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GUIDE

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Growing Degree Days for Hybrid Corn Production

Northeast Missouri

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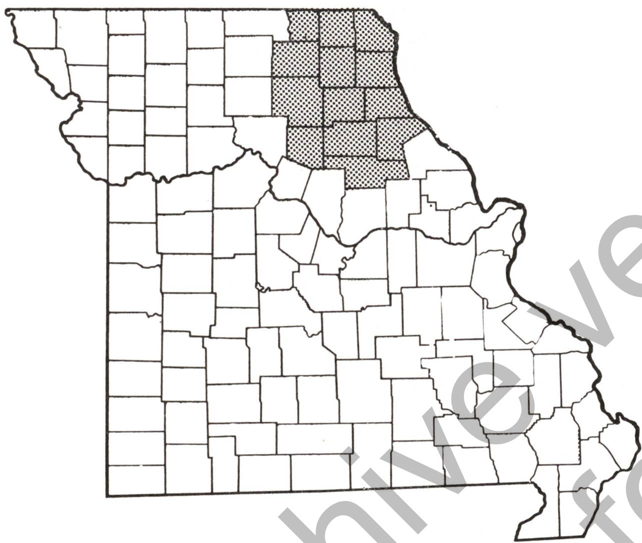

Figure 1. Area of applicability of this guide

Calculation of Growing Degree Days

In 1970 the Hybrid Seed Corn Industry adopted a new method for rating the maturity of corn. This method uses the thermal unit approach to the prediction of maturity which is more accurate than the old "days-to-maturity" ratings.

This new method is Growing Degree Days (GDD) and is based on the number of heat units necessary for corn to reach physiologic maturity.

These GDD's are calculated by subtracting a base temperature from the average of the maximum and minimum daily temperature. Corn growth diminishes when the temperature drops below 50°F, and when the temperature rises above 86°F the growth mechanism has a difficult time in using all of the heat energy that is available.

Consequently the GDD's are calculated according to the following definition:

$$GDD = \frac{\text{Max Temp } (\leq 86°F) + \text{Min Temp } (\geq 50°F)}{2} - 50°F$$

The maximum temperature is the highest temperature for the day (adjusted downward to 86°F if necessary) and the minimum temperature is the lowest for the day (adjusted upward to 50°F, if necessary). For example, if the high temperature for the day is 90°F and the minimum is 60°F

$$GDD = \frac{86+60}{2} - 50 = 23.$$

If, on the other hand, the maximum temperature was only 56°F and the minimum 40°F, then,

$$GDD = \frac{56+50}{2} - 50 = 3.$$

If the highest temperature for the day is equal to or less than 50, GDD = 0.

Calculation of the number of GDD's for any day can be simplified by using the nomogram presented in Figure 2. It was developed by Paul J. Waite, National Weather Service's Climatologist for Iowa. If, for example, the temperature extremes were 84°F and 56°F, by entering the left side of the graph with the minimum temperature (56) and the top of the graph with the maximum temperature (84), the number of GDD's (20) can be read at the point of intersection. In this way a grower may calculate and accumulate the GDD as the season progresses.

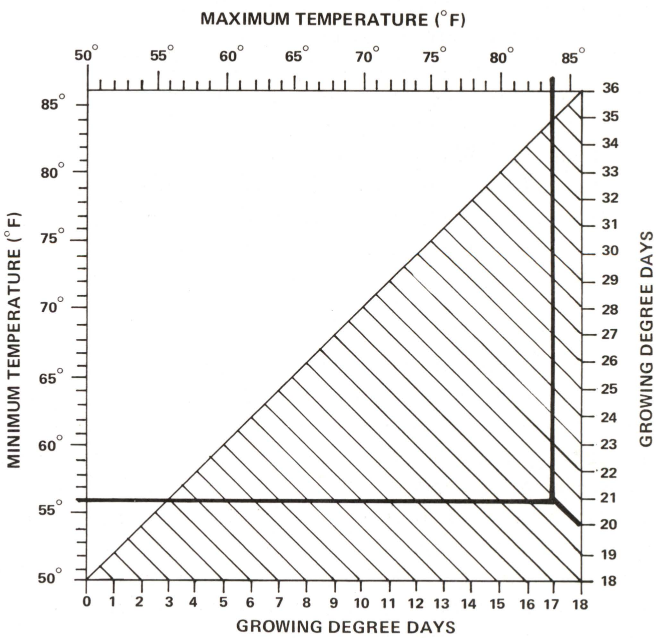

Figure 2. Nomogram for calculating growing degree days. (by Paul Waite)

Source of Data

For the area of northeastern Missouri indicated in Figure 1, data from the National Weather Service's cooperative observers located in Kirksville, Macon and Steffenville were used. Thirty years of data (1940-1969) from these three stations were analyzed using the computer facilities of the University of Missouri-Columbia. Then, the data were combined to produce the following table and figures.

