.02	28.02
27	69.12	39.55	0.00	21.07	55.76	35.57	0.22	7.778	83.12	50.07	0.00	27.08	82.20	58.55	0.00	29.38
28	74.52	44.29	0.00	20.33	64.87	37.55	0.00	25.42	77.14	63.84	0.43	6.184	77.50	55.54	0.00	27.34
29	77.05	50.70	0.00	13.47					70.79	54.10	1.32	19.03	83.82	52.72	0.00	29.53
30	77.47	57.70	0.01	8.271					72.27	47.88	0.00	28.93	78.01	73.02	0.01	17.83
31	62.11	51.15	0.00	8.490					76.33	45.05	0.02	28.42				
Avg	67.14	43.05	0.065	12.29	66.05	45.40	0.089	15.36	72.24	47.99	0.19	19.87	82.36	59.82	0.096	23.95
Max	83.40	65.55	0.99	21.07	79.79	63.72	1.03	26.22	83.12	63.84	2.46	28.93	88.34	71.51	2.02	29.53
Min	45.99	24.57	0.00	2.173	54.03	31.89	0.00	2.462	57.22	32.65	0.00	1.439	73.11	49.6	0.00	5.849
Total			2.02	380.9			2.48	430.1			5.94	616.0			2.88	718.6

Table 2. Continued.

