Range Cattle Research and Education Center February 2008

Research Report RC-2008-1

CLIMATOLOGICAL REPORT 2007
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 to 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 2007 obtained at the Range Cattle Research and Education Center (REC) Ona, Florida, and is compared to a 66-year summary of data collected from this location. The center is located 82^{o} 55' W and 27^{o} 26' 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 was checked by comparing with rainfall measured by a US Weather Service standard gauge. Measurements reported before 2006 were taken at 0900 h, thus data on a given day represent the previous 24-hour period. Beginning in 2006, measurements were recorded for an entire 24-h period beginning at midnight.

Rainfall

Annual rainfall for 2007 was 41.66 inches (Table 1), which was 12.14 inches (22.6%) less than the 66-year average of 53.80 inches (Table 1). The year with the least rainfall was 2000 when 32.02 inches were measured, and the year with the greatest rainfall was 1959 when 78.82 inches were recorded.

Monthly rainfall totals were below the 66-year average for all months except August and December (Figure 1; Table 1). March, April, and November were excessively dry compared to the 66-year mean. The dry weather, which lasted into June, prevented many common operations such as proper weed control timings and planting. Unless irrigation was provided, the spring hay harvest was marginal.

There were 12 occurrences during 2007 when daily rainfall equaled or exceeded 1 inch, three rain events that exceeded 2 inches, and two rain events that exceeded 3 inches (Table 2). The single greatest daily rain event was 13 September when 3.51 inches were recorded.

Table 1. Summary of rainfall by months. Range Cattle REC, 2007.

	1942 to 2007			2007	
Month	Maximum / month	Minimum / month	66-year average†	Total	Difference from 66-year average
	----------	----------	inches*	----------	----------
January	8.45	0.03	2.16	1.88	-0.28
February	9.59	0.02	2.63	2.47	-0.16
March	12.34	0.13	3.12	0.68	-2.44
April	11.91	0.00	2.48	1.93	-0.55
May	10.58	0.00	3.73	0.50	-1.57
June	18.99	2.79	8.69	8.60	-0.09
July	19.74	1.87	8.37	6.01	-2.36
August	16.10	3.13	8.25	8.36	+0.11
September	20.11	1.14	7.36	6.88	-0.48
October	11.25	0.04	3.07	2.15	-0.92
November	11.22	0.07	1.93	0.12	-1.81
December	8.61	0.16	2.01	2.08	+0.07
Year total			53.80	41.66	-12.14

*Inches x 2.54 = cm.

† Since rainfall records began in July 1942, means for January to June are 66-year means.

Table 2. Daily maximum and minimum temperature, precipitation, and solar radiation for 2007, Range Cattle REC.

