Range Cattle Research and Education Center
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CLIMATOLOGICAL REPORT 2003

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 germination, forage growth, palatability, and nutritive value. A knowledge of weather cycles and extremes is helpful to a successful cattle operation.

This research report presents a summary of rainfall, air temperature, evapotranspiration, and solar radiation for 2003 obtained at the Range Cattle Research and Education Center (REC) Ona, Florida. 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). Accuracy of rainfall as measured by the Weather Watch 2000 was checked by comparing with rainfall measured by a US Weather Service standard gauge.

Rainfall:

Annual rainfall for 2003 was 65.46 inches, which was 11.65 inches (22%) greater than the 62-year average of 53.81 inches (standard deviation 11.09 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 for the March to June period exceeded the 62-year means for these months (Table 1, Figure 1), which was very beneficial for pasture growth. Rainfall was not a limiting factor for pasture production in spring. Rainfall in June was excessive, but this was compensated for by less than normal rainfall in July.

Table 1. Summary of rainfall by months. Range Cattle REC, 2003.

	1942 to 2003			2003	
	Maximum month	Minimum month	62-yr Average†	Total	Diference from 62-yr average†
	- - - - - - - - - - - - - - - - - inches* - - - - - - - - - - - - - - - - - - -
January	8.45	0.03	2.21	1.03	-1.18
February	9.59	0.02	2.56	2.17	-0.39
March	12.34	0.13	3.22	4.31	+1.09
April	11.91	0.00	2.53	4.31	+1.78
May	10.58	0.00	3.71	5.36	+1.65
June	18.99	2.79	8.58	15.80	+7.22
July	19.74	1.87	8.51	4.51	-4.00
August	15.72	3.13	8.10	10.09	+1.99
September	20.11	1.14	7.34	11.04	+3.70
October	11.23	0.04	3.10	1.14	-1.96
November	11.22	0.07	1.96	2.71	+0.75
December	8.61	0.16	1.99	2.99	+1.00
Year total			53.81	69.46	+11.65

*Inches x 2.54 = cm.

† Since rainfall records began in July 1942, means for January to June are 61-yr means.

Table 2. Daily minimum and maximum temperature, precipitation, and solar radiation for 2003, Range Cattle REC.

	January				February				March				April			
Day	Max	Min	Rain	MJ/	Max	Min	Rain	MJ/	Max	Min	Rain	MJ/	Max	Min	Rain	MJ/
	°F	°F	inches	m^2	°F	°F	inches	m^2	°F	°F	inches	m^2	°F	°F	inches	m^2
1	79	64	0.91	9.50	79	49	0.00	16.42	83	65	0.00	11.23	62	38	0.00	27.65
2	77	54	0.00	13.82	69	41	0.00	12.96	85	71	0.00	12.10	71	49	0.00	25.06