Day	May				June				July				August			
	Max °F	Min °F	Rain inches	MJ/m ²	Max °F	Min °F	Rain inches	MJ/m ²	Max °F	Min °F	Rain inches	MJ/m ²	Max °F	Min °F	Rain inches	MJ/m ²
1	91.15	70.50	0.00	21.97	89.04	69.10	0.01	24.02	91.49	73.49	0.81	15.88	95.43	73.60	3.20	22.94
2	91.40	72.97	0.00	26.50	90.93	71.11	0.27	25.30	84.45	73.42	0.00	18.20	96.17	74.32	0.02	25.83
3	90.07	72.93	0.00	27.09	86.00	71.17	0.25	17.59	86.18	73.27	0.42	11.93	94.55	74.80	1.46	24.44
4	86.90	72.14	0.00	27.64	89.47	72.28	0.00	24.22	83.55	73.02	0.50	8.027	91.94	75.16	0.02	18.78
5	87.22	72.25	0.00	20.87	91.83	73.72	0.05	23.52	82.62	72.63	0.24	8.637	92.84	73.60	0.88	22.56
6	88.21	68.94	0.00	26.95	90.82	74.66	0.00	20.99	88.79	71.96	0.05	14.87	93.09	74.64	1.17	25.20
7	91.56	68.43	1.06	24.61	90.86	75.99	0.07	24.16	91.17	72.77	0.01	25.50	91.17	76.66	0.00	18.41
8	87.31	68.72	0.01	26.57	90.77	73.72	0.00	24.96	91.56	71.17	0.00	28.96	87.66	77.14	1.10	5.058
9	88.12	68.81	0.00	24.37	88.68	69.48	0.01	26.53	94.50	70.18	0.00	28.65	90.19	74.71	0.02	18.94
10	84.29	66.11	0.00	26.69	90.12	68.04	0.00	29.38	93.29	73.58	0.00	27.48	87.13	75.00	0.53	14.36
11	86.23	65.23	0.00	23.51	94.59	71.02	0.00	29.89	90.16	71.29	0.00	20.77	88.41	74.97	0.17	16.56
12	85.01	64.83	0.00	27.11	93.02	71.71	0.00	27.25	89.53	75.43	0.07	16.09	92.79	74.95	0.00	23.78
13	85.12	65.21	0.00	27.02	92.25	72.99	0.00	20.87	93.74	74.10	0.00	24.61	93.79	76.28	0.00	25.57
14	86.14	66.09	0.00	25.58	91.58	72.66	0.04	18.69	94.68	75.92	0.31	19.32	94.80	75.87	0.00	25.00
15	87.08	67.33	0.00	25.54	96.33	73.96	0.04	21.26	92.61	72.79	0.01	15.36	94.35	77.02	0.00	23.40
16	85.39	67.82	0.00	19.35	95.70	74.39	0.00	24.60	91.26	72.68	0.00	25.16	93.74	76.42	0.00	16.15
17	83.30	68.49	3.06	18.66	92.82	72.64	0.04	14.98	92.86	75.02	0.00	27.49	95.05	74.97	0.00	25.95
18	87.04	68.70	0.00	24.10	92.03	71.11	1.24	16.37	93.24	72.81	0.00	25.95	94.23	75.47	0.00	25.25
19	83.66	68.11	0.00	16.63	92.79	69.98	0.03	27.88	93.96	76.55	0.01	25.07	95.41	75.63	0.00	23.98
20	89.42	67.06	0.00	28.42	90.45	71.89	0.26	23.40	94.44	75.16	0.00	23.94	95.92	74.43	0.00	22.17
21	88.74	70.38	0.00	25.97	92.55	71.67	0.60	21.13	94.26	75.04	0.00	27.07	92.95	74.52	0.02	17.64
22	88.02	68.20	0.00	26.28	92.46	72.66	0.00	24.31	93.81	73.67	0.00	25.90	91.02	76.23	0.31	19.53
23	89.40	67.66	0.00	29.76	93.04	73.90	0.00	27.65	86.25	76.68	1.13	7.318	83.62	75.61	0.62	10.41
24	89.47	66.56	0.00	27.34	92.66	73.71	0.02	28.30	93.22	76.55	0.70	18.69	87.37	73.90	0.36	5.56
25	27.35	69.08	0.22	23.39	94.57	73.76	0.00	26.81	92.98	75.61	0.21	23.38	89.08	73.72	0.52	7.47
26	87.01	66.07	0.00	29.31	94.41	74.97	0.02	23.46	92.95	74.26	0.00	24.71	91.09	73.44	0.00	18.49
27	86.31	66.38	0.00	4.49	94.64	73.67	0.15	23.49	95.72	76.32	0.00	25.31	91.27	72.86	1.54	19.26
28	87.91	67.55	0.49	26.09	93.47	74.05	0.30	22.92	97.14	74.21	1.27	25.98	92.19	72.73	0.01	19.05
29	86.43	68.14	0.00	24.27	92.34	75.06	0.01	23.87	94.19	73.72	0.00	23.62	90.77	76.23	0.00	20.96
30	90.30	69.91	0.36	23.98	90.59	73.51	1.24	12.71	94.23	74.70	0.00	26.09	90.46	74.34	0.00	18.63
31	91.08	69.37	1.08	28.02					95.18	76.19	0.00	25.21	91.36	73.85	0.00	23.07
<u>Avg</u>	87.63	68.39	0.203	25.10	92.03	72.62	0.156	23.35	91.74	74.01	0.185	21.46	91.9	74.94	0.39	19.50
<u>Max</u>	91.56	72.97	3.060	29.76	96.33	75.99	1.24	29.89	97.14	76.68	1.27	28.96	96.17	77.14	3.20	25.95
<u>Min</u>	83.30	64.83	0.00	16.63	86.00	68.04	0.00	12.71	82.62	70.18	0.00	7.317	83.62	72.73	0.00	5.06
<u>Total</u>			6.28	778.1			4.65	700.5			5.74	665.2			11.95	604.4

Table 2. Continued.