	January				February				March				April			
Day	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	73	64	0.5	3.67	81	54	0	12.56	87	62	0	14.83	87	53	0	26.12
2	73	60	0	7.88	74	62	0.12	2.71	86	69	0	16.55	88	54	0	24.30
3	84	63	0	12.79	63	53	0.72	3.33	75	56	0	11.69	88	53	0	23.81
4	80	64	0	9.67	63	50	0.15	6.27	77	49	0	18.62	87	56	0	20.87
5	83	63	0	8.64	59	49	0.19	3.87	70	39	0	25.52	86	58	0	16.60
6	86	65	0	14.28	70	46	0	18.72	74	35	0	25.48	76	47	0.05	28.45
7	83	60	0	9.75	77	40	0	19.98	79	42	0	21.35	70	41	0	28.59
8	83	54	0	10.48	76	44	0	19.52	82	46	0	24.19	75	38	0	28.19
9	67	41	0.01	15.40	78	41	0	19.79	85	51	0	21.63	79	50	0.25	14.71
10	67	42	0	15.71	76	41	0	19.85	85	56	0	19.41	69	57	1.27	3.80
11	76	46	0	13.96	73	46	0	15.35	84	49	0	24.34	88	58	0.16	26.34
12	79	52	0	13.78	67	59	0.48	3.84	84	55	0	18.83	87	64	0.01	20.12
13	81	53	0	13.76	79	57	0.68	12.30	85	48	0	23.08	90	53	0	30.03
14	82	56	0	13.80	78	51	0	19.32	82	55	0	15.18	89	64	0	24.34
15	80	49	0	12.72	62	50	0	6.93	86	56	0	21.47	78	56	0.19	13.56
16	83	56	0	15.05	56	32	0	16.71	79	60	0.68	11.37	71	41	0	31.34
17	76	62	0	12.47	61	27	0	22.38	70	41	0	27.54	82	43	0	31.07
18	81	60	0	13.60	58	36	0.1	21.24	71	38	0	26.85	82	44	0	27.61
19	76	54	0	8.88	66	28	0	23.17	78	42	0	20.97	81	57	0	28.29
20	76	51	0	17.07	75	35	0	20.63	74	54	0	15.64	84	51	0	27.16
21	81	49	0	14.61	81	46	0	21.66	80	52	0	21.83	79	58	0	23.52
22	82	65	0	12.03	80	49	0	22.67	80	54	0	17.79	82	54	0	28.63
23	75	62	0.18	11.12	80	44	0.01	23.30	85	62	0	21.62	82	49	0	29.21
24	69	55	0	4.39	80	48	0	22.29	83	57	0	22.14	85	55	0	26.64
25	63	39	0.78	10.23	82	54	0	18.23	84	56	0	27.05	87	57	0	24.63
26	68	33	0.04	19.25	80	65	0.02	10.53	84	54	0	26.50	91	55	0	27.71
27	75	41	0	14.03	86	61	0	15.19	82	58	0	17.64	89	64	0	24.80
28	67	45	0.37	45.28	86	55	0	16.27	85	52	0	26.32	89	57	0	26.66
29	59	36	0	19.81					84	56	0	20.46	90	50	0	30.36
30	58	29	0	8.59					86	58	0	22.47	91	56	0	25.65
31	70	43	0	17.43					83	57	0	25.95				
Avg	75	52	0.06	13.55	73	47	0.09	15.66	81	52	0.02	21.11	83	53	0.06	24.77
Max	86	65	0.78	45.28	86	65	0.72	23.30	87	67	0.68	27.54	91	64	1.27	31.34
Min	58	29	0	3.67	56	27	0	2.71	70	35	0	11.37	69	38	0	3.80
Total			1.88				2.47	438.51			0.68	654.31			1.93	743.1

Table 2. Continued.

