THE EFFECT OF CLIMATIC CONDITIONS ON THE RATE OF GROWTH OF DATE PALMS

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(WITH ONE FIGURE)

The observations on which this study of the effect of climate on the rate of growth of date palms is based were made at the Cooperative Date Orchard, Tempe, Arizona, by F. H. SIMMONS, at the suggestion and under the supervision of Director R. H. FORBES of the Arizona Agricultural Experiment Station. The length of every leaf on four palms—two Deglet Noors and two Rhars—was carefully measured weekly during 1906 and 1907. By the system adopted the maximum error did not exceed one-quarter inch. In addition to the leaf measurements, daily records were kept of maximum and minimum atmospheric temperatures, and of soil temperatures at one foot, three feet, and five feet below the surface. A record of the level of the ground water was also kept, but this factor probably had no influence on the rate of growth, since the deeper roots were immersed in water at all times throughout the two years.

The data representing the weekly growth of all the separate leaves are too voluminous to use in their entirety. In most cases, after a new leaf has emerged well from the central bud, it makes the greater part of its growth in five or six weeks. After that the weekly growth, as shown by elongation, becomes much less, and finally appears as a negative quantity. This is due to the base of the leaves surrounding the entire stalk, which, as it expands, tends to draw the leaf as a whole lower down on the stalk. After repeated trials to obtain from this mass of data a series of consistent and comparable figures representing weekly growth, it was found that the sum of the elongation of the inner five leaves, that were unfolded sufficiently to be measured, gave the most satisfactory series. These were then calculated for each of the four palms and plotted as a curve, the ordinates of which represent the weekly growths (fig. 1). The maximum and minimum daily temperature,

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and the daily soil temperature one foot below the surface at 7:00 A.M. are also plotted.

The temperature factor, as influencing the rate of growth, has other components than those expressed by maximum and minimum alone, because duration of temperature is of the utmost importance. The soil temperature is to a certain extent an index of all these, but in this case is modified by still other factors, such as evaporation. Continuous thermographic records were lacking, so that it became necessary to construct somewhat arbitrary ones. In the dry air and under the clear skies of Arizona the thermographic record is subject to relatively few variations from a normal form. In general the lowest point of the curve falls about sunrise, and the highest at 1:00 or 2:00 P.M. By the use of these points a fairly accurate thermographic record for this region can be drawn from the daily maximum and minimum temperatures. This alone, however, furnishes no usable data for the construction of a curve representing the total daily amount of heat received. If we assume some empirical temperature as that below which no marked growth takes place, and use this as a base line on the thermograph sheet, the areas lying above this line represent, at least relatively, the heat available for growth.

The selection of such a base line is not an easy matter, and at best must be somewhat arbitrary. The data obtained, however, will be relative and consistent on any base line chosen. For the present case 50° F. was selected, because the date palm does not seem to utilize temperatures below that, at least to any marked degree. Growth after the surface soil temperature reached 50° F. was practically nothing. This is not to be construed as meaning that no growth would occur at a uniform temperature of 50° F., but under actual climatic conditions the minimum temperature which would accompany a maximum of 50° F. would effectually inhibit growth. It will be noticed in this connection that during the first week of January 1906 growth was entirely inhibited, while during the winter of 1907, when the daily maximum was always above 50° F. and the minimum seldom below 30° F., growth never entirely ceased.

The curve representing the weekly heat-time areas, when plotted

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along with those representing the growth of the palms, coincides in general with them, with one exception. Both years the rate of growth was maintained late into the fall considerably in excess of the amount of heat available. This may have been due to the continuance of the great activity which the plant experienced during the late summer and early fall months; that is, it was in better condition to utilize the available heat at this time than at a corresponding period in the spring.

The curves for the rate of growth show it to be the most active, not at the period of highest maximum, but rather at that of the highest minimum temperatures, which means warm nights. This falls in July, August, and sometimes September; and it is at this time that weakly palms recover their vitality. By far the greater part of the total yearly growth falls in the last half-year. The spring growth is much less luxuriant than the fall growth. The warm nights of July and August are due to the somewhat increased humidity, which prevents the usual rapid radiation after sundown. Humidity in itself is undoubtedly an important factor, but probably has less to do with the rate of growth of date palms than with other plants.