3	75	60	0.00	12.10	73	41	0.00	19.01	83	61	0.05	12.96	76	52	0.00	23.33
4	64	40	0.01	10.37	77	53	0.00	16.42	79	62	0.63	14.69	79	60	0.00	20.74
5	60	36	0.00	16.42	78	56	0.10	10.37	85	64	0.01	17.28	85	60	0.00	25.06
6	66	40	0.00	15.55	73	47	0.00	18.14	87	68	0.00	18.14	86	66	0.00	21.60
7	69	41	0.00	15.55	81	61	0.00	14.69	87	68	0.00	17.28	87	69	0.00	19.87
8	62	34	0.00	16.42	74	57	0.00	4.32	85	70	0.00	16.42	89	70	0.00	20.74
9	65	42	0.00	16.42	64	55	0.04	10.37	82	63	0.44	12.96	87	67	0.15	20.74
10	70	52	0.00	15.55	77	56	0.00	7.78	85	66	0.01	18.14	83	58	1.14	19.01
11	76	59	0.04	11.23	80	50	0.50	10.37	81	62	0.00	16.42	67	59	0.01	18.14
12	70	44	0.00	15.55	73	43	0.00	19.87	85	65	0.00	19.01	69	51	0.00	18.14
13	65	48	0.00	12.96	71	43	0.00	19.87	87	67	0.03	14.69	78	49	0.00	26.78
14	71	49	0.00	10.37	73	44	0.00	19.01	85	63	0.00	19.87	82	53	0.00	26.78
15	65	41	0.00	12.10	77	56	0.00	18.14	85	65	0.00	17.28	84	59	0.00	24.19
16	68	40	0.00	16.42	83	61	0.00	17.28	84	63	0.00	17.28	82	60	0.00	25.92
17	74	52	0.02	16.42	83	64	0.47	8.64	85	65	0.84	17.28	84	64	0.00	21.60
18	57	31	0.00	12.10	73	47	0.01	14.69	82	61	0.26	15.55	86	61	0.00	24.19
19	54	32	0.00	16.42	71	50	0.00	19.87	83	62	0.55	16.42	87	64	0.00	24.19
20	61	35	0.00	17.28	80	58	0.00	18.14	87	72	0.00	18.14	86	62	0.00	25.92
21	70	37	0.00	17.28	84	64	0.00	11.23	88	73	0.38	19.01	85	62	0.00	25.06
22	72	50	0.00	17.28	86	67	0.00	13.82	83	69	0.43	8.64	85	63	0.00	23.33

23	75	56	0.05	13.82	84	57	0.50	13.82	82	64	0.00	11.23	84	57	0.00	23.33
24	63	28	0.00	15.55	74	47	0.00	22.46	70	59	0.55	10.37	83	57	0.00	25.92
25	49	33	0.00	19.01	80	58	0.00	21.60	77	53	0.00	25.06	87	69	0.00	22.46
26	66	44	0.00	15.55	82	62	0.00	15.55	80	61	0.00	21.60	85	63	2.83	18.14
27	71	44	0.00	16.42	84	63	0.00	17.28	82	65	0.00	17.28	75	61	0.00	11.23
28	66	36	0.00	18.14	80	69	0.55	7.28	79	62	0.13	12.10	84	66	0.00	23.33
29	69	49	0.00	16.42					83	61	0.00	18.14	87	68	0.18	21.60
30	73	48	0.00	13.82					86	61	0.00	18.14	85	69	0.00	23.33
31	77	53	0.00	15.55					75	46	0.00	7.78				
Avg	68	44		14.88	77	54		15.00	83	64		15.89	82	60		22.58
Max	79	64	0.91	19.01	86	69	0.55	22.46	88	73	0.84	25.06	89	70	2.83	27.65
Min	49	28	0	9.50	64	41	0	4.32	70	46	0	7.78	62	38	0	11.23
Total			1.03	461.39			2.17	419.90			4.31	492.49			4.31	677.38

Table 2. Continued

	May				June				July				August			
Day	Max	Min	Rain	MJ/	Max	Min	Rain	MJ/	Max	Min	Rain	MJ/	Max	Min	Rain	MJ/
	°F	°F	inches	m^2	°F	°F	inches	m^2	°F	°F	inches	m^2	°F	°F	inches	m^2
1	80	70	0.56	13.82	87	70	0.00	25.92	93	75	0.00	22.46	91	73	0.36	17.28
2	83	65	0.01	20.7	89	69	0.00	26.7	91	73	0.00	25.0	91	73	0.66	18.1

