



Temperature and Precipitation Predictions

for the Holland, Virginia Area

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TEMPERATURE AND PRECIPITATION PREDICTIONS
FOR THE
HOLLAND, VIRGINIA AREA

D. L. Hallock¹

The weather has a great deal of influence on the success or failure of many industries. It would be an invaluable aid to the farm manager, for instance, if he knew in advance the temperature and moisture conditions his crops would undergo during the year. It is not possible to predict all facets of the weather with reasonable certainty, but many factors can be predicted on a calculated-risk basis.

Regular weather records at the Tidewater Research Station (formerly called Holland Experiment Station) go back to February 1, 1933. Daily maximum and minimum temperatures and precipitation observations are recorded according to U. S. Weather Bureau specifications, utilizing official thermometers and rain gauges. In this report, estimates are given for certain risks or chances of occurrence of various air temperatures and amounts of precipitation at particular times, based on these 32-year records. This information is applicable, generally, to the peanut-growing area of Virginia. However, temperatures will average slightly cooler near the Piedmont.

TEMPERATURE

Means and Extremes: The average and extreme temperatures at Holland for the period 1933 to 1964 are presented in Table 1. Note that average daily maximum temperatures for June, July, August, and September differ by only 2°; the average daily minimum temperatures for June, and particularly September, are 3 to 6° lower. Thus, the average daily temperature of both July and August is higher than for June and September. January, February, and December are the coldest months -- the average daily maximums and minimums differing only slightly.

In regard to the temperature extremes, note that a higher temperature was recorded in January, the coldest month, than in February or December. On the other hand, January 1940 had the lowest average daily temperature of any month during the past 32 years. The highest average daily temperature for any month occurred in July 1949 (81°). The average daily temperature of every July since 1932 has been at least 75°. The highest temperature recorded at Holland is 105°. Temperatures 100° or higher occurred only in May, June, July, and August, even though the average temperature of September is 4° higher than May. Temperatures of 96 to 99° have occurred also in April, September, and October.

Below zero temperatures occurred several times at this Station, all prior to 1945. The lowest temperature on record is 3° below zero, recorded last in

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Table 1. Average and extreme* temperatures in degrees Fahrenheit at Holland, Virginia.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
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Average Daily Temperatures By Months For 32 Years

Maximum	51	53	61	71	78	86	88	87	88	72	63	52	70
Minimum	30	31	37	46	55	63	67	66	60	48	38	30	48
Average	40	42	49	58	67	75	77	76	71	61	50	41	59

Extremes Among Average Daily Temperatures By Months During 32 Years

Highest Year	53 1950	50 1939	59 1945	62 1960	72 1953	79 1952	81 1949	80 1955	76 1933	66 1941	57 1948	50 1956	61 1949
Lowest Year	29 1940	32 1934	38 1960	54 1940	63 1954	70 1956	75 1962	73 1946	67 1937	56 1964	46 1939	34 1963	57 1958

Extreme Daily Temperatures During 32 Years

Maximum Year	78 1944	79 1948	90 1945	96 1960	100 1941	105 1952	105 1942	100 1953	99 1954	98 1954	86 1959	78 1951	--
Minimum Year	-3 1940	-3 1936	4 1943	21 1964	30 1956	40 1945	47 1961	45 1952	36 1943	20 1962	13 1933	2 1942	--

* Latest occurrence recorded.

January 1940. Temperatures of 47° or below have occurred at least once during each month.

The average daily air temperatures for certain 7-day periods throughout the year are given in Figure 1. Also, the highest average daily maximum and the lowest average daily minimum temperatures for similar weekly periods over the last 32 years are presented. Note that the coldest week averaged about 10° and the hottest week about 98°.

General Temperature Predictions: The chances of any maximum and minimum daily temperatures exceeding certain limits are estimated for each month (Figures 2a and 2b). These curves indicate rather vividly that greatest variability among temperature extremes occurs in the cold months. Note that chances are extremely low that any minimum daily temperature will be 80° or above.

The number of days with maximum temperatures above and minimum temperatures below certain limits that may be expected during each month are given in Table 4 of the Appendix. For instance, one can expect the maximum temperature to be higher than 70° during 26 days in May; there will be only 2 such days in January. Similarly, it is likely there will be only one day in many years during which the temperature drops to 50° or lower in July.

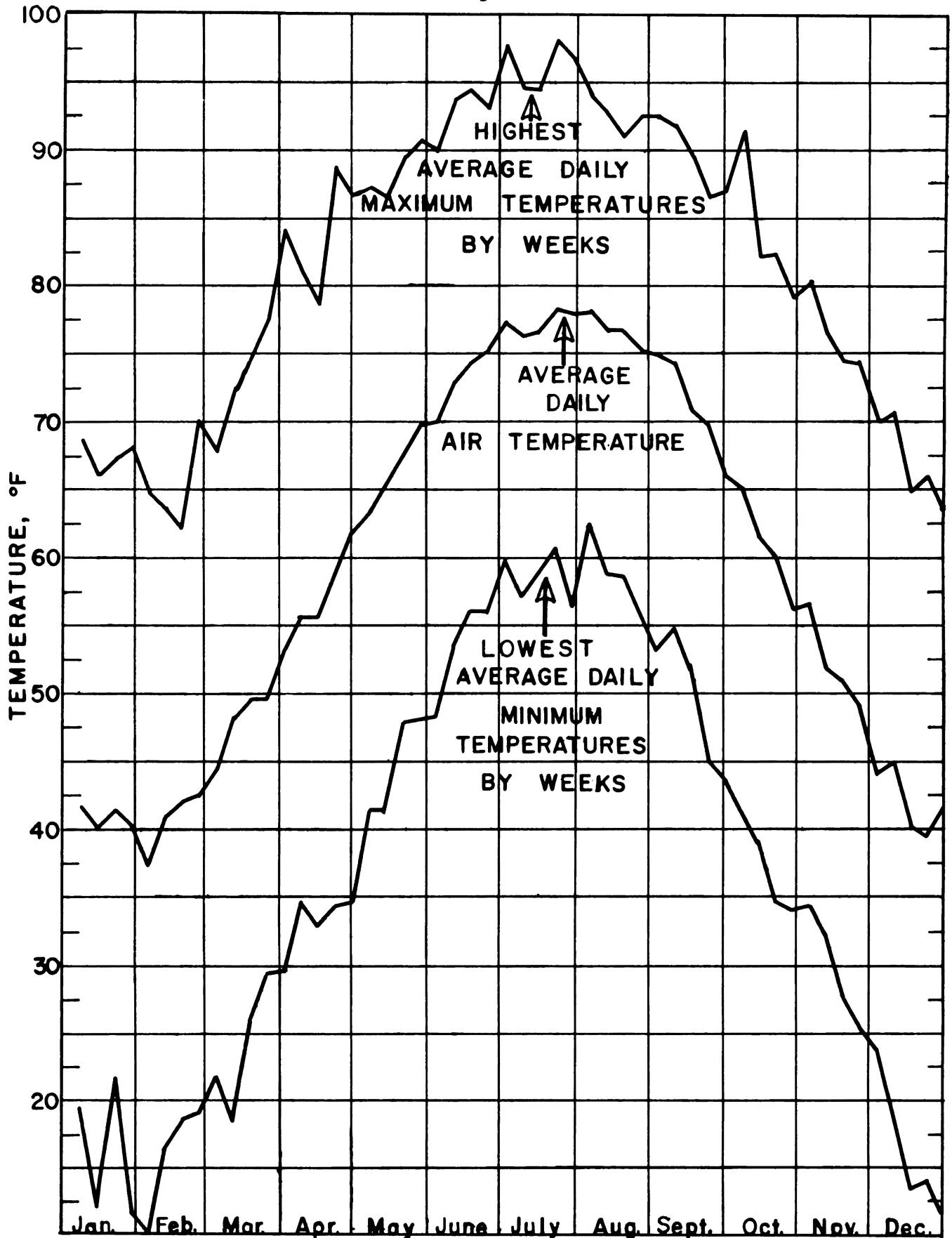


Figure 1. Air temperatures for similar weeks at Holland, Virginia, 1933 to 1964.