	May				June				July				August			
Day	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	88	51	0	27.16	78	66	1.3	5.66	91	69	0.02	13.38	87	72	0.13	12.74
2	92	53	0	27.13	83	68	0.7	19.89	92	68	0.09	15.35	82	72	1.83	10.61
3	94	56	0	30.30	87	68	0	26.59	91	67	1.02	19.14	94	69	0	28.17
4	95	58	0	29.36	87	68	0	25.81	98	70	1.4	8.94	95	70	0	29.28
5	91	66	0.34	19.43	90	65	0	26.64	88	71	0	18.80	94	70	0	26.88
6	91	61	0	23.92	86	68	0	9.65	91	72	0.08	17.06	94	73	0	24.65
7	78	51	0	30.12	91	68	1.28	22.49	93	72	0	23.86	95	72	0	24.71
8	82	51	0	28.42	88	66	0.37	17.07	92	71	0	22.54	96	73	0.46	22.57
9	86	56	0	29.87	92	63	0	28.15	95	71	0	25.80	95	72	0	25.69
10	89	60	0	21.46	95	69	0.05	24.14	94	72	1.64	22.86	97	73	0	27.37
11	90	59	0	25.37	93	71	0	19.85	95	74	0	25.29	97	72	0.56	24.65
12	91	63	0	19.05	93	69	0.1	29.42	94	72	0	28.29	95	71	0	24.05
13	93	65	0	24.79	87	65	0.03	16.63	92	74	0	25.22	94	72	0	25.37
14	89	64	0.02	15.13	88	62	0	26.00	93	71	0	29.30	93	73	0.02	20.55
15	86	65	0	23.61	91	65	0	24.03	96	69	0.23	26.10	92	73	0.02	18.64
16	91	64	0	20.53	93	66	0	27.26	93	70	0.05	24.84	92	71	0.22	21.72
17	89	60	0.14	21.16	91	67	0	25.38	95	72	0	28.77	92	70	0	25.27
18	88	60	0	20.81	86	70	0.37	12.92	97	73	0	28.83	90	69	0	24.54
19	86	63	0	23.03	92	68	0	23.25	95	72	0.02	15.40	94	71	0	25.55
20	87	59	0	25.42	92	68	0	24.11	95	69	0	27.34	94	75	0	24.73
21	87	53	0	31.32	87	70	0.37	20.17	93	70	0.48	13.92	94	73	0	24.96
22	89	60	0	27.29	91	67	0	26.99	90	68	0	25.10	94	69	0	26.19
23	88	63	0	27.57	90	62	0	25.90	87	72	0.29	15.05	92	69	0	23.08
24	87	61	0	26.79	93	64	0	26.76	89	69	0.03	13.99	94	71	0.07	14.17
25	88	62	0	28.34	96	65	0	29.00	94	69	0	26.09	95	69	2.78	23.39
26	87	60	0	24.62	91	66	0	25.01	95	73	0	27.82	93	69	0.95	22.06
27	89	59	0	23.78	88	71	0.54	20.06	94	69	0	22.31	94	75	0.12	25.61
28	91	60	0	25.17	88	69	0.01	16.44	92	67	0	20.78	94	72	0	25.69
29	89	61	0	25.24	89	70	0	21.80	88	71	0.39	19.16	94	72	0	26.43
30	88	62	0	23.71	94	70	3.48	16.39	90	71	0.14	20.38	93	71	0	24.49
31	88	62	0	19.60					87	72	0.13	10.51	92	72	1.2	13.37
Avg	98	66	0.02	24.82	90	67	0.29	22.12	93	71	0.19	21.36	93	72	0.27	23.13
Max	95	65	0.34	31.32	96	71	3.48	29.42	98	74	1.64	29.30	97	75	2.78	29.28
Min	78	51	0	15.13	78	62	0	5.66	87	67	0	8.94	82	69	0	10.61
Total			0.5	769.51			8.6	663.45			6.01	662.20			8.36	717.16

Table 2. Continued.

