Growing Degree Days for Corn in Kentucky

By D. B. Egli, Doyle Cook, Allen B. Elam and C. G. Poneleit

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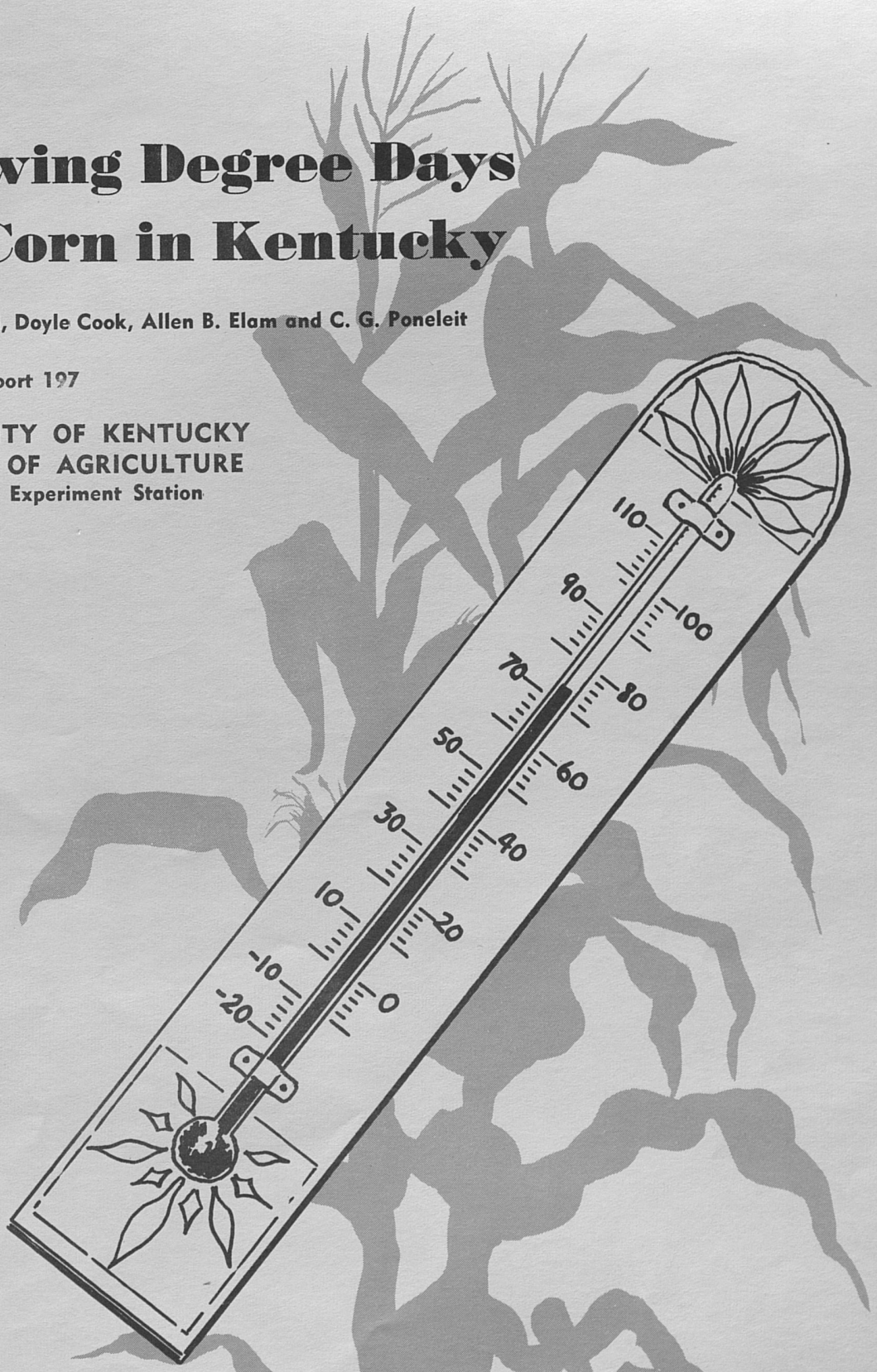