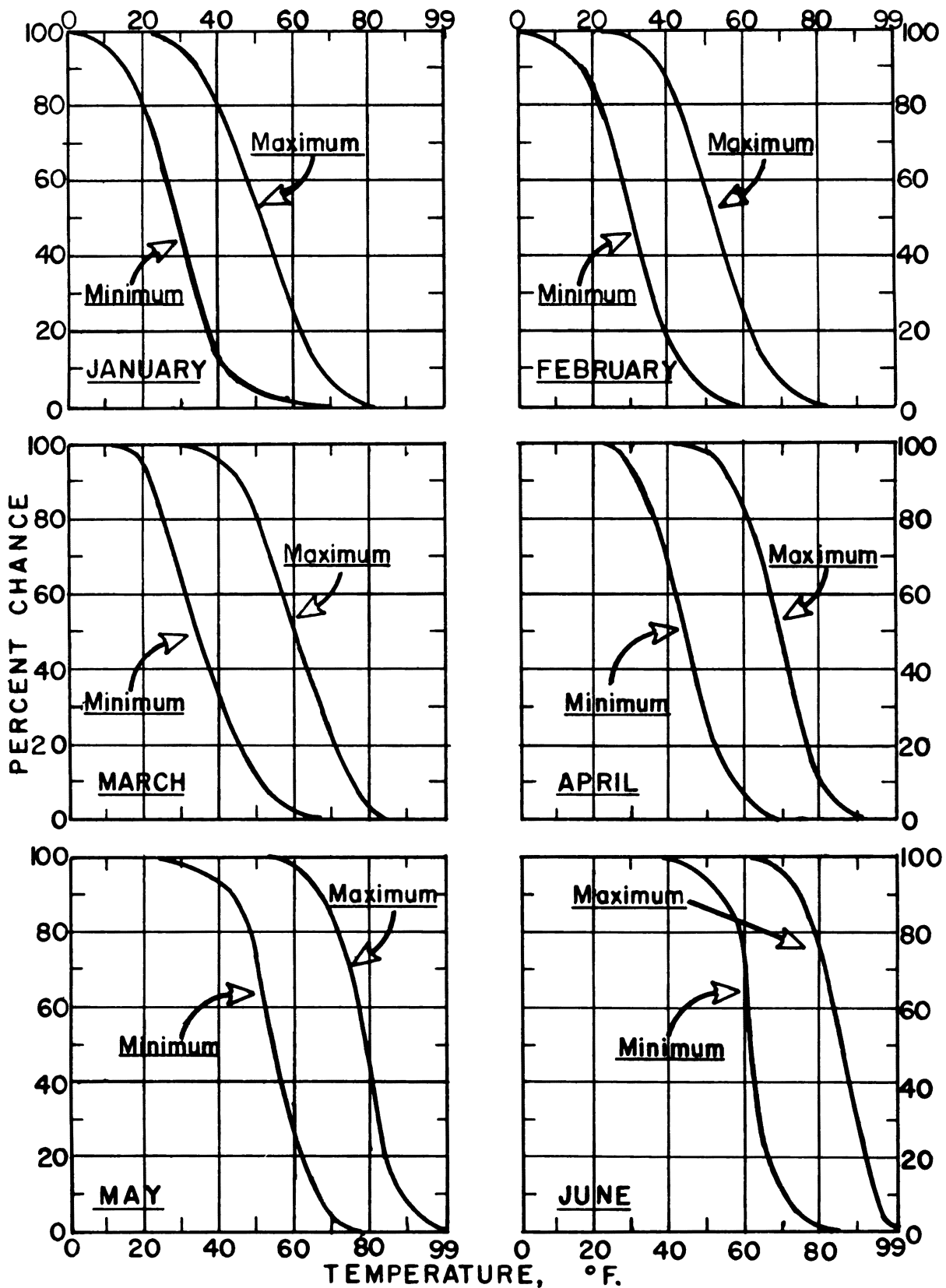


Figure 2a. Chances of maximum and minimum daily temperatures exceeding certain limits at Holland.