Discussion and Explanation of the Table and Graphs

Data of the average monthly Growing Degree Days for northeastern Missouri are represented in Table 1 and Figures 3 and 4. In the region, the growing season for corn seldom begins before mid April and usually ends in October. Thus, these computations were made only for that seven-month period.

Table 1 is the tabular listing of the average number of Growing Degree Days for each week during the growing season. The standard deviations are presented as a measurement of the variability of the GDD's. As this table indicates, there is a much greater variability in the spring than in the summer. This is explained by the climatic conditions of northeastern Missouri. Spring is a time of conflict between the lingering winter air masses and the warm southern air masses. For example, in 1967 winter seemed slow to leave and the temperatures averaged 5°F below normal. The GDD's were only 318, which was 160 below normal. On the other hand, in the spring of 1962 the warm southerly air mass arrived early and May averaged about 8°F above normal. The accumulated GDD's for the month were 618 or 140 above normal. Summertime temperature variations are generally much smaller from year to year. Thus, while GDD's seldom vary more than 20 percent from summer to summer, they can be expected to vary as much as 33 percent from spring to spring.

Figure 3 is an indication of the dependency of the rate of accumulation of GDD's on the planting date. For example, if one normally plants on April 30, he would expect that it would take 132 days to accumulate 2700 GDD's while if he planted on May 15, it would take 127 days to accumulate the same number of GDD's.

Figure 4 indicates the probability of the last spring and the first fall freezes in graphic form along with the graphic presentation of accumulated growing degree days from April 1, May 1 and June 1, for northeastern Missouri. The user may first determine under what freeze risk he is willing to plant. This would indicate the date he would want to start accumulating GDD's.

For example, if he was willing to accept a 20 percent risk of frost, he would not plan to plant before April 30. And, if the corn was rated at 2700 GDD's, he would, on the average, expect the corn to reach maturity around September 11. Freezing temperatures do not normally occur this early in northeastern Missouri. However, if due to some circumstances planting was delayed until June 1, he would not expect to accumulate 2700 GDD's before October 8, which would indicate about 30 percent risk of frost before the corn crop could reach maturity.

It is also possible to obtain the average length of the growing season from Figure 4. The number of days from the date of the 50 percent probability of the last spring freeze to the date of the 50 percent probability of the first fall freeze is the average length of the growing season. Thus, for northeastern Missouri the average growing season runs from April 19 to October 14, a total of 178 days.

Table 1. AVERAGE GROWING DEGREE DAYS BY WEEK

Week Ending		Mean	SD*	Week Ending		Mean	SD*
April	11	38	21	July	25	173	19
April	18	51	26	August	1	177	18
April	25	67	24	August	8	172	19
May	2	74	28	August	15	161	21
May	9	85	36	August	22	156	20
May	16	90	31	August	29	154	25
May	23	101	33	September	5	148	26
May	30	112	27	September	12	128	23
June	6	128	28	September	19	120	29
June	13	146	26	September	26	99	22
June	20	144	25	October	3	90	25
June	27	158	23	October	10	83	27
July	4	165	19	October	17	79	28
July	11	166	17	October	24	66	27
July	18	170	19	October	31	50	28

*SD = Standard Deviation of Mean

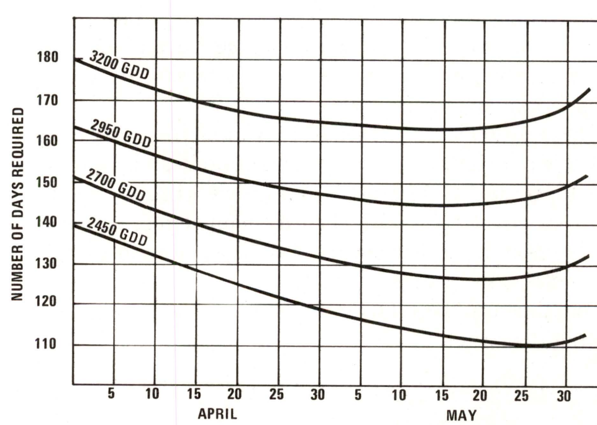

Figure 3. The average number of days required to accumulate a specified number of growing degree days for various planting dates.