	September				October				November				December			
Day	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	72	0.21	18.84	86	67	0.01	20.53	85	72	0.027	12.66	83	59	0	14.01
2	93	72	0.04	19.28	87	70	0.84	12.93	84	61	0	19.33	86	59	0	16.20
3	92	70	0	20.12	91	70	0.01	16.85	78	52	0	19.54	83	56	0	15.45
4	93	72	0	26.21	92	74	0	19.23	80	46	0	19.38	72	42	0	17.06
5	93	72	0.07	22.84	90	74	0.22	13.54	79	44	0	20.30	74	38	0	16.26
6	91	69	0	22.26	89	75	0	17.50	80	51	0	15.30	82	49	0	15.73
7	91	70	0.05	23.96	88	74	0	15.59	74	50	0	14.10	85	51	0	12.66
8	92	71	0	20.97	88	72	0	18.69	76	46	0	18.35	85	61	0	14.32
9	90	71	0	24.47	90	71	0	20.31	75	46	0	9.58	84	59	0	14.15
10	87	70	0	12.23	91	69	0	20.47	77	41	0	19.15	84	60	0	11.10
11	92	71	0.02	19.18	91	69	0	20.94	79	49	0	17.57	84	60	0	13.72
12	96	70	0	22.17	88	67	0	20.23	80	53	0	11.35	84	59	0	12.64
13	95	69	3.51	21.71	87	66	0	19.03	79	57	0	3.15	88	57	0	15.04
14	94	69	0.71	24.99	86	64	0	20.50	81	56	0	14.02	80	65	1.7	5.52
15	94	72	0	23.18	88	65	0	18.55	82	51	0	17.58	85	69	0.01	9.79
16	94	73	0.74	21.80	90	66	0	17.36	65	40	0	5.55	75	48	0.19	12.21
17	92	73	0	23.58	91	67	0	16.46	76	41	0	17.84	59	38	0	17.14
18	89	70	0.01	23.62	89	70	0	14.12	80	47	0	14.70	73	38	0	12.28
19	86	72	0.17	17.27	90	69	0.1	16.83	79	51	0	14.65	79	48	0	11.40
20	86	69	0.25	12.32	79	73	0.27	6.42	81	54	0	15.29	77	50	0	11.49
21	91	72	0.08	24.97	88	72	0.12	11.96	82	54	0	14.5	75	50	0.183	15.57
22	87	71	0.42	11.67	90	74	0	15.64	83	59	0	11.25	73	46	0	10.07
23	89	72	0.59	10.78	89	71	0.06	17.48	75	56	0.06	9.85	80	57	0	12.42
24	89	71	0.01	20.28	79	68	0.05	6.51	81	50	0.02	15.07	82	54	0	9.62
25	89	71	0	21.73	75	64	0.07	7.60	85	61	0.01	14.04	82	56	0	9.28
26	85	70	0	16.15	84	65	0	13.02	85	62	0	13.28	73	53	0	6.25
27	90	68	0	21.66	83	71	0.08	7.38	86	62	0	12.45	85	54	0	13.07
28	92	71	0	22.28	83	70	0	10.71	84	64	0	9.37	85	61	0	14.01
29	88	71	0	19.44	84	69	0.12	12.88	86	63	0	12.56	84	59	0	9.68
30	86	68	0	23.13	80	70	0.19	9.89	80	62	0	7.96	84	63	0	12.17
31					83	71	0.01	12.32					83	65	0	6.89
Avg	91	71	0.23	20.44	87	70	0.07	15.21	80	53	0.00	14.01	80	60	0.07	12.49
Max	96	73	3.51	26.21	92	75	0.84	20.94	86	72	0.06	20.30	88	69	1.7	17.14
Min	85	68	0	10.78	75	64	0	6.42	65	40	0	3.15	59	38	0	5.52
Total			6.88	613.09			2.15	471.45			0.117	420.16			2.083	387.19

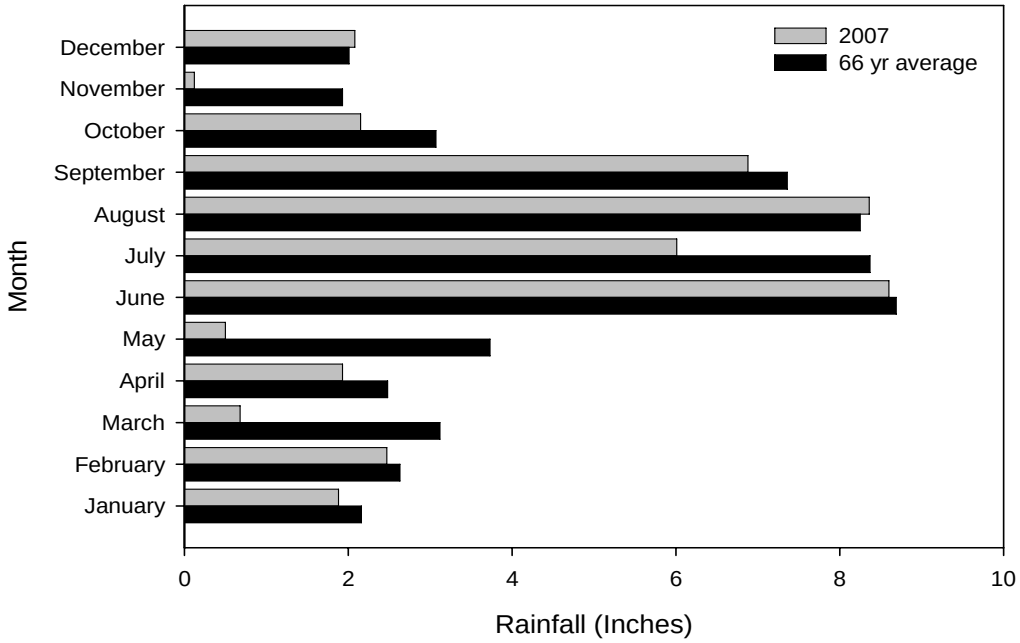

Figure 1. Monthly rainfall in 2007 compared with the 66-year average.