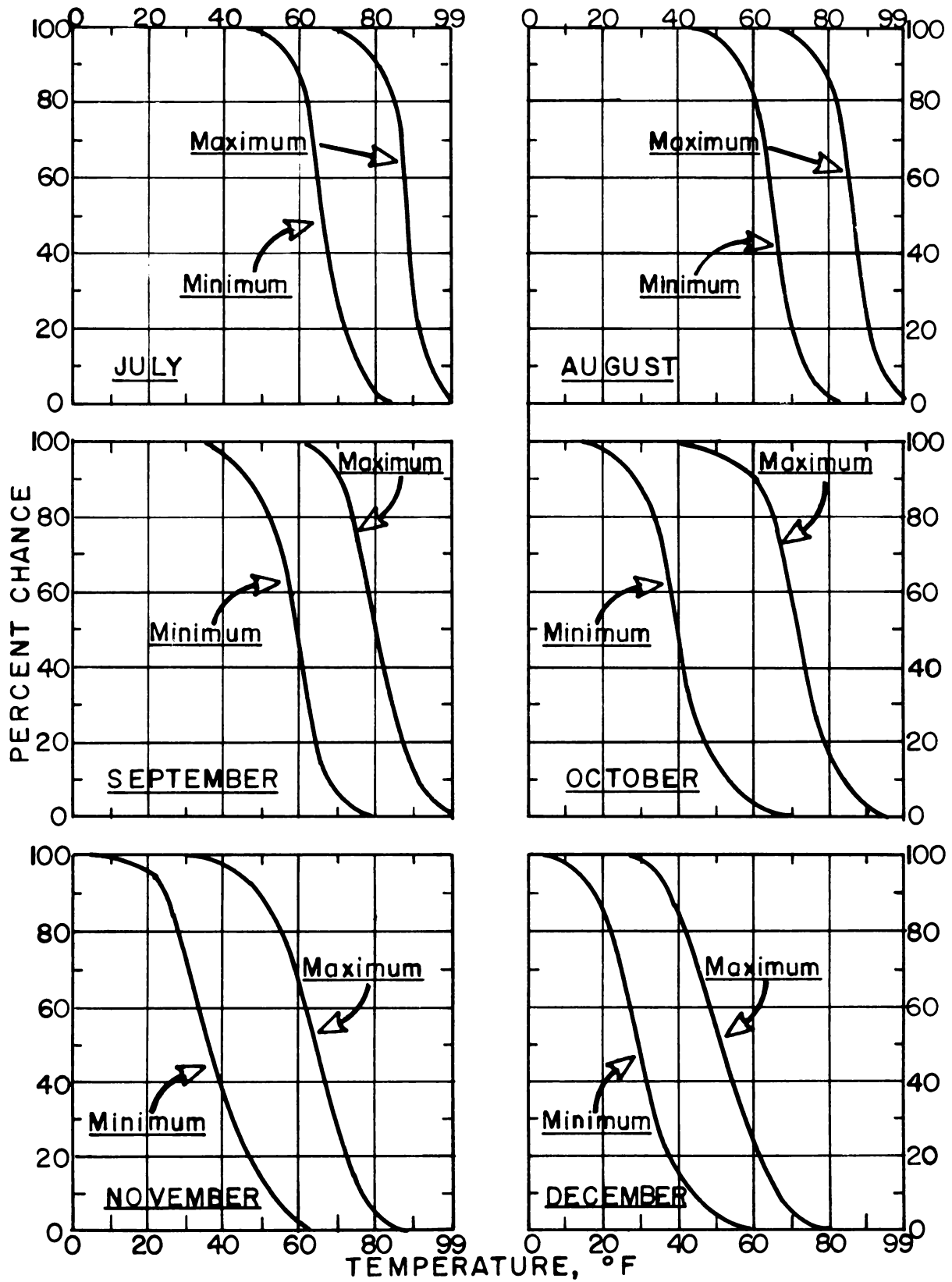


Figure 2b. Chances of maximum and minimum daily temperatures exceeding certain limits at Holland.

Cold Hazard Predictions: Frequently there are economic advantages obtainable to growers who can market their crops at "off peak" times. To do this, they must generally subject their crops to greater frost hazards than the "in-season" grower. What are the low-temperature risks which watermelon growers, for instance, must take in the Holland area to "beat the market"? Figure 3 indicates a 40% chance that 32° temperatures will not occur after April 15. If a particular farmer wishes to take a 20% chance on freeze (32° or lower) damage to his young watermelon plants, then he should plan for seedling emergence about April 25. In other words, the chance of all temperatures being above 32° after April 25 is 80%. For more tolerant plants, similar cold hazard data are also given for 28 and 24° limits (Figure 3).

The chances of certain low temperatures by particular dates in the fall are given in Figure 4. This information may be used to estimate cold risk for late-season crops. For instance, the 28° curve indicates a 35% chance of temperatures as low as 28° by November 12. Therefore, growers wishing to take this risk should plan to harvest crops sensitive to 28° colds no later than mid-November.

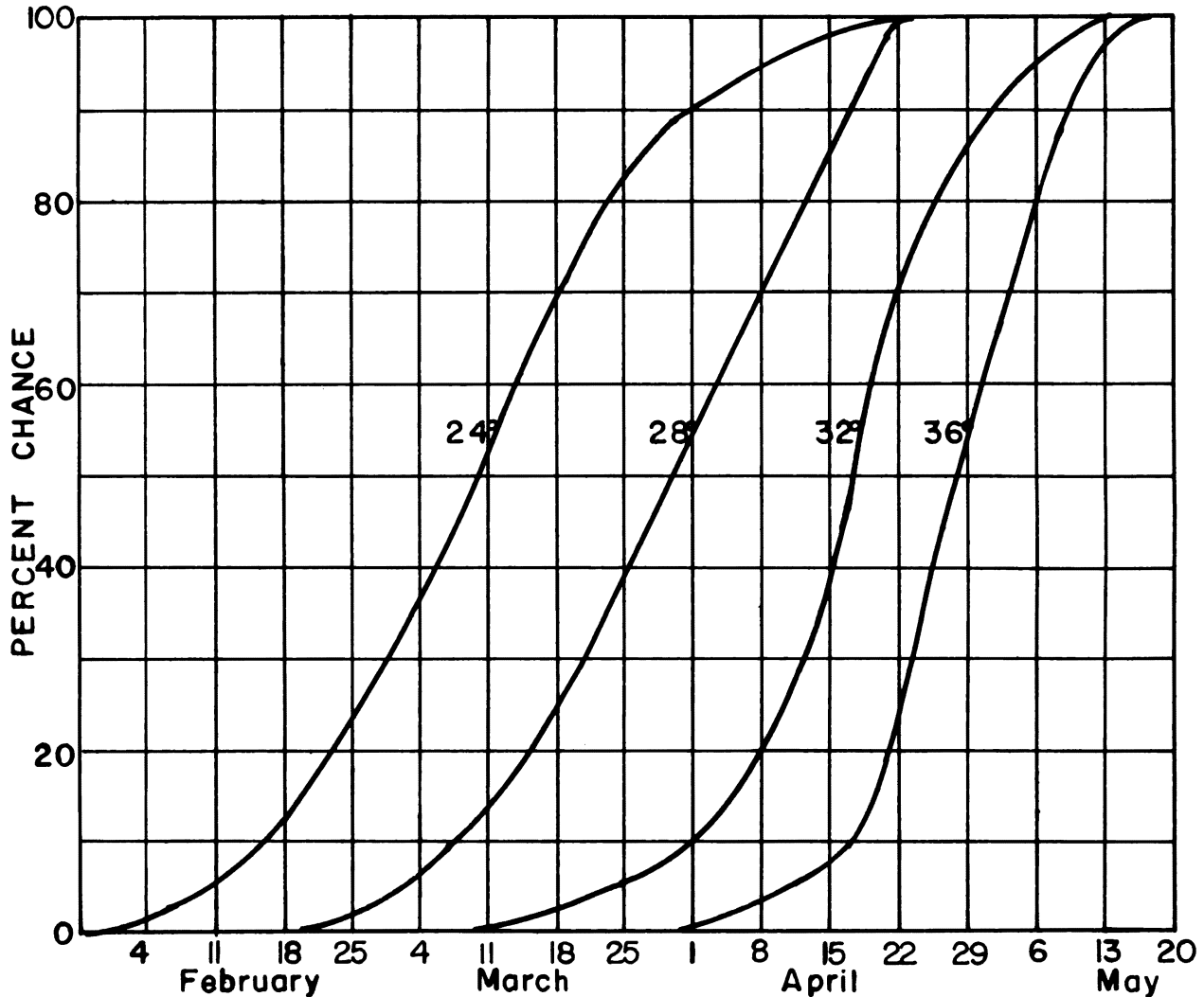


Figure 3. Chances of not having certain temperatures (or lower) after particular dates in the spring at Holland.