				4				8				6				4
3	86	66	0.00	25.92	91	70	0.05	23.33	89	74	0.00	17.28	91	72	0.44	15.55
4	89	65	0.00	25.06	84	72	0.18	9.50	88	72	0.00	17.28	90	73	0.12	19.87
5	89	69	0.00	24.19	88	72	0.12	16.42	89	71	0.31	14.69	90	74	0.03	20.74
6	91	71	0.00	22.46	88	70	0.00	16.42	92	75	0.00	21.60	88	74	0.00	12.96
7	91	71	0.00	24.19	91	73	0.92	20.74	91	73	0.00	21.60	90	75	0.00	23.33
8	93	71	0.00	25.92	89	76	0.16	19.01	92	76	0.09	21.60	86	73	0.23	11.23
9	93	70	0.00	25.06	88	73	0.41	15.55	93	72	0.84	17.28	84	73	0.07	12.96
10	93	71	0.00	25.06	85	70	0.47	8.64	94	73	0.00	23.33	85	72	1.40	4.32
11	93	72	0.00	22.46	92	71	0.00	25.06	93	76	0.01	25.06	82	72	0.52	7.78
12	90	70	0.00	24.19	92	72	0.00	23.33	93	73	0.44	19.87	84	70	1.36	9.50
13	90	71	0.00	25.06	91	72	0.00	19.87	94	73	0.08	18.14	93	75	0.21	19.87
14	90	68	0.00	25.06	92	71	0.01	21.60	91	74	0.10	19.87	91	75	0.68	22.46
15	88	66	0.34	14.69	93	74	0.00	23.33	92	72	0.00	20.74	84	75	0.31	9.50
16	89	68	0.00	20.74	92	75	0.00	20.74	91	73	0.00	20.74	92	74	0.00	19.87
17	92	69	0.00	21.60	88	72	0.97	18.14	89	71	0.00	17.28	92	72	0.22	18.14
18	92	71	0.98	23.33	92	73	0.03	22.46	93	73	0.00	23.33	92	73	0.00	25.06
19	91	71	0.69	25.92	83	73	0.91	6.91	93	71	0.01	23.33	94	74	0.96	10.37
20	92	68	1.91	21.60	88	74	1.25	14.69	91	73	0.30	16.42	86	70	1.39	9.50
21	89	68	0.00	23.33	76	73	5.17	4.32	91	75	0.01	22.46	88	72	0.38	18.14
22	87	67	0.00	23.3	76	72	2.90	9.05	91	72	0.00	24.1	90	73	0.05	17.2

				3								9				8
23	88	70	0.44	20.74	81	75	1.03	4.32	91	73	0.06	17.28	87	72	0.19	11.23
24	79	69	0.43	7.78	84	73	0.10	13.82	92	70	0.00	20.74	89	72	0.37	13.82
25	88	69	0.00	21.60	89	70	0.00	23.33	90	70	0.01	21.60	92	73	0.11	18.14
26	90	68	0.00	25.92	89	69	0.00	25.92	89	70	1.59	14.69	90	74	0.00	17.28
27	90	67	0.00	25.06	90	72	0.00	23.33	92	74	0.00	20.74	91	74	0.00	17.28
28	89	72	0.00	22.46	91	72	0.03	19.87	93	74	0.00	23.33	93	75	0.00	20.74
29	84	67	0.00	18.14	86	71	0.79	16.42	93	72	0.00	21.60	90	75	0.03	15.55
30	85	64	0.00	25.92	91	75	0.30	21.60	92	71	0.12	24.19	93	75	0.00	19.87
31	86	66	0.00	25.06					90	71	0.54	16.42	93	76	0.00	22.46
Avg	89	69		22.47	88	72		17.91	92	73		20.46	89	73		16.14
Max	93	72	1.91	25.92	93	76	5.17	26.78	94	76	1.59	25.06	94	76	1.40	25.06
Min	79	64	0	7.78	76	69	0	4.32	88	70	0	14.69	82	70	0	4.32
Total			5.36	696.41			15.80	537.42			4.51	634.20			10.09	500.22

Table 2. Continued

	September				October				November				December			
Day	Max	Min	Rain	MJ/	Max	Min	Rain	MJ/	Max	Min	Rain	MJ/	Max	Min	Rain	MJ/
	°F	°F	inches	m^2	°F	°F	inches	m^2	°F	°F	inches	m^2	°F	°F	inches	m^2
1	92	75	0.05	19.87	80	73	0.01	6.91	86	66	0.00	16.42	73	54	0.00	15.55