Day	September				October				November				December			
	Max °F	Min °F	Rain inches	MJ/ m ²	Max °F	Min °F	Rain inches	MJ/ m ²	Max °F	Min °F	Rain inches	MJ/ m ²	Max °F	Min °F	Rain inches	MJ/ m ²
1	91.44	70.38	0.00	25.21	88.11	63.61	0.00	19.35	87.48	61.66	0.00	12.84	68.99	45.01	0.01	14.34
2	91.44	69.31	0.00	20.88	88.27	65.97	0.00	21.49	77.65	70.56	0.14	4.600	65.07	38.93	0.00	18.57
3	92.17	68.95	0.00	24.66	85.84	64.00	0.00	22.47	87.04	64.72	0.38	15.48	67.80	35.14	0.00	18.66
4	90.73	72.48	0.00	22.91	83.26	59.04	0.00	23.62	74.82	65.70	1.65	6.085	71.87	33.98	0.00	18.04
5	90.16	72.48	0.00	15.74	84.94	57.56	0.00	22.38	66.96	46.33	0.01	19.07	74.98	49.69	0.01	13.65
6	91.51	72.88	0.65	16.67	82.08	59.70	0.00	23.51	64.60	44.14	0.00	21.56	54.63	33.70	0.00	18.48
7	91.17	73.45	0.21	19.43	82.27	54.39	0.00	23.74	70.05	43.53	0.00	20.54	55.17	28.51	0.00	18.88
8	89.98	74.07	0.53	18.28	85.46	55.31	0.00	23.91	74.44	46.24	0.00	20.17	60.78	29.89	0.03	17.99
9	93.09	74.28	0.00	22.63	86.95	56.57	0.00	22.77	79.16	43.86	0.00	20.07	62.80	42.66	0.12	13.47
10	94.05	74.88	0.06	21.55	87.33	58.39	0.00	19.79	82.17	45.32	0.00	34.10	71.01	37.86	0.00	17.68
11	94.08	74.48	0.05	22.76	87.13	58.75	0.00	22.75	81.12	50.23	0.00	18.43	66.38	43.14	0.00	11.60
12	94.86	75.22	0.04	20.34	88.05	62.82	0.00	28.24	80.24	57.79	0.00	18.09	74.35	41.27	0.02	9.756
13	92.30	74.95	0.00	21.47	87.37	65.17	0.00	20.23	78.44	53.10	0.00	18.45	54.30	36.33	0.00	12.12
14	91.09	72.00	0.00	21.25	86.25	62.96	0.00	14.40	78.53	52.21	0.00	18.23	51.82	27.57	0.00	18.97
15	91.65	69.29	0.00	23.30	83.48	52.83	0.00	22.84	81.34	51.44	0.00	18.35	59.14	27.13	0.00	18.36
16	91.62	71.55	0.00	21.23	81.18	50.94	0.00	23.24	82.54	58.15	0.00	15.61	70.70	30.45	0.00	17.85
17	90.55	72.19	0.00	22.15	83.97	53.40	0.00	28.74	83.75	65.43	0.00	10.84	78.21	51.37	0.00	17.51
18	91.29	70.11	0.00	24.19	83.21	55.44	0.00	22.42	80.85	52.65	0.00	12.66	69.04	47.14	0.63	4.968
19	89.67	69.76	0.02	18.31	83.73	60.42	0.00	12.53	79.05	48.49	0.00	17.06	62.65	50.43	0.01	3.468
20	91.27	68.77	0.00	23.48	85.06	62.38	0.00	14.00	78.19	55.09	0.00	13.10	64.94	38.69	0.00	17.79
21	90.07	69.24	0.00	20.12	85.57	57.20	0.00	19.82	81.23	57.79	0.00	14.26	73.22	38.18	0.00	16.95
22	90.36	71.31	0.01	17.55	85.86	59.56	0.00	18.82	83.66	60.53	0.02	14.24	75.02	42.28	0.00	15.23
23	91.67	73.35	0.66	18.44	87.31	62.13	0.00	20.54	83.50	58.37	0.00	16.96	69.96	44.73	0.00	17.27
24	90.72	74.26	0.00	17.29	89.26	67.03	0.00	20.01	82.72	53.94	0.00	17.17	70.43	39.19	0.00	17.67
25	89.92	74.17	0.00	16.38	90.46	69.71	0.00	18.11	84.72	57.38	0.00	15.33	73.31	43.31	0.00	15.95
26	91.63	71.37	0.28	19.51	91.96	69.98	0.00	19.24	81.61	65.66	0.04	8.455	65.19	41.07	0.01	13.22
27	91.78	70.95	0.01	21.33	91.24	70.16	0.00	16.73	74.12	62.40	0.53	5.009	52.43	29.41	0.00	18.63
28	85.98	73.04	1.08	5.955	92.16	67.24	0.00	18.81	79.61	54.28	0.00	13.39	58.87	25.64	0.00	18.88
29	86.67	71.76	0.00	17.41	84.43	63.50	0.00	16.77	84.54	64.35	0.00	13.58	68.41	26.81	0.00	17.82
30	87.55	65.01	0.00	20.04	86.58	60.48	0.00	19.45	85.06	65.61	0.00	13.83	72.25	40.00	0.00	7.218
31					87.78	57.49	0.00	19.83					79.18	57.61	0.00	13.43
<u>Avg</u>	91.02	71.86	0.12	20.01	86.44	60.78	0.00	20.66	79.64	55.90	0.923	15.59	66.55	38.62	0.027	15.30
<u>Max</u>	94.86	75.22	1.08	25.21	92.16	70.16	0.00	28.74	87.48	70.56	1.65	34.10	79.18	57.61	0.63	18.97
<u>Min</u>	85.98	65.01	0.00	5.95	82.08	50.94	0.00	15.53	64.60	43.53	0.00	4.600	51.82	25.64	0.00	3.468
<u>Total</u>			3.60	600.4			0.00	640.5			2.77	467.6			0.84	474.4