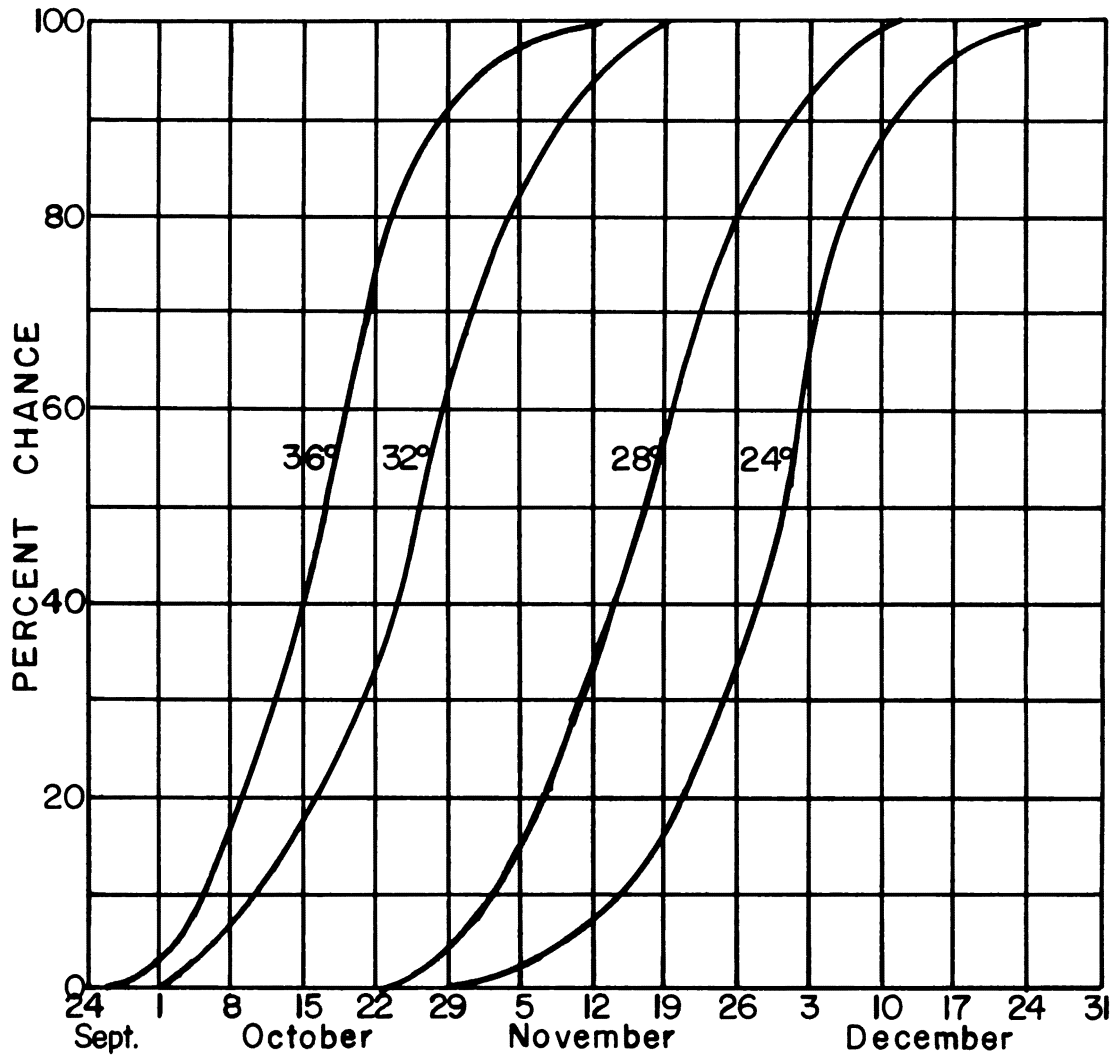


Figure 4. Chances for having certain temperatures (or lower) before particular dates in the fall at Holland.

Figure 5 provides useful information for growers of full-season crops and others interested in the length of warm-season periods without certain low temperatures. During the last 32 years at Holland there were no seasons shorter than 140 days between 32° temperatures in the spring and fall. Similarly, minimum length periods of 180 and 210 days have been recorded between the last 28 and 24° spring temperatures, respectively, and their first occurrence in the fall. The length of periods without such temperatures may seem rather short. However, by taking a 20% chance (Figure 5), crops needing approximately 30-day longer seasons generally may be grown.

In using this cool-temperature information, some adjustments may be necessary since the data were obtained in a standard instrument shelter about 5' above the ground. Temperatures near the ground may be a few degrees below those in the shelter. Thus, under some conditions, the chances of escaping particular low temperatures may not be as good as given in the graphs.

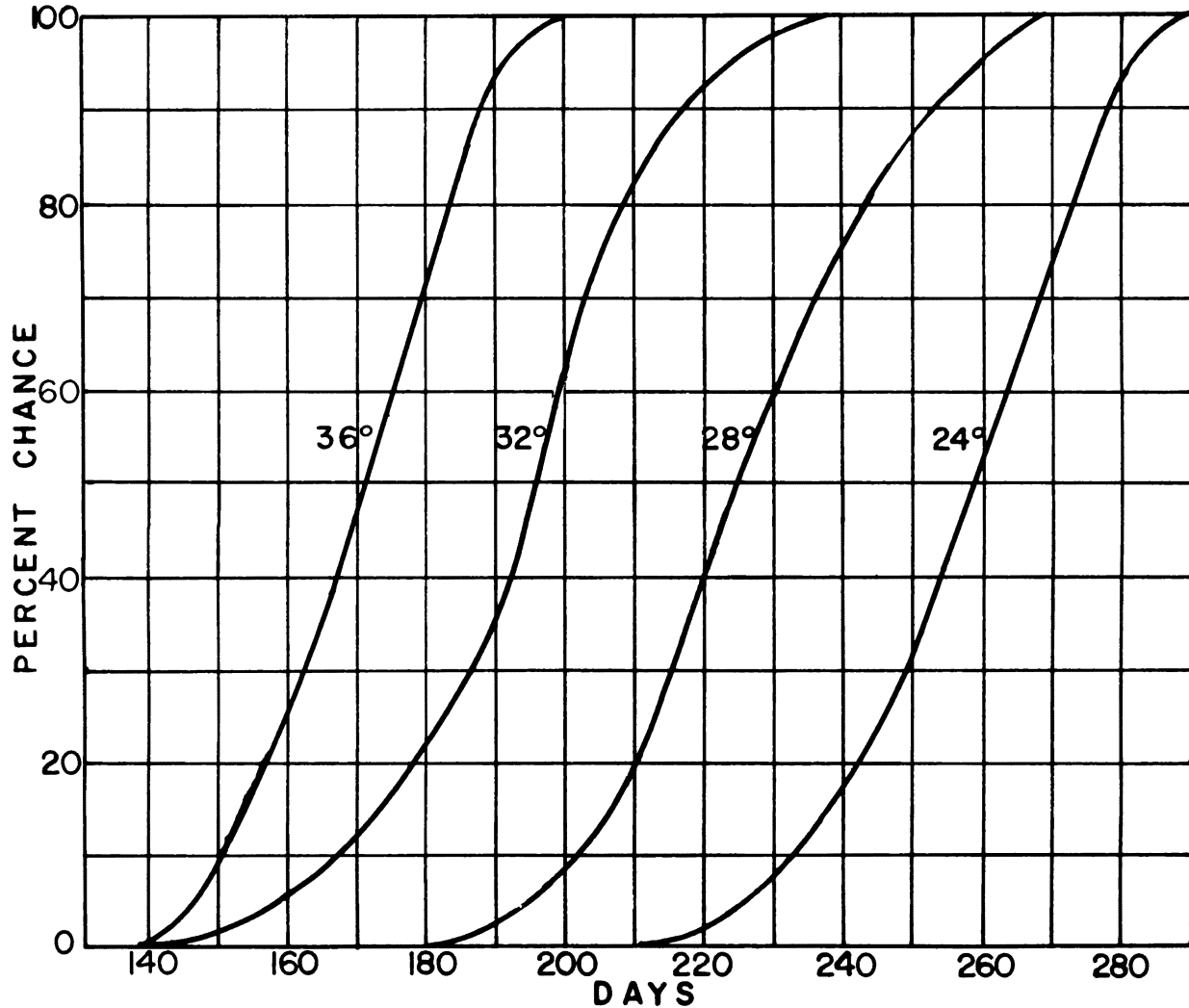


Figure 5. Chances for having less than a specified number of days between certain temperatures (or lower) in the spring and their first occurrence in the fall at Holland.