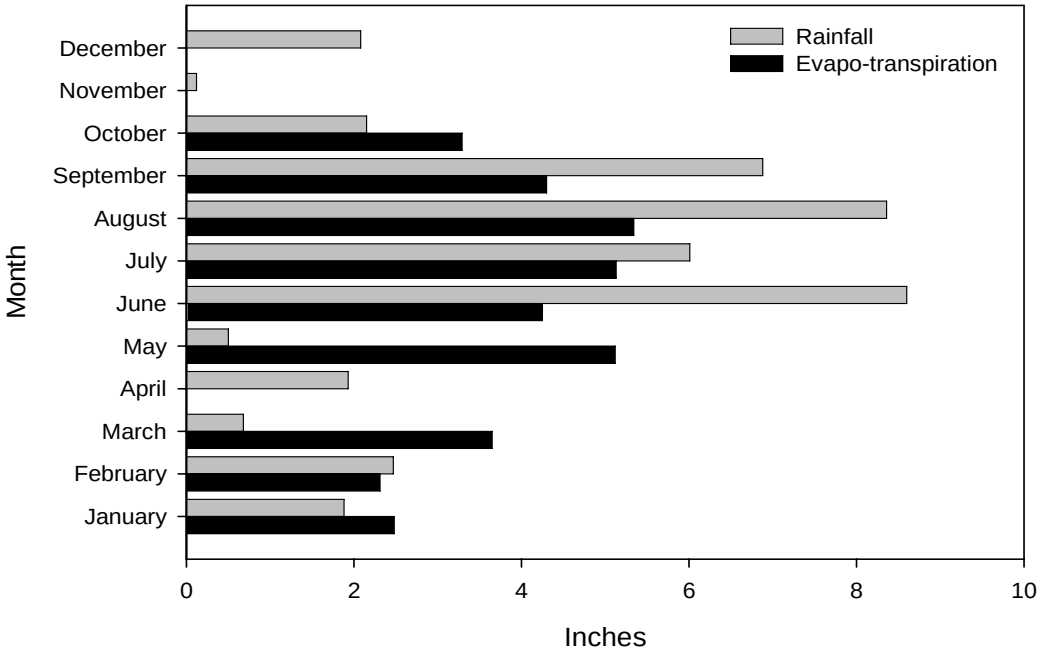

Figure 2. Monthly rainfall compared with evapo-transpiration during 2007. Cumulative rainfall = 41.66” and cumulative evapo-transpiration = 35.87”. No Evapo-transpiration data were collected during April, November or December due to complications with the FAWN weather system..

Evapo-transpiration

Evapo-transpiration is the total amount of water transferred from the earth to the atmosphere. Evapo-transpiration exceeded rainfall in January, March, May, and October during 2007 (Figure 2). Evapo-transpiration generally exceeds rainfall in January to May and October to December, which are months with limited rainfall. According to the data, rainfall exceeded evapo-transpiration by 5.79 inches for the entire year. However, no data were available during April, November and December, when evapo-transpiration typically exceeds rainfall.

Solar Radiation:

Daily solar radiation is shown in Table 2, and 2007 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 2007 (783 MJ) to produce 11,197 lb/A of plant dry matter. Total solar radiation for 2006 was 6,960 MJ.