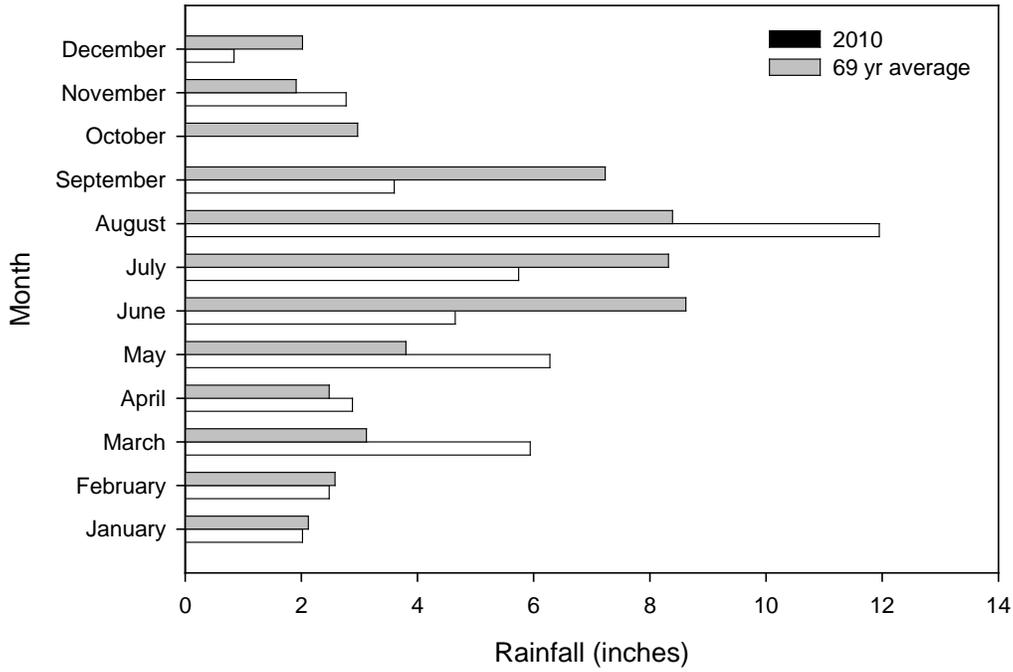


Figure 1. Monthly rainfall in 2010 compared with the 69-year average.