RAINFALL

Means and extremes: The average and extreme amounts of precipitation at Holland for the years 1933 through 1964 are recorded in Table 2. In general, the annual precipitation is approximately 49". Recorded extremes were nearly 64" (1949) and less than 35" (1941), about 15" off the average.

Distribution of rainfall throughout the year is generally quite good. Normally, the 3 hottest months also have the highest rainfall, particularly July and August. Thus, prolonged drouths during mid-summer are the exception rather than the rule. Recorded extremes in monthly precipitation were 15.6" in August 1949 and 0.21" in September 1958 when the largest daily precipitation was only 0.14". The greatest amount of rain during any day (24 hours) was 6.4", which occurred in August 1949. Extremely heavy rainfall usually occurs in connection with hurricanes.

Table 2. Average and extreme amounts* of precipitation in inches at Holland, 1933 to 1964.

Month	Average	Extremes by months				Highest daily precipitation	
		Highest	Year	Lowest	Year	Year	Year
January	3.65	8.63	1937	1.41	1951	2.62	1952
February	3.74	7.39	1939	1.12	1947	2.36	1945
March	3.53	6.76	1934	0.91	1946	2.80	1933
April	3.28	5.66	1959	0.95	1942	2.35	1943
May	3.55	8.38	1961	0.65	1936	2.55	1949
June	4.60	7.62	1963	0.57	1964	6.20	1963
July	6.20	13.75	1935	1.32	1953	4.37	1959
August	6.44	15.57	1949	1.00	1943	6.41	1949
September	4.44	10.34	1955	0.21	1958	6.00	1963
October	3.17	12.72	1959	0.35	1934	5.38	1958
November	3.27	8.32	1948	0.29	1933	3.08	1949
December	2.97	5.79	1945	0.88	1933	2.93	1958
Year	48.84	63.79	1949	34.59	1941	-	-

*/ The last occurrence is recorded in duplicated instances.

Weekly Precipitation Predictions: Predictions for weekly precipitation in excess of 0.20", 0.50", 0.75", by 1" increments from 1" to 7", are given in Table 3. Note there is at least a 15% chance for more than 1" of precipitation during any particular week of the year. There are only a few weeks of the year for which there is a 15% or better chance of having more than 3".

Drouth Hazard Predictions: Although the total amount of rainfall is important, proper distribution of that moisture throughout the cropping season is of equal or greater importance. Estimates of drouth risks during the principal growing season at Holland are given in Figures 6 and 7.

Figure 6 gives the chances of having only 0.50" of rain or less during periods up to 5 weeks long. There were no 4-week periods without rainfall from 1933 to 1964. However, there were three 5-week periods with no more than 0.25" of rain and three 6-week periods with 0.50" or less. These long, dry periods occurred mostly in the fall. The likelihood of having such severe drouth periods is quite low. Two-week periods with 0.50" of rain or less may be expected less than 40% of the time (Figure 6). Similarly, for 3- and 4-week periods the chances are less than 25% and 15%, respectively.

The chances for receiving 1" or less of rainfall during periods of various lengths, beginning on certain dates between mid-March and late November, are predicted in Figure 7. Note that likelihood of having no more than 1" of rainfall during a 2-week period may be as high as 50%, particularly in the fall and to some extent in April. Similar statements, although with less chance of occurrence, apply to longer periods with less than 1.01" of rain. There was only one 11-week period (Sept. 17-Dec. 2) with less than 1.01" of rain during the 32-year record. However, the chance of such extended dry periods during the hot months, when most crops require high moisture, is lower than at other times of the warm season. In fact, the chance of having any periods 3 or more

Table 3. Percent chance of the total precipitation for each week being above certain amounts at Holland.

Date	Inches of Precipitation									
	0.20	0.50	0.75	1.0	2.0	3.0	4.0	5.0	6.0	7.0
Jan. 1-7	71.0	61.3	41.9	35.5	9.7	3.2	0	0	0	0
8-14	83.9	51.6	29.0	22.6	3.2	0	0	0	0	0
15-20	74.2	54.8	51.6	35.5	12.9	6.4	3.2	0	0	0
22-28	87.1	64.6	41.9	29.0	6.4	0	0	0	0	0
29-4	67.7	48.4	38.7	22.6	9.7	9.7	0	0	0	0
Feb. 5-11	90.3	71.0	54.8	51.6	12.9	0	0	0	0	0
12-18	80.4	61.3	51.6	38.7	6.4	0	0	0	0	0
19-25	80.4	67.7	58.1	25.8	9.7	0	0	0	0	0
26-4	87.5	71.9	56.2	34.4	9.4	3.1	0	0	0	0
Mar. 5-11	84.4	65.6	43.8	37.5	3.2	0	0	0	0	0
12-18	84.4	46.9	37.5	21.9	6.2	0	0	0	0	0
19-25	81.2	81.2	56.2	34.4	6.2	0	0	0	0	0
26-1	81.2	53.1	40.6	28.1	9.4	0	0	0	0	0
Apr. 2-8	81.2	59.4	53.1	31.2	6.2	3.1	0	0	0	0
9-15	81.2	68.8	56.2	34.4	9.4	0	0	0	0	0
16-22	62.5	40.6	28.1	21.9	3.1	0	0	0	0	0
23-29	62.5	37.5	28.1	25.0	6.2	3.1	0	0	0	0
30-6	62.5	43.8	43.8	34.4	6.2	0	0	0	0	0
May 7-13	65.6	40.6	31.2	28.1	12.5	6.2	3.1	0	0	0
14-20	65.6	40.6	34.4	21.9	18.8	0	0	0	0	0
21-27	78.1	65.6	56.2	43.8	9.4	0	0	0	0	0
28-3	81.2	56.2	46.9	37.5	9.4	3.1	3.1	3.1	3.1	0
June 4-10	65.6	50.0	46.9	31.2	25.0	6.2	0	0	0	0
11-17	78.1	59.4	59.4	46.9	15.6	9.4	3.1	0	0	0
18-24	78.1	62.5	43.8	28.1	6.2	0	0	0	0	0
25-1	75.0	65.6	59.4	56.2	25.0	9.4	3.1	0	0	0
July 2-8	78.1	62.5	59.4	43.8	15.6	3.1	0	0	0	0
9-15	87.5	78.1	75.0	62.5	28.1	18.8	12.5	6.2	3.1	0
16-22	78.1	65.6	62.5	50.0	25.0	9.4	9.4	3.1	0	0
23-29	93.8	68.8	56.2	40.6	18.8	12.5	3.1	3.1	3.1	0
30-5	81.2	71.9	65.6	56.2	28.1	21.9	15.6	6.2	6.2	6.2
Aug. 6-12	75.0	59.4	56.2	50.0	50.0	15.6	3.1	3.1	0	0
13-19	68.8	53.1	43.8	43.8	25.0	18.8	9.4	6.2	6.2	6.2
20-26	75.0	68.8	56.2	53.1	28.1	12.5	6.2	3.1	3.1	0
27-2	68.8	65.6	56.2	43.8	12.5	9.4	3.1	3.1	0	0
Sept. 3-9	75.0	50.0	43.8	21.9	9.4	6.2	6.2	3.1	0	0
10-16	65.6	56.2	53.1	50.0	21.9	9.4	6.2	6.2	0	0
17-23	53.1	46.9	43.8	40.6	12.5	9.4	9.4	9.4	0	0
24-30	78.1	50.0	40.6	31.2	15.6	9.4	3.1	0	0	0
Oct. 1-7	59.4	43.8	37.5	28.1	9.4	6.2	3.1	0	0	0
8-14	46.9	34.4	25.0	25.0	12.5	3.1	3.1	3.1	0	0
15-21	59.4	37.5	28.1	25.0	9.4	9.4	0	0	0	0
22-28	50.0	28.1	25.0	21.9	9.4	3.1	3.1	3.1	3.1	0
29-4	62.5	56.2	46.9	31.2	12.5	3.1	3.1	0	0	0
Nov. 5-11	71.9	53.1	43.8	25.0	6.2	0	0	0	0	0
12-18	43.8	37.5	34.4	31.2	6.2	3.1	0	0	0	0
19-25	75.0	62.5	40.6	34.4	12.5	6.2	0	0	0	0
26-2	62.5	34.4	28.1	15.6	9.4	0	0	0	0	0
Dec. 3-9	71.9	56.2	40.6	25.0	6.2	0	0	0	0	0
10-16	81.2	53.1	40.6	37.5	6.2	3.1	0	0	0	0
17-23	59.4	46.9	28.1	21.9	0	0	0	0	0	0
24-31	87.5	68.8	37.5	34.4	9.4	3.1	0	0	0	0