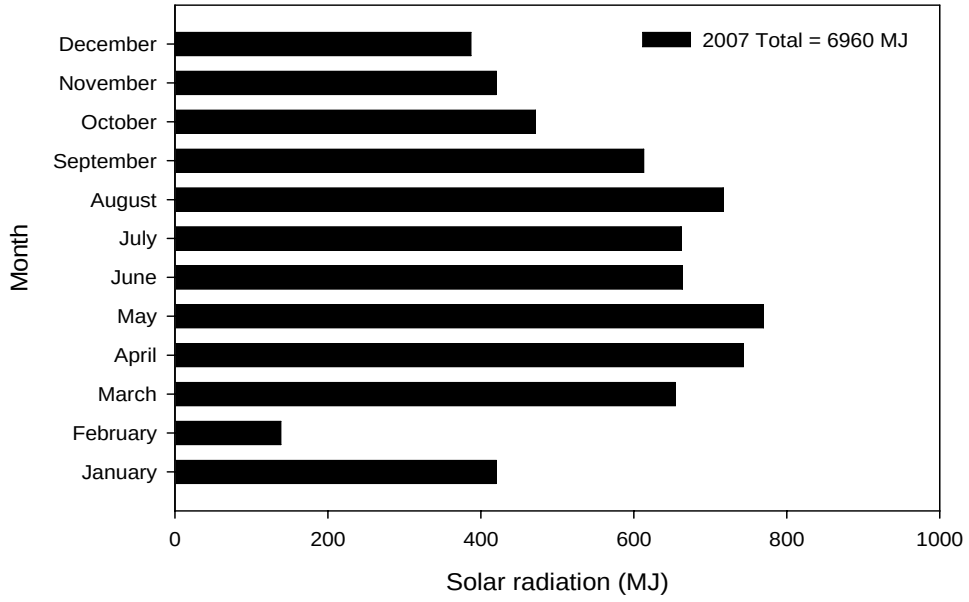

Figure 3. Total montly solar radiation for 2007. Cumulative solar radiation in 2007 = 6960 MJ (MJ = Joules x 1,000,000)

Temperature

There were four days when daily-low shelter temperature was at or below 32 ^{o}F (Table 2). The extreme low temperature for 2007 occurred on 17 February when shelter temperature reached 26.9 ^{o}F. Scattered frost begins when air temperature drops to 35 ^{o}F. Based on this fact, there were 4 incidences of frost (data not shown) in 2007. Except for Janury, October, and December, all months in 2007 had lower mean low temperatures compared with the 63-year means (Table 3). Overall, mean low temperature for 2007 was 1.0 ^{o}F lower than the 63-year mean.

Table 3. Summary of minimum temperature* for 2007 by months, Range Cattle REC.

	Shelter†					Ground level‡	
	1944-07	2007	1944-07		2007	2007	
	Avg.	Avg.	Extreme		Extreme	Avg.	Extreme
Month	low	low	low	Year	low	low	low
	----------^{o}F----------				----------^{o}F----------		
January	49.4	52.0	18	1981	29.2	65.6	56.2
February	50.6	47.2	26	1976	26.9	65.2	53.7
March	54.5	52.3	26	1980	34.6	67.0	61.7
April	58.0	53.0	34	1971	37.9	70.6	64.7
May	63.3	59.6	43	1945	50.5	76.7	72.4
June	69.0	67.1	52	1984	62.0	77.8	65.9
July	71.2	70.6	62	several	66.7	80.7	73.5
August	71.8	71.5	61	1977	68.8	82.1	78.6
September	71.1	70.7	51	1962	67.5	80.7	76.9
October	64.8	69.7	39	several	63.7	78.6	75.6
November	56.9	53.4	25	1970	40.2	70.1	65.6
December	51.3	54.4	20	1962	37.6	68.2	59.7
Average	61.0	60.0				73.6	67.0

*^{o}C = (^{o}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 Figures 4 and 5, respectively. The fall freeze hazard shows the chance of experiencing the first attainment of a critical temperature before a selected date, while the spring freeze hazard shows the chance of the last attainment of a critical temperature before a critical date. Based on records from 1944 to 1991, 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, a

frost susceptible crop (assuming 32 °F) planted before the 1st of February would stand a 50% chance of survival (Figure 4). A grower has a significant likelihood of experiencing five crop frosts over ten years by planting before the 1st of February.