Growing Degree Days for Corn in Kentucky

D. B. Egli,[1] Doyle Cook,[2] Allen B. Elam, Jr.,[3] and C. G. Poneleit[4]

Selection of a corn hybrid is based on many factors. One of the factors of particular concern to the farmer is the maturity rating of the hybrid. Maturity rating systems in the past have included the use of the number of calendar days from planting to maturity or were systems in which hybrids were compared with a standard hybrid and assigned relative maturity ratings. The 1967 growing season, which was unusually cool throughout much of the corn belt, pointed up the shortcomings of the older systems of labeling corn maturities. Primarily as a result of the cool weather, many corn hybrids did not mature when they were supposed to, and farmers sent millions of bushels of high-moisture corn to market.

The growth and maturity of a corn hybrid are closely related to daily and seasonal temperature levels. Consequently, a maturity rating system based on temperature should provide a better index of maturity than one not related to temperature.

GROWING DEGREE DAYS

Since corn growth is largely controlled by seasonal temperature levels, it has long been postulated by many agronomists and corn breeders that a more accurate scheme for labeling corn hybrid maturity is possible by applying the concept of growing degree days. The growing degree day approach is a method of predicting corn maturities by summing the mean daily temperatures above an assumed base or threshold temperature. It is assumed that little or no plant growth occurs below the selected threshold. A base temperature of 50 degrees (F) is usually assumed for corn. A particular hybrid has a rather specific growing degree requirement sometimes called the varietal constant. Thus, regardless of the planting date or location, the hybrid will mature when the total number of accumulated growing degree days is equal to the varietal constant, assuming relatively normal growing conditions.

By knowing the varietal constant for various hybrids, it is possible to use the information presented in this publication to choose a hybrid that will mature at the desired time—or for late plantings or double cropping management systems, to select a hybrid that will have a reasonable chance of maturing before frost.

Methods of Calculation of Degree Days

Growing degree days for Kentucky were calculated by averaging the maximum and minimum air temperatures for a particular day and subtracting the base temperature (50 degrees F.). This gives the growing degree days for that day.

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For example, if the maximum air temperature was 80 and the minimum was 60, the average for that day would be $\frac{80 + 60}{2} = 70$. Subtracting the base of 50 gives 20 growing degree days for that day.

The following modification was applied to the basic daily growing degree equation. If the maximum air temperature exceeded 86°F, 86°F was used as the maximum to calculate the mean. This largely eliminates the excessive accumulation of growing degree days in periods of dry, hot weather when corn is usually under moisture stress during the hot portion of the day. Similarly, if the minimum air temperature was less than 50°F, 50°F was used as the minimum air temperature to calculate the mean. This corrects for a deficient accumulation of growing degree days when the maximum air temperature may be in the 60's while the night temperature drops quickly to a value below 50. The growing degree days were than accumulated across the growing season.

It has been shown (1)[5] that the time of day at which temperature readings are made at a particular weather station can influence the mean temperature observed and the growing degree day accumulation for that station. Consequently, all stations used in this summary were adjusted to a common observation time (midnight), following the method developed by Weaver and Miller (2).

The summation of growing degree days began on March 15 in each year and stopped with the first frost (minimum air temperature less than 28°F) in the fall. Thirty-nine National Weather Service climatological stations in Kentucky were the source of the data used to calculate the growing degree data presented in the accompanying charts. The stations used and their locations are presented in Fig. 1. Temperature data for the period 1949-68 were utilized for most stations; however, at some stations shorter periods of record were used as a result of missing or irregular data.

USE OF DATA

Figure 2 represents the mean number of growing degree days occurring from March 15 to the first frost in the fall. Differences in terrain and exposure may cause local variations from the values in Figure 2, particularly in the mountainous areas of eastern Kentucky.

Figures 3 through 6 represent the mean date that totals of 2400, 2800, and 3200 growing degree days were reached when the accumulation is started on various dates, for the various climatological divisions of Kentucky (see Fig. 1 for the climatological divisions). These figures make it possible to determine the approximate date of maturity for a range of planting dates and varietal constants. Corn planted on these dates and requiring less than 3200 growing degree days to reach maturity will mature before frost at most locations in Kentucky.

For example, in the western part of the state (Western Division), a hybrid that requires 2800 growing degree days to reach maturity, if planted on April 5 would reach maturity, on the average, approximately August 24.