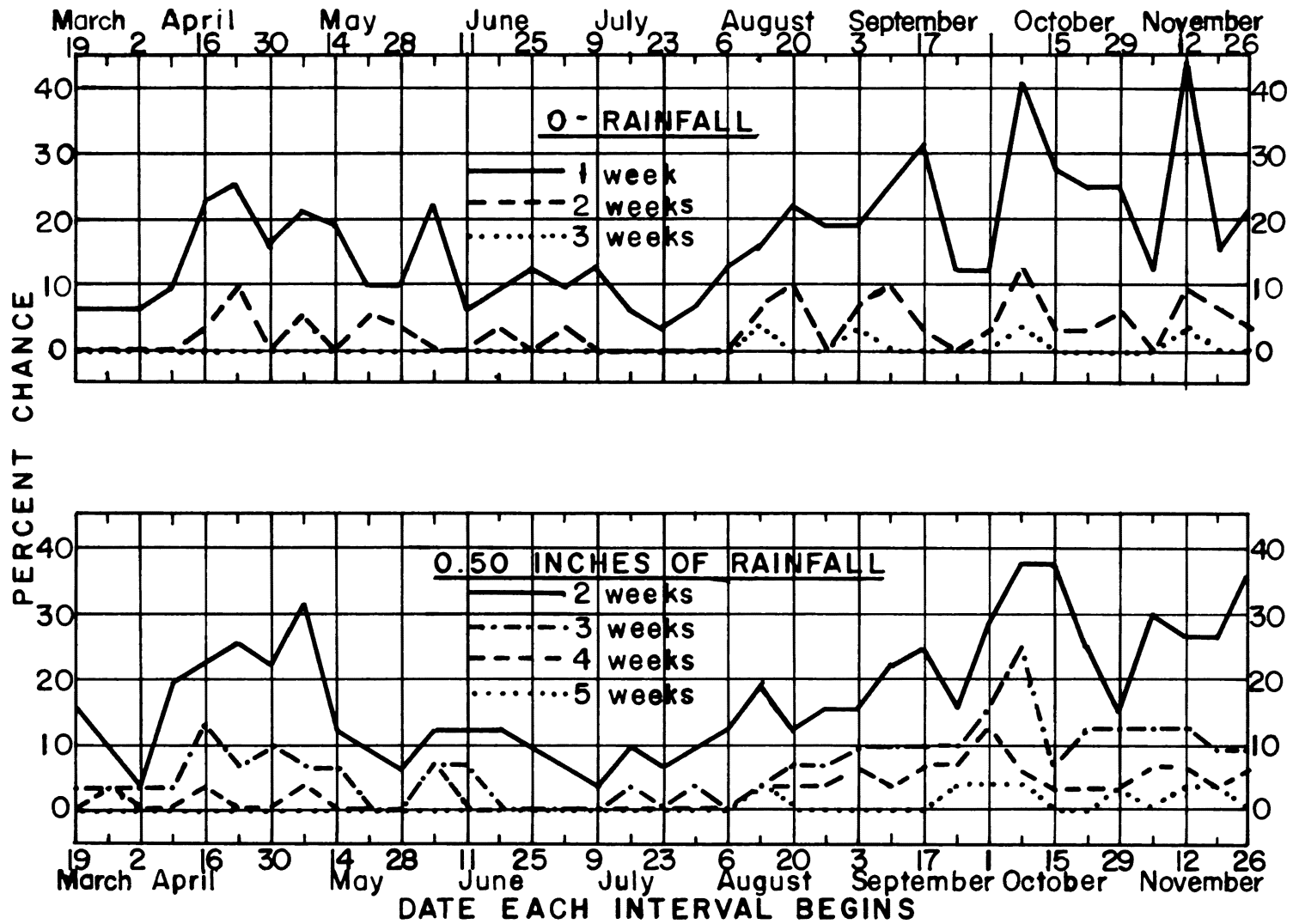


Figure 6. Chances of receiving no more than specified amounts of rainfall during various intervals at Holland.