The chief relations of temperature to the rate of growth of date palms according to these measurements are: first, the period of maximum growth coincides with that of highest minimum rather than with that of highest maximum temperature, and this falls during the summer period of highest relative humidity; second, the rate of growth throughout the entire year is, in most cases, in proportion to the heat-time units over 50° F.

The rate of maturation of the fruit is probably influenced by the same factors as the rate of growth of the foliage. The effect of high minimum temperature in promoting the maturing and ripening of the Deglet Noor date has recently been called to the writer's attention by M. BRIQUEZ, the civil governor of Gafsa in Southern Tunis. The oasis of Gafsa, which lies not over 75 miles northeast of the Djerid region, where the finest Deglet Noor dates are produced, produces only second quality fruit. The difference in altitude between the two oases is about 900 feet, Gafsa being 1126 feet and Tozeur in the Djerid 197 feet. The two are separated by

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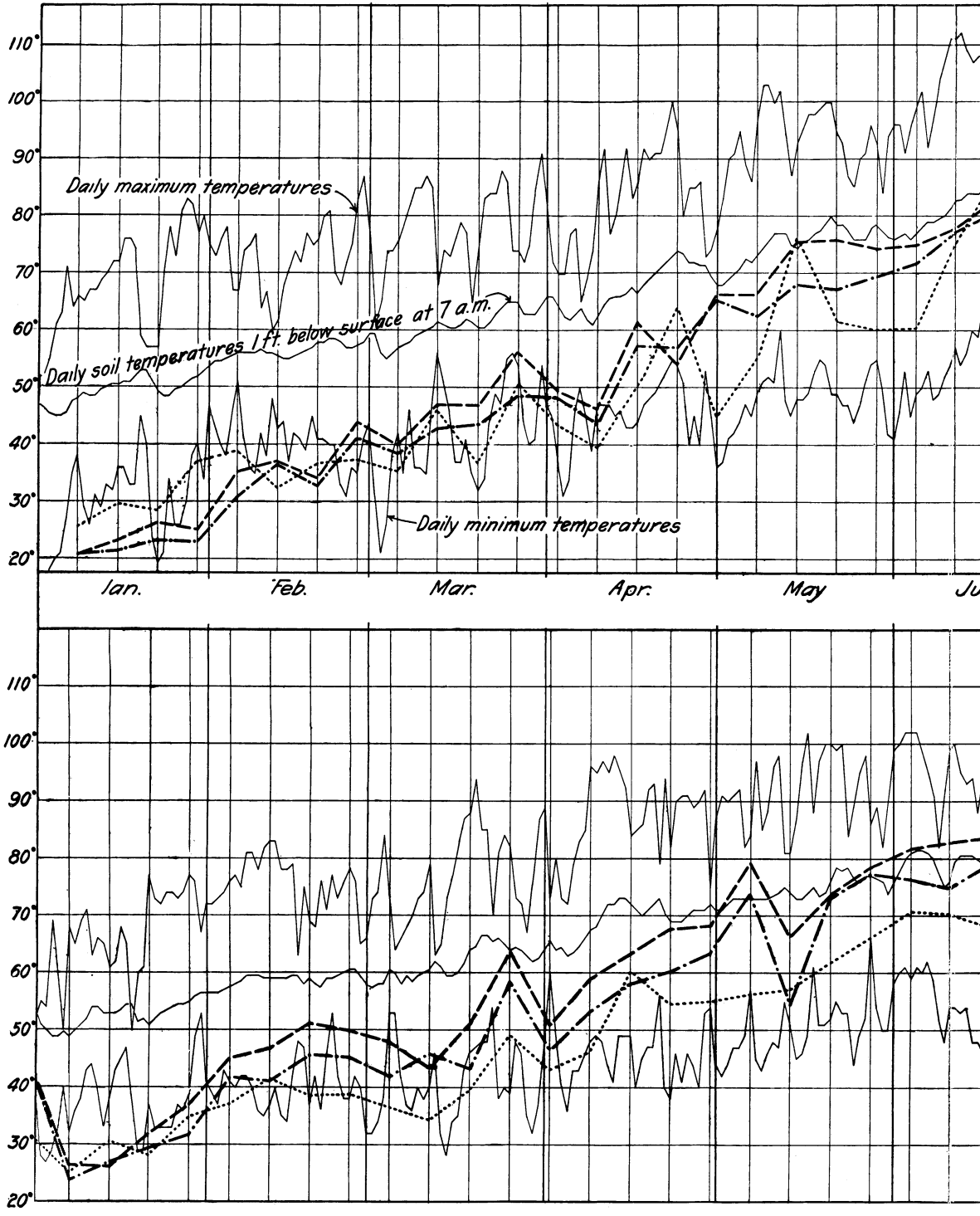