5/ Numbers in parenthesis refer to the references listed at the end of this publication.

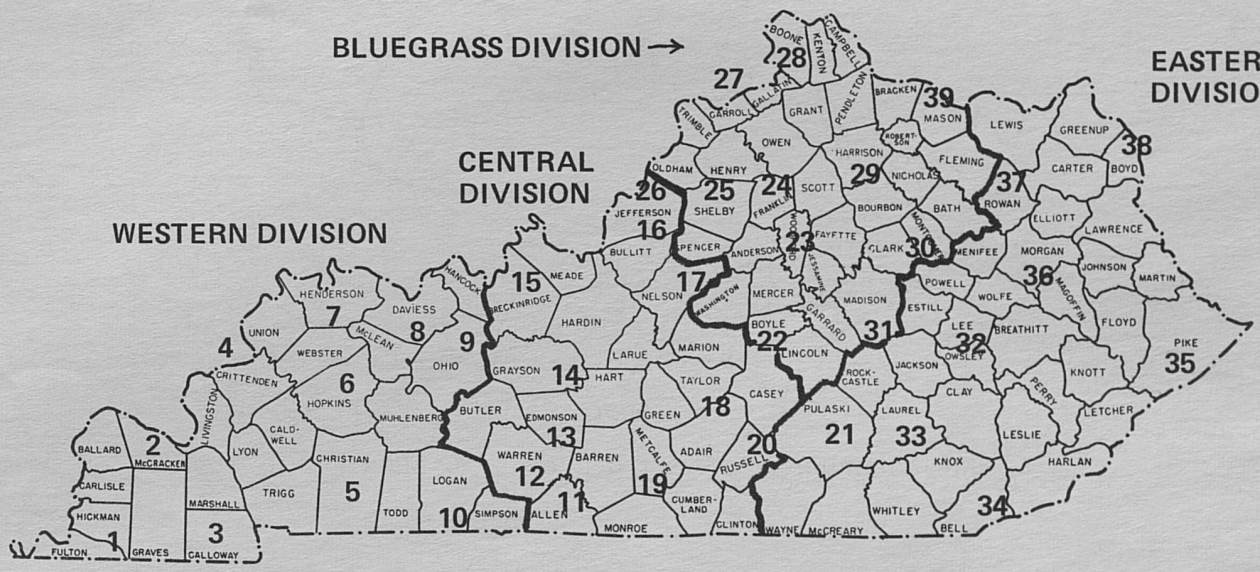

Fig. 1.—Stations from which temperature records were used.

1. Hickman
2. Paducah FAA
3. Murray
4. Fords Ferry
5. Hopkinsville
6. Madisonville
7. Henderson
8. Owensboro
9. Beaver Dam
10. Russellville
11. Scottsville
12. Bowling Green FAA
13. Mammoth Cave
14. Leitchfield
15. Irvington
16. Louisville WB
17. Bardstown
18. Campbellsville
19. Summer Shade
20. Wolf Creek Dam
21. Somerset
22. Danville
23. Lexington WB
24. Frankfort
25. Shelbyville
26. Anchorage
27. Carrollton
28. Covington
29. Cynthiana
30. Mount Sterling
31. Richmond
32. Heidelberg
33. London FAA
34. Middlesboro
35. Pikeville
36. West Liberty
37. Farmers
38. Ashland
39. Maysville