2	92	73	1.02	15.55	81	70	0.00	9.50	84	67	0.00	15.55	74	43	0.00	15.55
3	89	75	0.09	16.42	79	68	0.00	10.37	85	70	0.08	14.69	77	51	0.00	14.69
4	90	74	0.94	14.69	86	71	0.00	16.42	84	70	0.01	11.23	77	56	0.00	12.10
5	85	76	0.27	10.37	86	71	0.00	15.55	84	71	0.00	8.64	82	59	0.00	13.82
6	82	73	1.25	3.46	87	69	0.00	18.14	89	73	0.81	11.23	74	50	0.00	6.05
7	88	74	0.07	19.87	89	69	0.00	19.01	81	68	1.22	7.78	58	37	0.00	15.55
8	90	74	0.00	20.74	88	68	0.00	18.14	86	71	0.01	13.82	64	40	0.00	16.42
9	89	70	0.00	22.46	89	70	0.00	19.01	86	73	0.00	12.96	72	53	0.00	12.96
10	88	72	0.00	21.60	88	70	0.00	19.01	83	70	0.00	10.37	77	59	0.00	11.23
11	90	71	0.00	20.74	86	72	0.01	12.10	83	67	0.00	12.96	77	52	0.03	7.78
12	88	70	0.00	22.46	88	72	0.00	12.10	84	65	0.00	16.42	64	38	0.00	14.69
13	91	72	0.00	20.74	88	72	0.00	14.69	84	62	0.00	14.69	70	51	0.01	15.55
14	90	72	1.82	15.55	87	73	0.00	12.10	83	52	0.00	15.55	76	63	1.57	8.64
15	92	73	0.00	22.46	87	70	0.03	13.82	79	55	0.00	17.28	71	44	0.19	4.32
16	90	71	0.00	19.87	81	60	0.00	19.87	81	58	0.00	16.42	66	49	0.01	15.55
17	89	74	0.00	18.14	84	64	0.00	19.01	82	61	0.00	13.82	76	63	1.17	8.64
18	90	70	0.04	18.14	86	64	0.00	14.69	83	65	0.00	11.23	64	36	0.01	8.64
19	91	71	0.00	22.46	84	63	0.00	19.87	85	67	0.01	12.10	62	46	0.00	15.55
20	93	75	0.00	19.01	85	68	0.00	17.28	74	53	0.57	5.18	61	38	0.00	16.42
21	90	75	0.13	15.55	85	66	0.00	16.42	75	54	0.00	17.28	58	36	0.00	16.42

22	91	73	0.00	20.74	86	60	0.00	17.28	79	56	0.00	16.42	65	45	0.00	15.55	
23	90	73	0.00	18.14	85	66	0.00	18.14	79	57	0.00	13.82	72	54	0.00	14.69	
24	86	72	0.00	11.23	86	57	0.00	17.28	82	57	0.00	15.55	77	51	0.00	13.82	
25	92	73	0.00	22.46	87	64	0.00	19.01	82	66	0.00	15.55	76	48	0.00	11.23	
26	87	71	2.65	10.37	87	69	0.07	14.69	80	62	0.00	10.37	68	49	0.00	12.10	
27	84	74	0.00	15.55	86	67	0.00	15.55	83	62	0.00	14.69	73	50	0.00	12.96	
28	86	73	0.70	9.50	87	69	0.00	15.55	84	59	0.00	13.82	74	49	0.00	15.55	
29	84	73	1.36	8.64	82	66	1.02	6.05	83	43	0.00	14.69	75	52	0.00	12.96	
30	77	72	0.65	3.46	81	58	0.00	17.28	61	41	0.00	17.28	77	54	0.00	11.23	
31					84	66	0.00	17.28					80	54	0.00	12.96	
Avg	89	73		16.68	85	67		15.55	82	62		13.59	71	49		12.88	
Max	93	76	2.65	22.46	89	73	1.02	19.87	89	73	1.22	17.28	82	63	1.57	16.42	
Min	77	70	0	3.46	79	57	0	6.05	61	41	0	5.18	58	36	0	4.32	
Total			11.04	500.24			1.14	482.12			2.71	407.81			2.99	399.17	