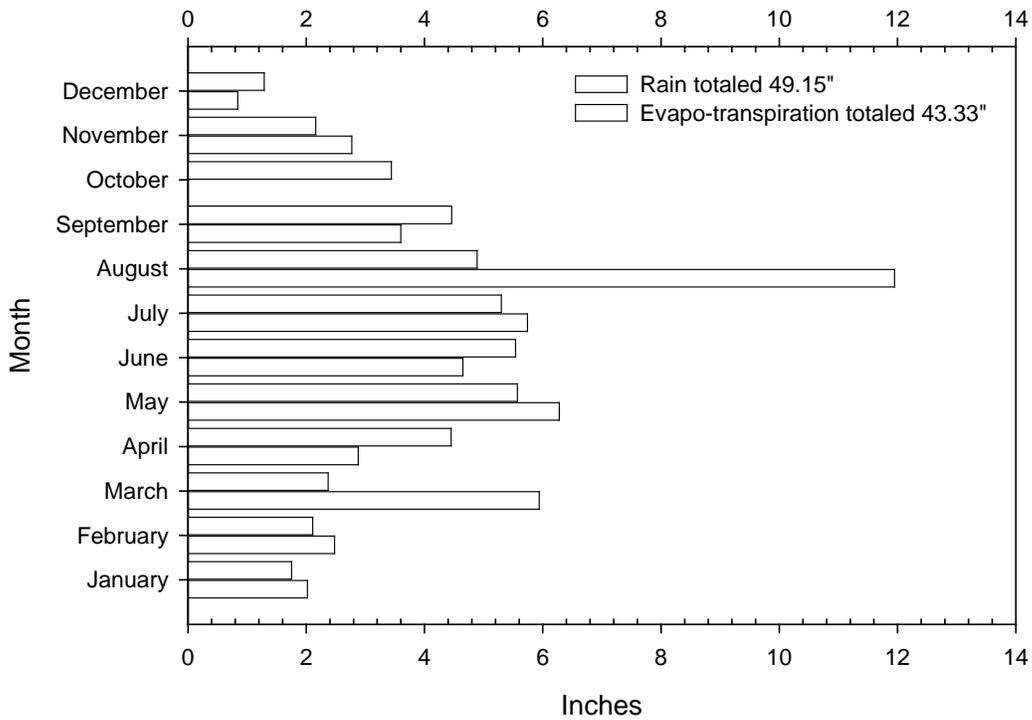


Figure 2. Monthly rainfall compared with evapo-transpiration during 2010. Cumulative rainfall = 49.15" and cumulative evapo-transpiration = 43.33".

Solar Radiation:

Daily solar radiation is shown in Table 2, and 2010 total monthly solar radiation can be seen in Figure 3. For interpretation of solar radiation as it pertains to plant growth, 1 MJ results in about 14.3 lb/A of plant dry matter if soil water, temperature, and fertility are not limiting and vegetative cover is complete. Theoretically, enough solar radiation was received in April 2010 (718.6 MJ) to produce 10,276 lb/A of plant dry matter. Total solar radiation for 2010 was 7,077 MJ.