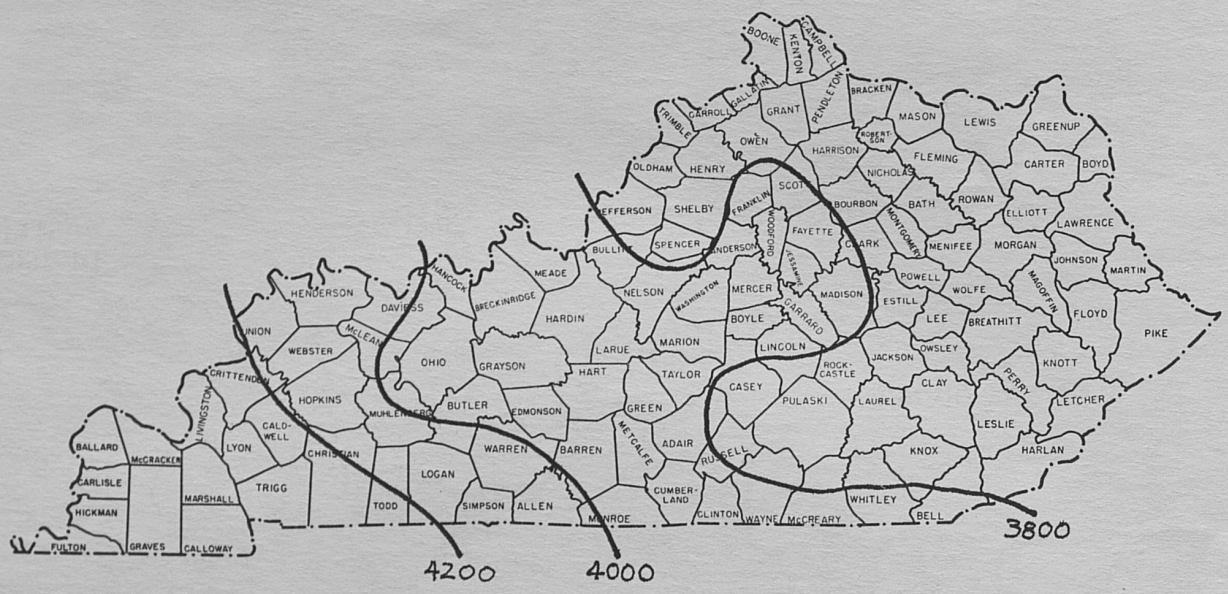

Fig. 2.—Mean number of growing degree days, March 15 to frost.

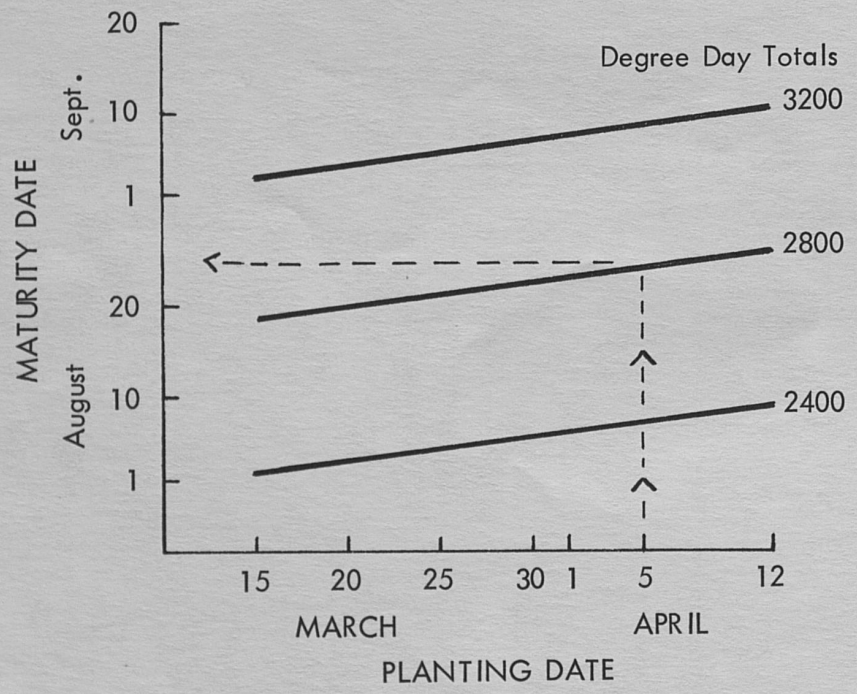

Fig. 3.—Mean date that various totals are reached for a given planting date, Western Division. For example, a hybrid requiring 2800 growing degree days for maturity, if planted on April 5 would reach maturity, on the average, on August 25 (dotted line).