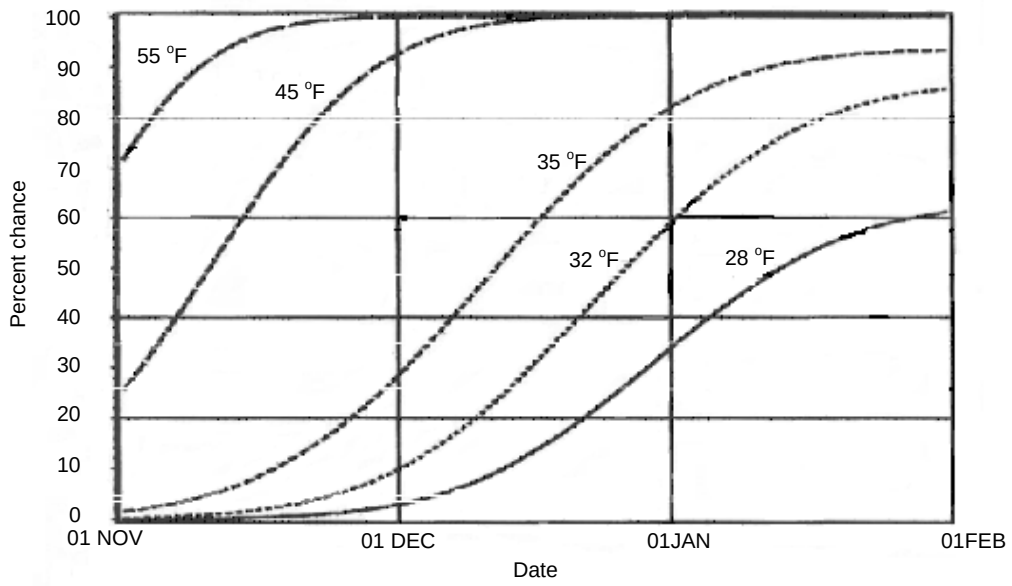

Figure 4. Fall freeze hazard showing the chance of the first attainment of a given temperature before a selected date.

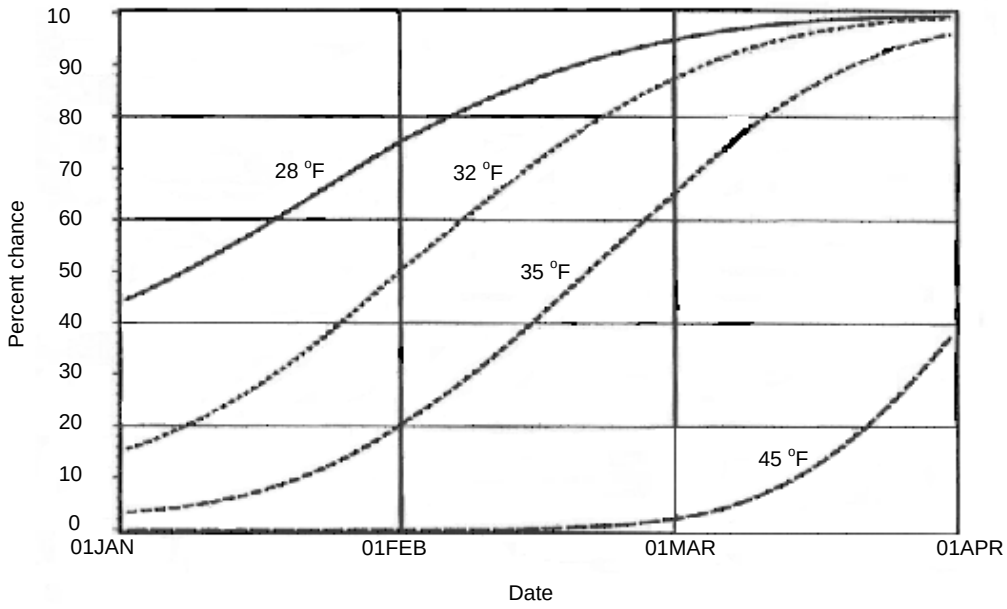

Figure 5. Spring freeze hazard showing the chance of the last attainment of a given temperature before a selected date.

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