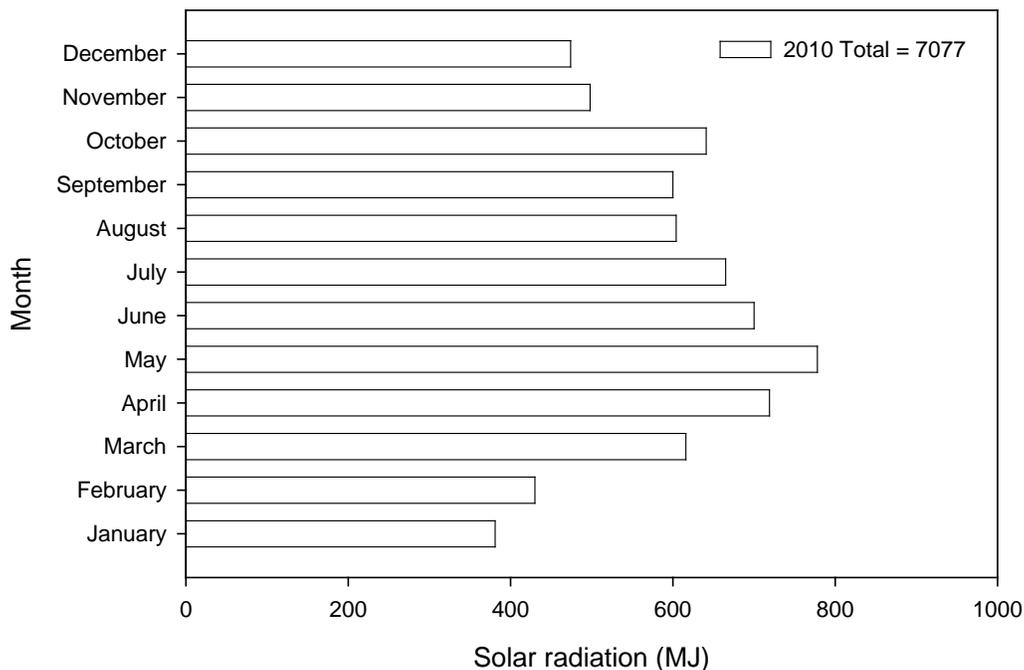


Figure 3. Total monthly solar radiation for 2010. Cumulative solar radiation in 2010 = 7,077 MJ (MJ = Joules x 1,000,000)

Temperature

Daily-low shelter temperatures at or below 32 °F were observed on eighteen days (Table 2). The extreme low temperature for 2010 occurred on 12 January when shelter temperature reached 24.6 °F. Scattered frost begins when air temperature drops to 35 °F. Air temperatures at or below 35°F were observed on 25 days in 2010, resulting in widespread or scattered frost across the landscape (data not shown). Mean low temperatures were lower than the 68-year means in January, February, March, October, November, and December in 2010 (Table 3). Overall, mean low temperature for 2009 was 15.1 °F lower than the 67-year mean.

Table 3. Summary of minimum temperature* for 2010 by month, Range Cattle REC.

Month	Shelter†				Ground level‡		
	1944-10 Avg. low	2010 Avg. low	1944-10 Extreme low	Year	2010 Extreme low	2010 Avg. low Extreme low	
	-----°F-----					-----°F-----	
January	49.2	43.1	18	1981	25	56	46
February	50.4	45.4	24	2009	32	57	52
March	54.3	48.0	26	1980	33	60	52
April	57.9	59.8	34	1971	50	69	62
May	63.3	68.4	43	1945	65	77	74
June	70.0	72.6	52	1984	68	81	78
July	71.2	74.0	62	several	70	81	78
August	71.9	74.9	61	1977	73	82	80
September	71.1	71.9	51	1962	65	81	78
October	64.7	60.8	38	2008	51	75	71
November	56.8	55.9	25	1970	44	67	62
December	51.1	39.3	20	1962	26	56	50
Average	61.0	45.8				70	65

*°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 1960 to 2010, 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 survival of a frost-susceptible crop (assuming 32 °F) planted before the 1st of February (Figure 4-B). A grower has a significant likelihood of experiencing five crop frosts over ten years by planting before the 1st of February.