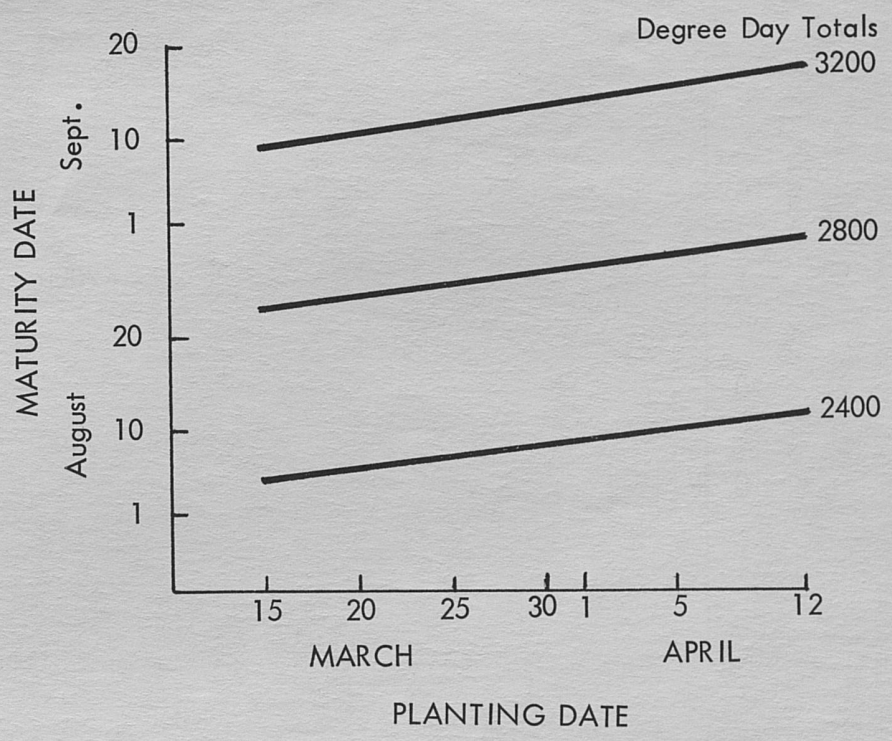

Fig. 4.—Mean date that various totals are reached for a given planting date, Central Division.

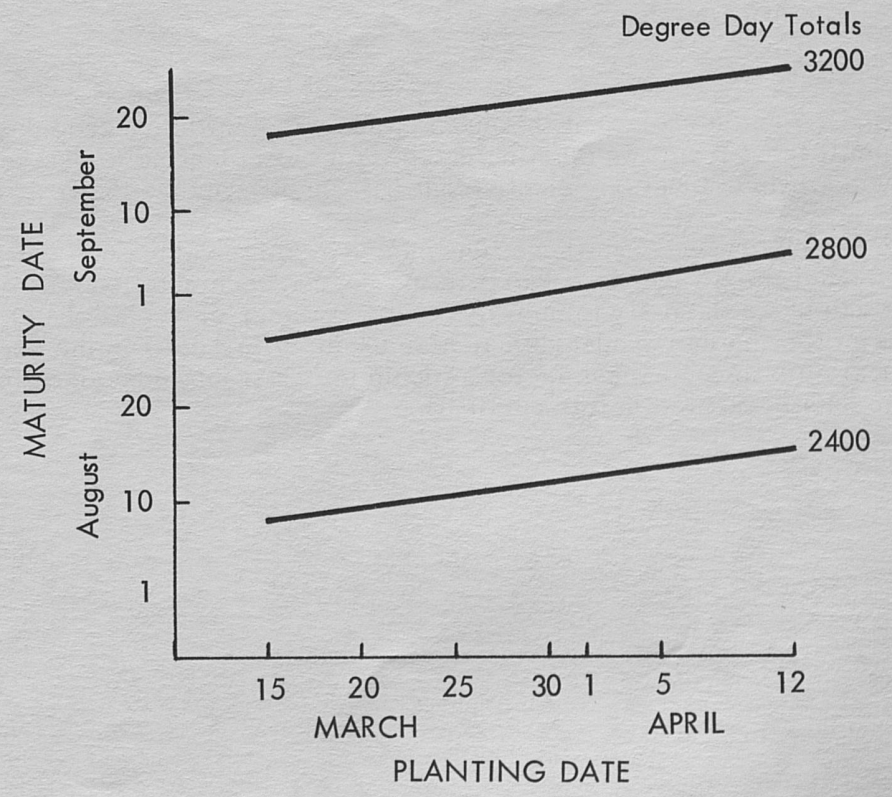

Fig. 5.—Mean date that various totals are reached for a given planting date, Bluegrass Division.