FIG. 1.—Curves showing the relation between tempera

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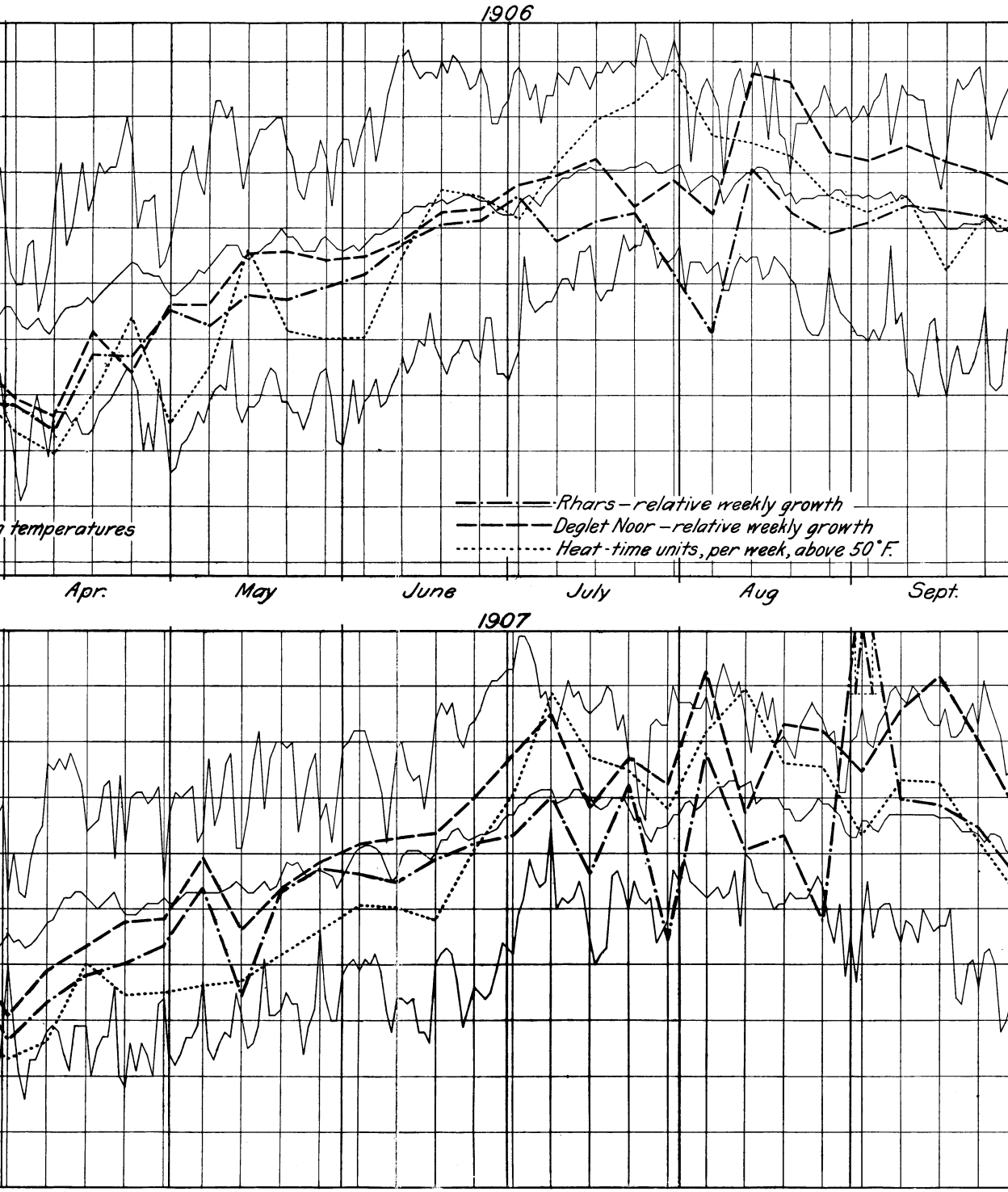

FIG. 1.—Curves showing the relation between temperature conditions and the rate of growth of Deglet Noor and Rhars date palm