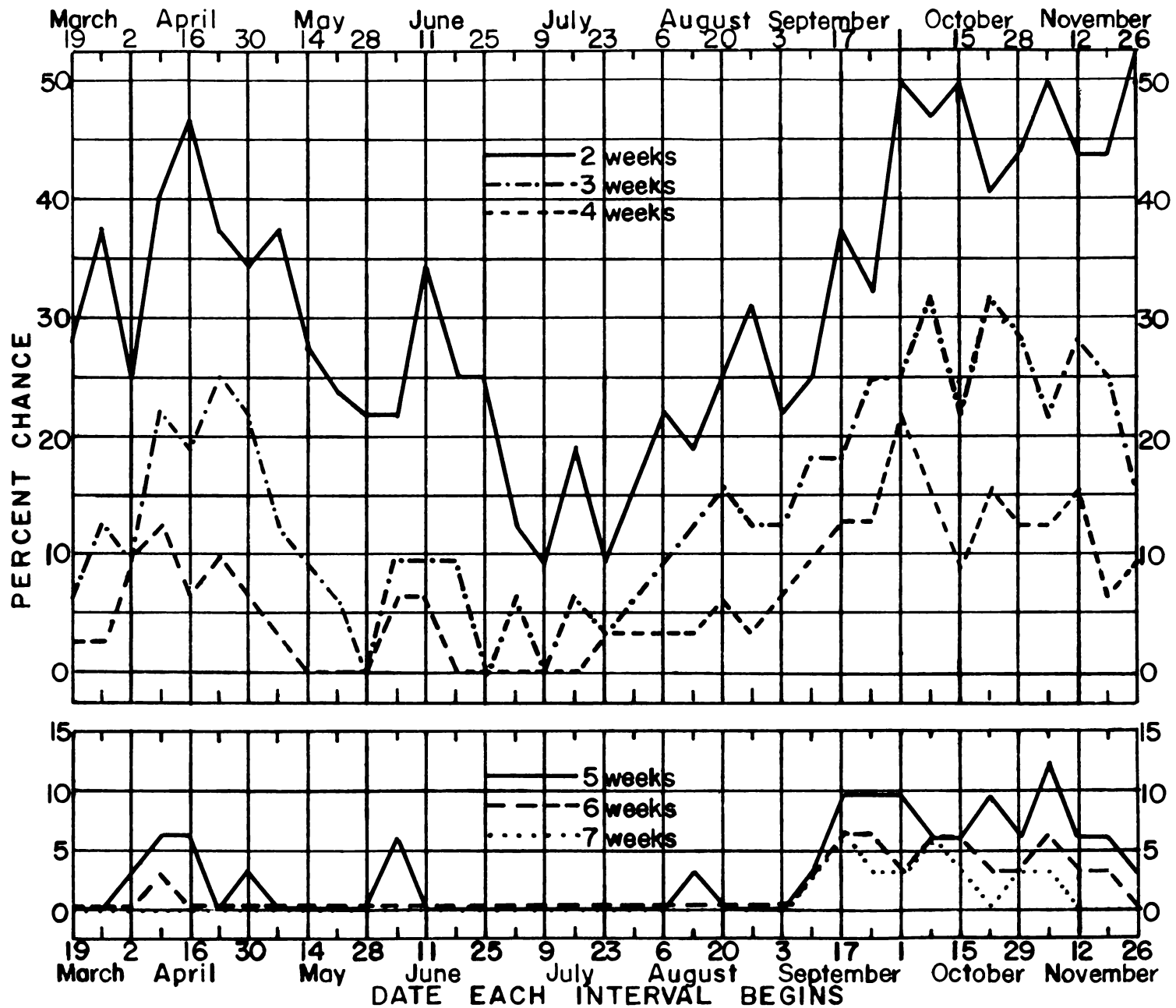


Figure 7. Chances of receiving no more than 1" of rainfall during various intervals at Holland.

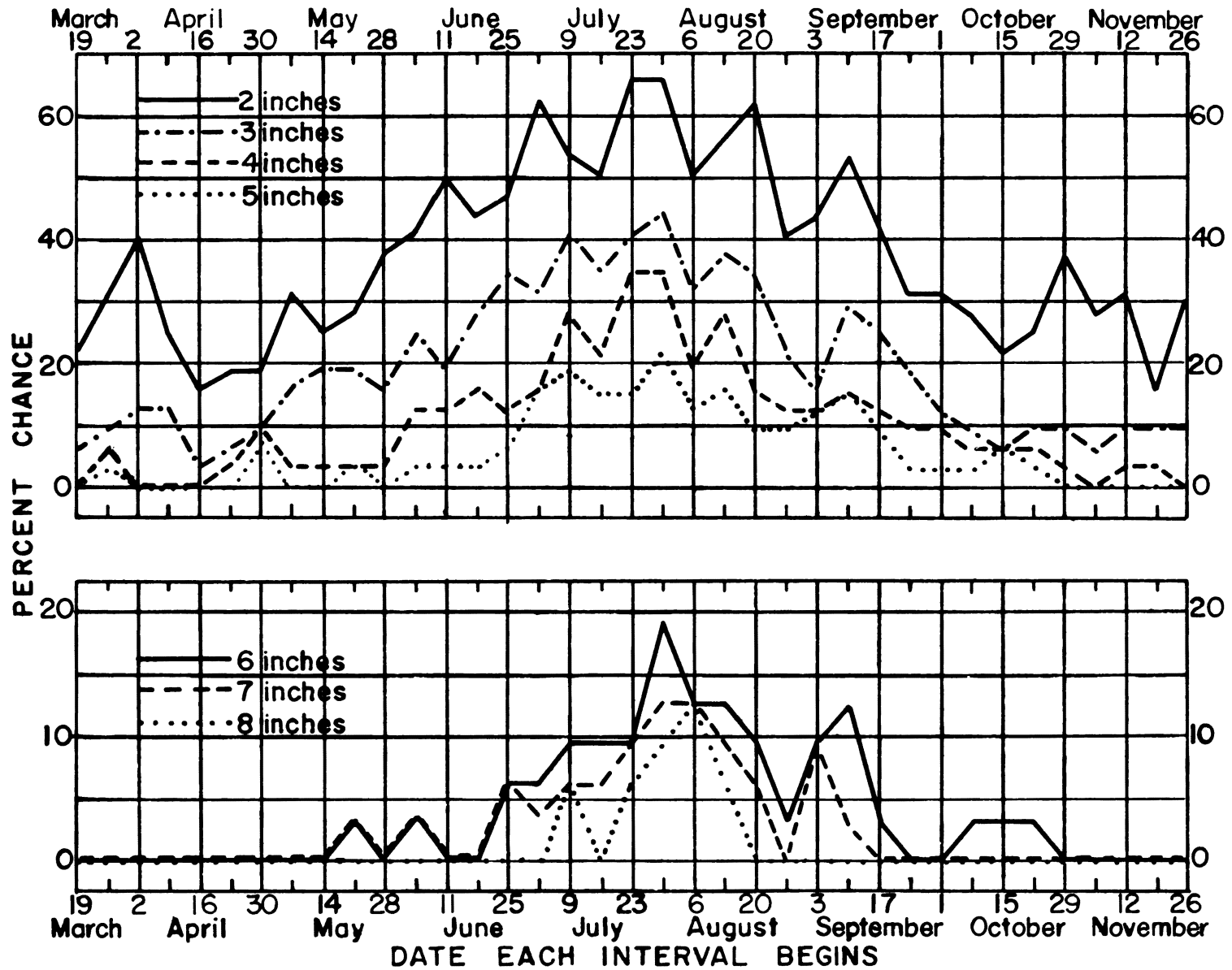


Figure 8. Chances of exceeding specified amounts of rainfall during 2-week intervals at Holland.

weeks long with only 1" of rain or less during May, June, July, and August is 15% or below. These data evidence the generally favorable rainfall pattern which may be expected for full-season crops: less rainfall during planting and harvesting, and relatively abundant rainfall when temperatures are highest. Nevertheless, it is apparent that fall-planted crops may be subject occasionally to rather extensive dry periods.

When estimating drouth risks, note that during hot months drouth conditions develop much quicker than under cool temperatures, given similar precipitation. Thus, drouth risks are somewhat greater in the summer and somewhat less in the spring and fall than indicated by the data for low rainfall given in Figures 6 and 7.

Excessive Precipitation Predictions: Excessive precipitation does occur sometimes, and may cause significant losses. In the fall of 1964, many peanut fields were not harvested because the land was too wet to support machinery before the crop rotted. Delayed plantings and exaggerated weed growth can easily result from excessive moisture in spring and early summer.

The likelihood of receiving more than 2 to 8" of rainfall in 2-week periods throughout the growing season is predicted in Figure 8. Note, that chances for more than 2" of rainfall in any particular 2-week period during June, July, and August are often 50% or higher. During these hot months, 2" of precipitation may not be excessive because of rapid drying rate. During the spring or fall, however, such rains may be excessive causing delay in many farm operations. Fortunately, the chances for heavy rains in the Holland area during the planting and harvesting season are considerably lower than for the growing season.

The graphs in the bottom part of Figure 8 show that most of the rains in excess of 6 to 8" in 2 weeks will occur principally in July and August. More than 9" of rainfall during a 2-week period occurred 3 times in the last 32 years, all during August.

Snowfall Predictions: During the past 32 years, snow accumulations have occurred only in January, February, March, April, November, and December. No more than a trace of snowfall was recorded in 5 of the 32 years (1933, 1958, 1949, 1952, 1953). The most snowfall recorded for one year (1948) is 22.5"; in one month (Feb. 1948) 18.5"; and one day (Feb. 1948) 10". In 1940, one inch of snow was received as late as April 13. The average annual snowfall at Holland is 7.5".