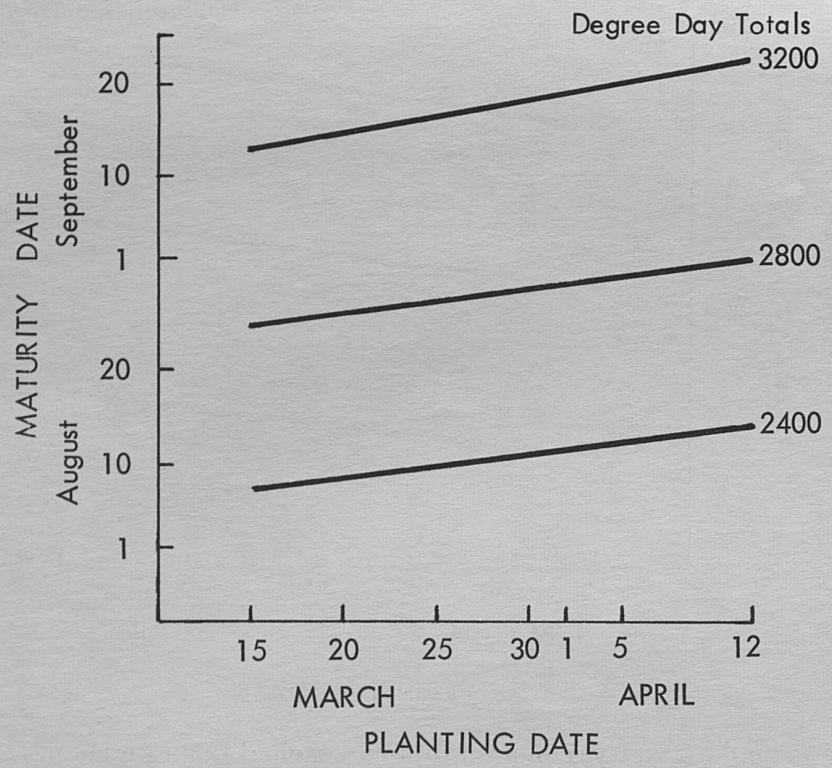

Fig. 6.—Mean date that various totals are reached for a given planting date, Eastern Division.

Figures 7 and 8 represent the mean number of growing degree days remaining until frost from two starting dates. As corn planting is delayed into May and June a hybrid must be selected that will mature before the first frost.

The values presented in these figures are average values calculated from long term temperature records. The growing degree accumulation will deviate from these values as the daily temperatures are warmer or cooler than normal. Differences in terrain and exposure may also cause differences in the accumulation in local situations. These factors should be taken into consideration when utilizing the data presented in this publication.