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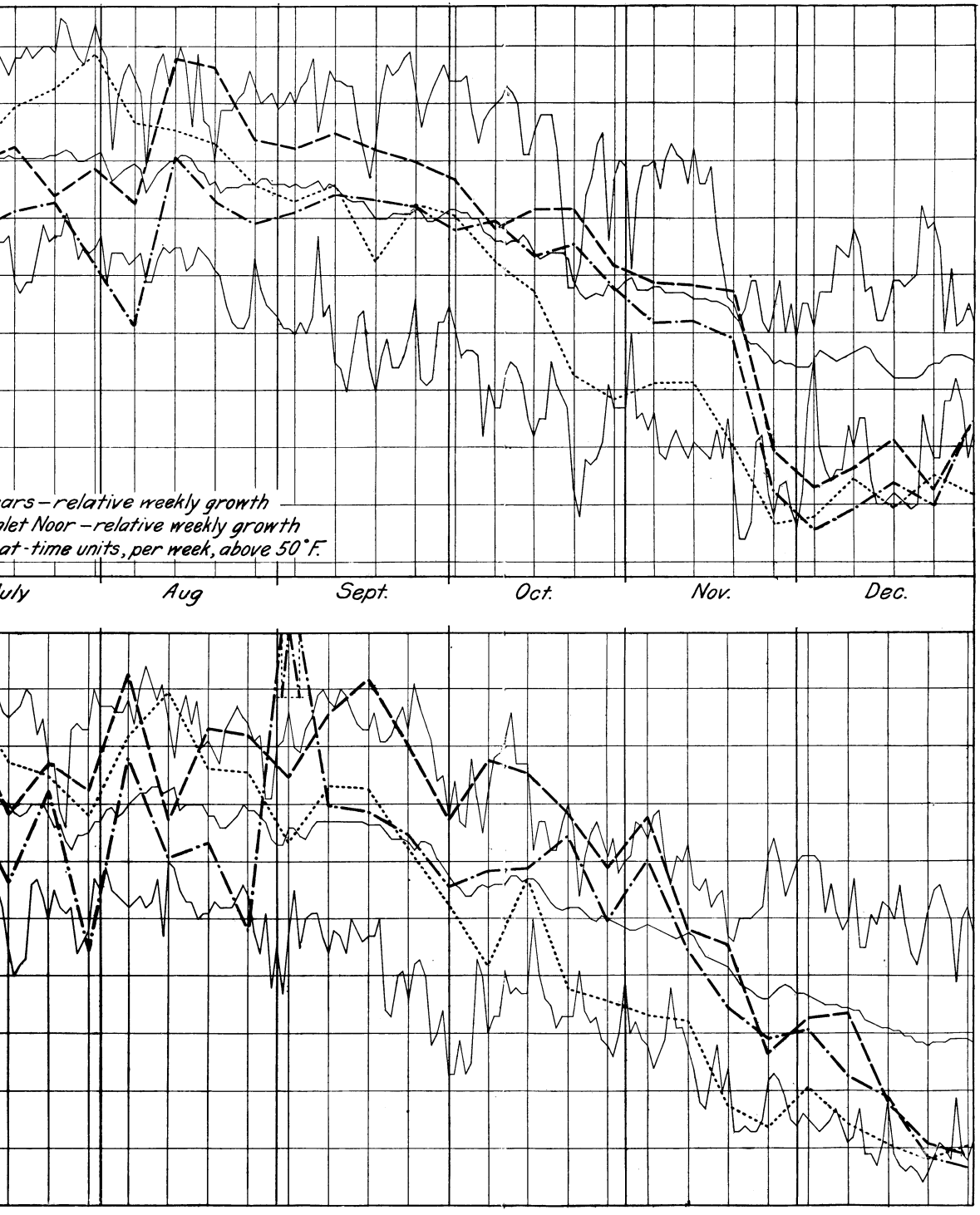

the rate of growth of Deglet Noor and Rhars date palm

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several ranges of very low mountains, but the Djerid is exposed to the Sahara on the south. The result is that while the day temperatures at Gafsa are only 6 or 7° F. cooler than at Tozeur, the night temperatures vary by 30 or 35° F. Thus, high minimum temperature seems to be a more important factor in determining the maturation of the fruit than high maximum temperature. This observation is in perfect harmony with the curves for rate of growth obtained at Tempe, Arizona.

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