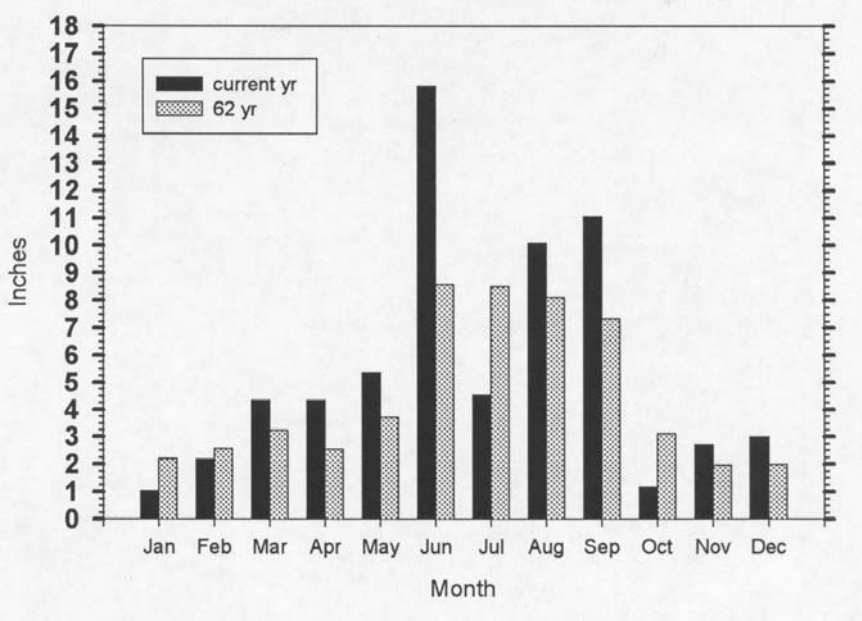

Figure 1. Rainfall in 2003 compared with the 62-year mean.

There were 20 occurrences during 2003 when daily rain equaled or exceeded 1 inch and four rain events that exceeded 2 inches (Table 2). The single greatest daily rain event was 21 June when 5.17 inches were recorded. Except for July, which was 4 inches below the 62-year mean rainfall, all summer months were above 62-year means and there was typical flooding of pastures at Ona. (Fig.1).

Evapo-transpiration

Evapo-transpiration exceeded rainfall in only three months during 2003 (Figure 2). This was unusual because evapo- transpiration generally exceeds rainfall in January to May and October to December, which are months with limited rainfall. For the year, rainfall exceeded evapo-transpiration by 30.08 inches. Historically, annual evapo-transpiration has exceed annual rainfall at the Range Cattle REC.

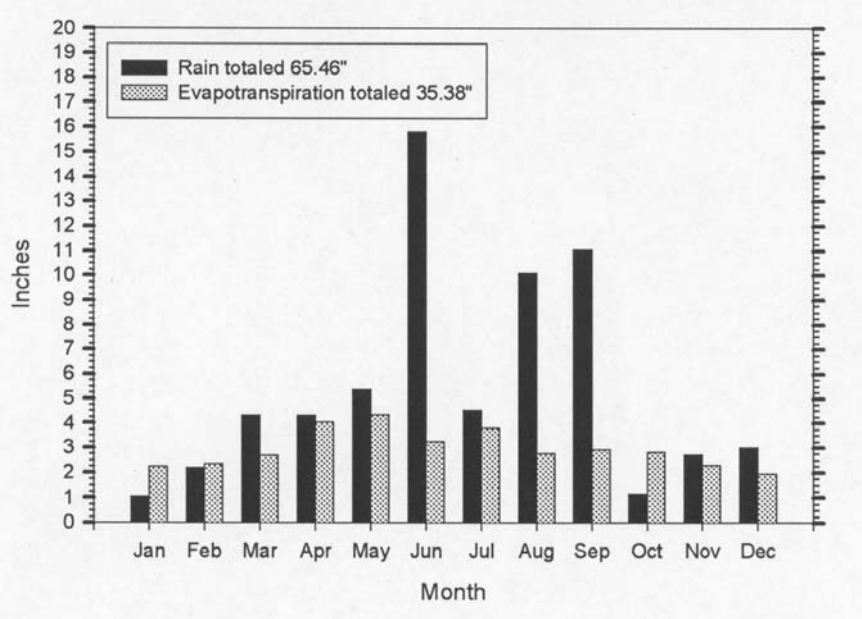

Figure 2. Monthly rainfall compared with evapo-transpiration during 2003.