The predictions for certain amounts of snowfall at Holland are given in Figure 9. Since the snow from a particular storm usually melts before any subsequent storms occur in the Holland area, the 24-hour accumulation predictions may be more useful than those for the monthly totals. It is particularly interesting that chances of having 6 to 8" snows (24-hours) in March are higher than for any other month. However, the chance of such storms does not exceed 10% during any month. Also, the likelihood of having snow during March is less than for January, February, and December. Normally, the most total snowfall of any month occurs in January, followed closely by February, with considerably less expected in December.

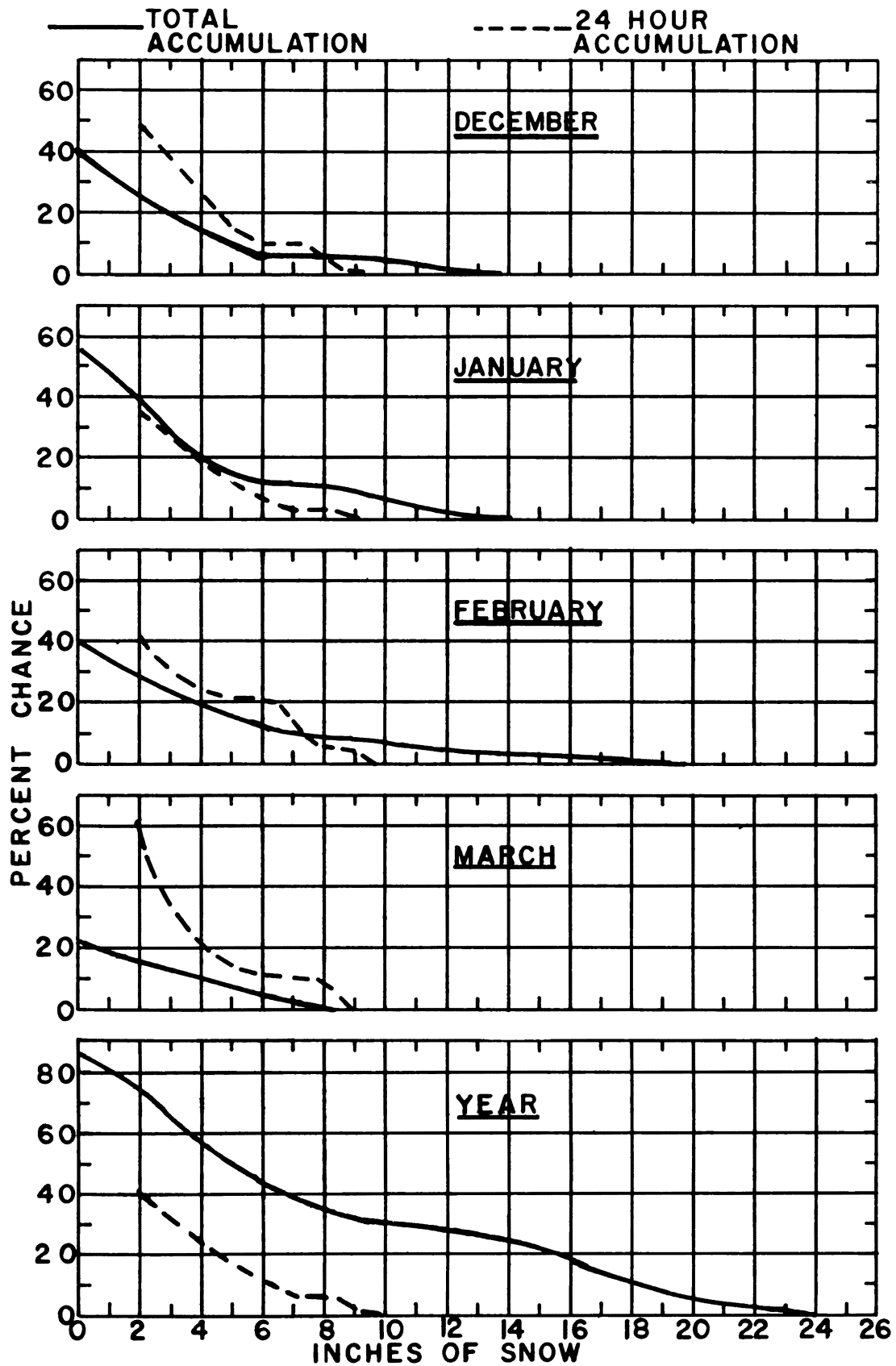


Figure 9. Chances of exceeding specified amounts of snow annually, monthly, and daily during any particular snowstorm at Holland.

ACKNOWLEDGEMENTS

Prior to 1953, much of the data used in this bulletin were obtained by the following: Mr. E. T. Batten, Mr. Raleigh Roberts, Dr. L. I. Miller, Dr. G. M. Boush, Mr. Allen H. Allison, and Dr. Wayne Howe. The U. S. Weather Bureau furnished the instruments for the 32-year period.

APPENDIX

Table 4. Number of days per month expected to have temperatures above and minimum temperatures below certain limits, Holland.

Temperature: Limit	Month											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Temperatures Above Limit												
20°F	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
25	30.8	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0
30	29.8	27.7	30.9	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	30.6
35	28.0	26.3	30.6	30.0	31.0	30.0	31.0	31.0	30.0	31.0	29.9	29.1
40	25.0	24.2	30.0	29.9	31.0	30.0	31.0	31.0	30.0	31.0	29.6	26.8
50	15.3	16.1	24.7	29.3	31.0	30.0	31.0	31.0	30.0	30.9	26.2	17.0
60	7.9	7.3	15.5	24.9	30.3	30.0	31.0	31.0	30.0	28.6	17.9	7.9
70	2.1	1.7	6.9	14.8	25.7	29.2	30.9	30.9	27.7	19.0	7.6	1.4
80	0	0	1.1	6.2	15.0	23.3	28.1	26.6	17.2	5.1	0.8	0
90	0	0	0	0.5	2.2	9.1	10.9	7.7	3.4	0.2	0	0
99	0	0	0	0	0.1	0.3	0.4	0.1	0	0	0	0
Temperatures Below Limit												
1°F	0.3	0.1	0	0	0	0	0	0	0	0	0	0
6	0.6	0.2	0	0	0	0	0	0	0	0	0	0.1
11	1.2	0.6	0	0	0	0	0	0	0	0	0.2	0.4
16	2.8	1.9	0.2	0	0	0	0	0	0	0	0.3	1.9
21	6.0	4.0	1.0	0	0	0	0	0	0	0	0.7	4.9
26	11.6	8.4	3.6	0.3	0	0	0	0	0	0.2	3.0	9.9
31	17.0	14.5	8.4	2.2	0.1	0	0	0	0	1.0	7.4	17.0
36	22.1	19.6	14.5	5.3	0.4	0	0	0	0	3.5	13.2	22.7
41	25.8	23.2	20.3	10.0	1.8	0.1	0	0	0.4	7.8	18.3	25.8
51	29.8	26.9	27.3	19.8	8.7	1.3	0.1	0.7	4.4	17.5	25.3	29.5
61	30.9	27.9	30.3	27.9	22.0	8.9	4.1	5.7	13.9	26.8	29.4	30.8
71	31.0	28.0	31.0	30.0	30.8	26.8	22.7	23.7	27.8	30.9	30.0	31.0
81	31.0	28.0	31.0	30.0	31.0	30.0	30.9	30.9	30.0	31.0	30.0	31.0
91	31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0