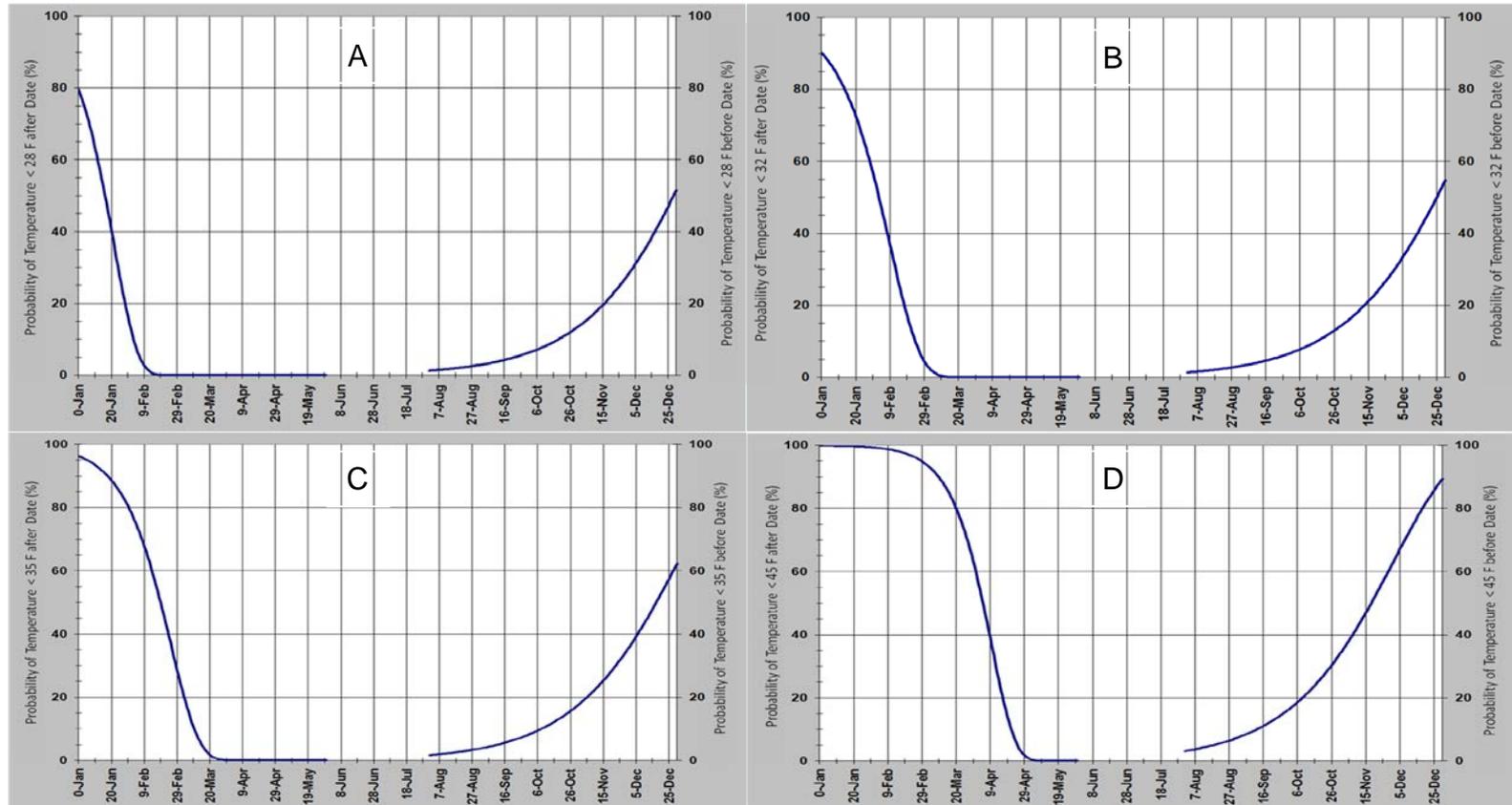


Figure 4. Spring and fall freeze hazard showing temperature probabilities after the spring date and before the fall date. Trend lines for temperature probabilities <math>< 28^{\circ}\text{F}</math> (A), <math>< 32^{\circ}\text{F}</math> (B), <math>< 35^{\circ}\text{F}</math> (C), and <math>< 45^{\circ}\text{F}</math> (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>

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