Temperature:

There were three and seven days when daily low-shelter and daily low ground temperatures, respectively, were at or below 32 °F (Table 2). The extreme low temperature for 2003 occurred on 24 January when shelter and ground temperature reached 28 and 27 °F, respectively. Scattered frost occurs when ground temperature reaches 34 °F. Based on this observation, there were 11 incidences of frost (data not shown). Except for January and December, all months in 2003 had higher mean low temperatures compared with the 60-year means (Table 3). March was especially warm, and combined with greater than normal rainfall, March was an excellent month for pasture growth. Overall, mean temperature for 2003 was 2.4 °F higher than the 60-year mean.

Table 3. Summary of minimum temperature (°F)* by months, Range Cattle REC.

	Shelter Temperature					Ground Temperature	
	1944-03	2003	1944-03		2003	2003	
	Avg. Low	Avg. Low	Extreme Low	Year	Extreme Low	Avg. Low	Extreme Low
January	49.3	44.3	18	1981	28	41.8	27

February	50.7	54.3	26	1976	41	51.8	37
March	54.6	63.8	26	1980	46	61.3	44
April	58.2	60.2	34	1971	38	57.3	35
May	63.3	68.7	43	1945	64	66.5	61
June	68.9	72.1	52	1984	69	69.9	66
July	71.2	72.7	62	several	70	70.8	68
August	71.7	73.3	61	1977	70	71.3	69
September	71.0	72.8	56	1962	70	70.7	67
October	64.7	67.3	42	several	57	64.5	54
November	56.9	62.0	25	1970	41	59.1	36
December	51.2	49.2	20	1962	36	46.0	32
Avg.	61.0	63.4			52.5	60.9	49.7
* °C = (°F - 32) x 0.555							

Solar Radiation:

Daily solar radiation is shown in Table 2, and 2003 total monthly solar radiation can be seen graphically 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 May 2001 (696 MJ) to produce 9,950 lb/A of plant dry matter. Total solar radiation for 2003 was 6208 MJ.