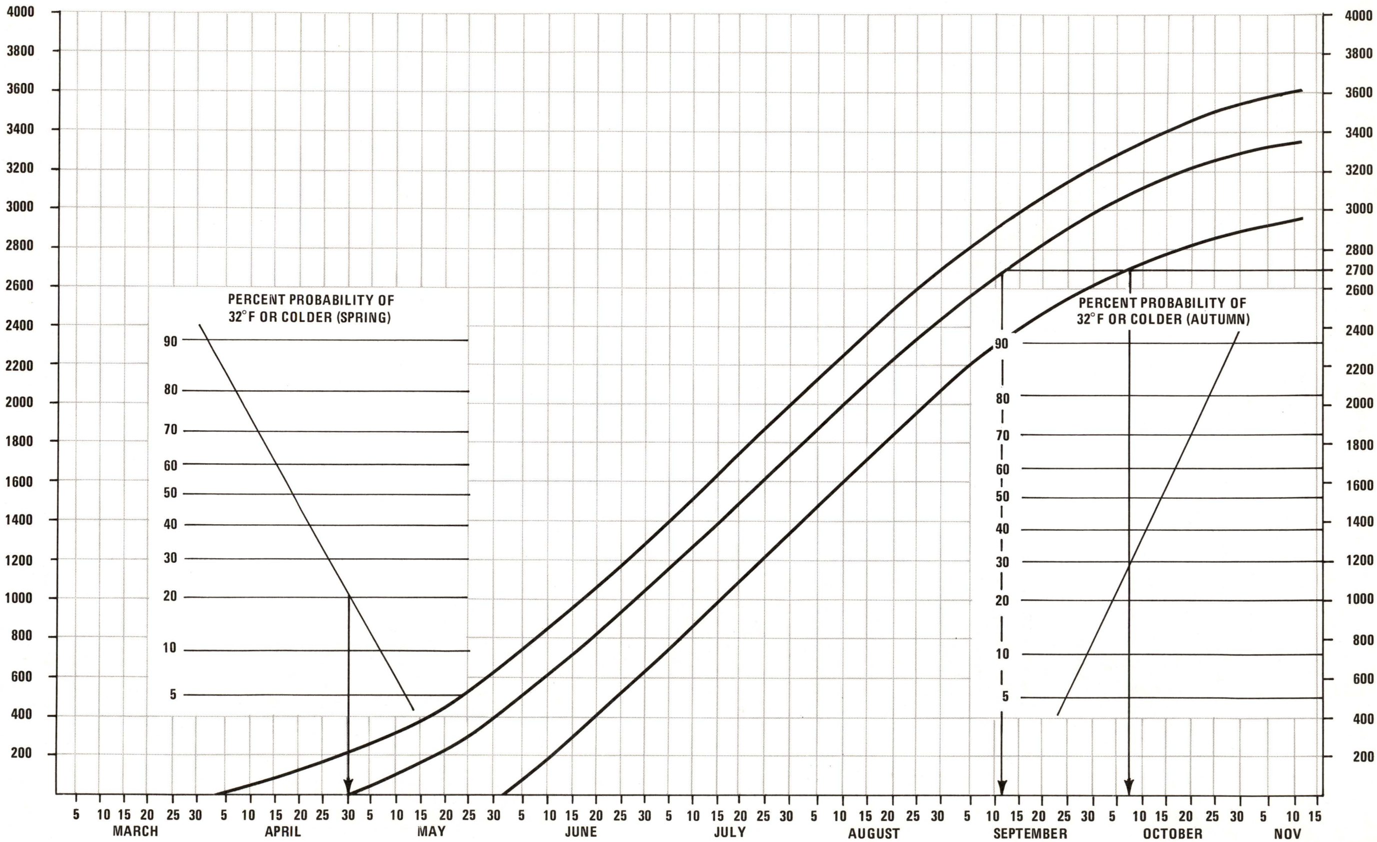

Figure 4. Average seasonal growing degree day accumulation and freeze probabilities.

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