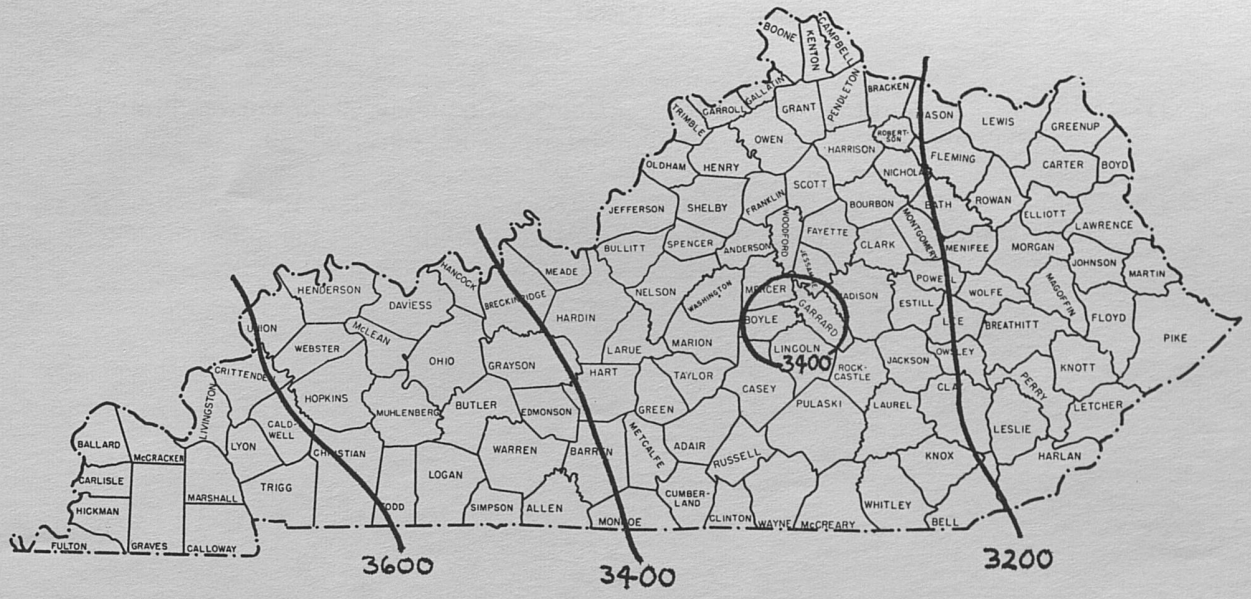

Fig. 7.—Mean number of growing degree days remaining until frost after May 10.

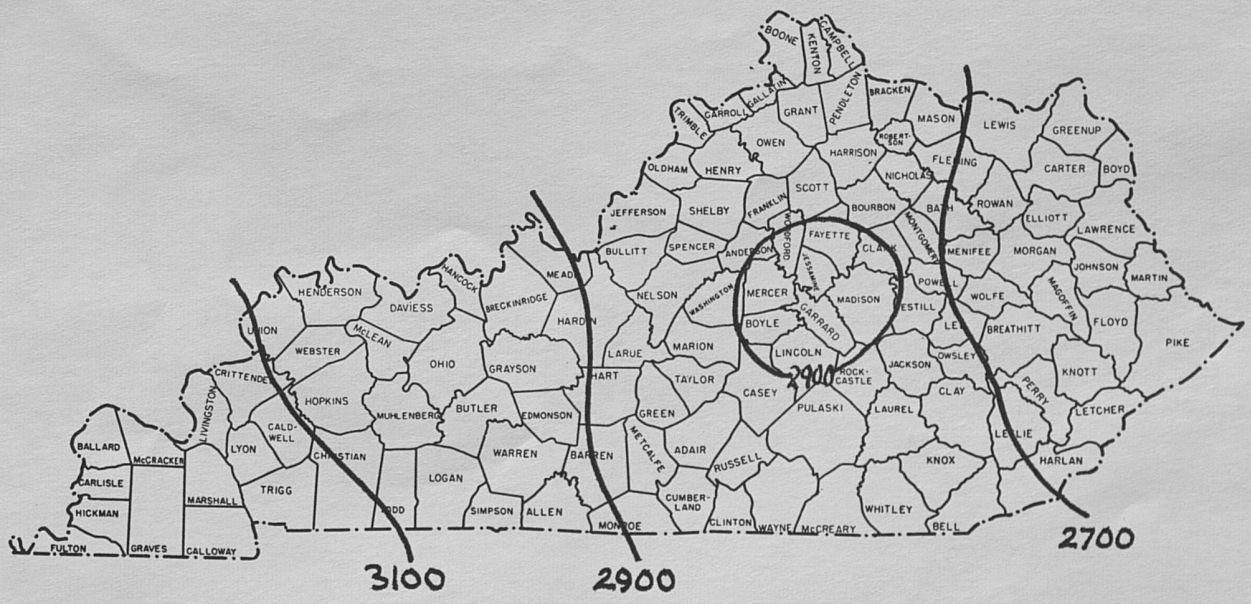

Fig. 8.—Mean number of growing degree days remaining until frost after June 7.

REFERENCES

(1) Mitchell, J. Murray, Jr. 1958. Effect of Changing Observation Time on Mean Temperature. Bull. Amer. Meteor. Soc. 39(2):83-89.

(2) Weaver, C. R. and M. E. Miller. 1970. Temperature Adjustments for Discrepancies Due to Time of Observation (unpublished manuscript).

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