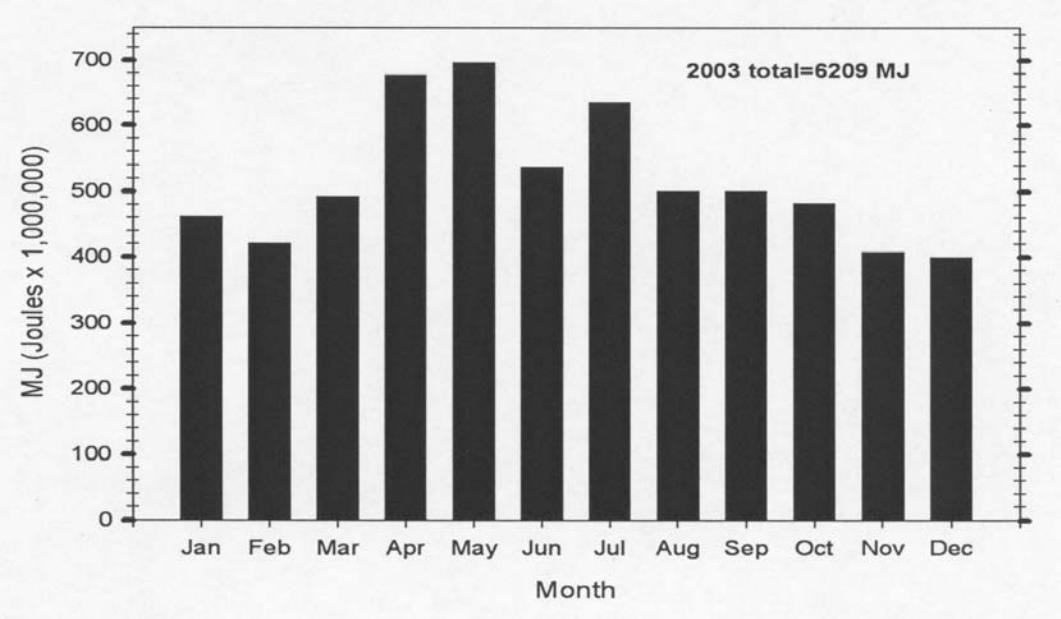

Figure 3. Total monthly solar radiation for 2003.

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 would probably lose five crops over 10 years by planting before the 1st of February.

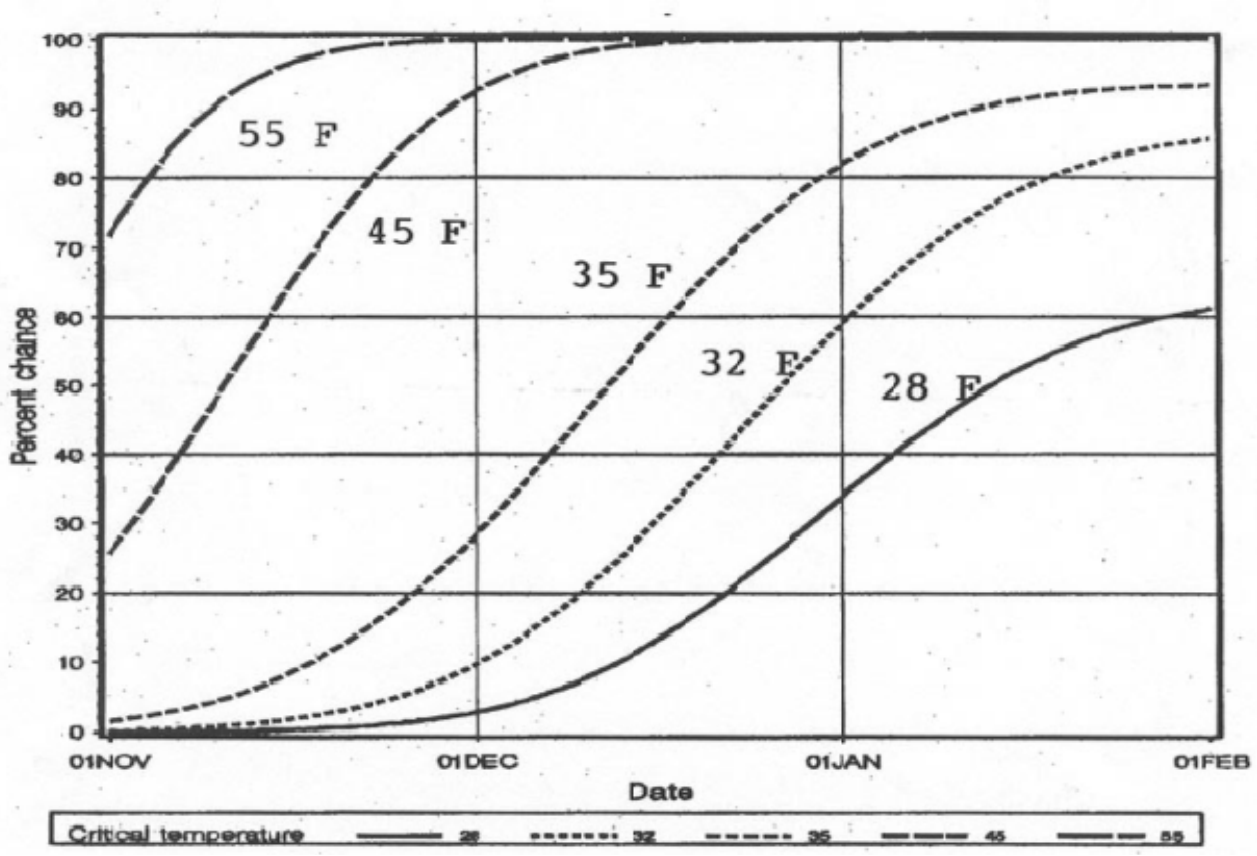

Figure 4. Fall freeze hazard showing the chance of the first attainment of a given temperature before a selected date.

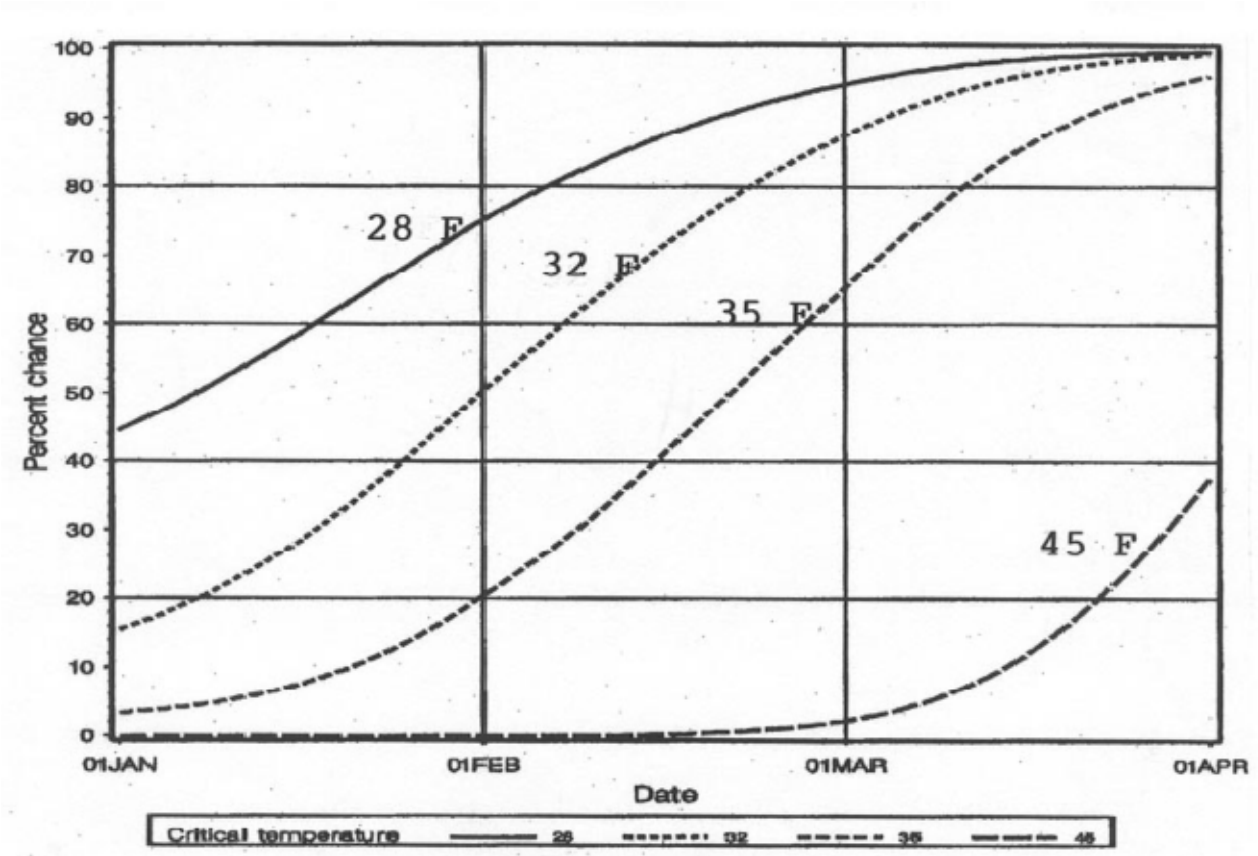

Figure 5. Spring freeze hazard showing the chance of the last attainment of a given temperature before a selected date.

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