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# Growing Degree Days for Hybrid Corn Production

## Southwest Missouri

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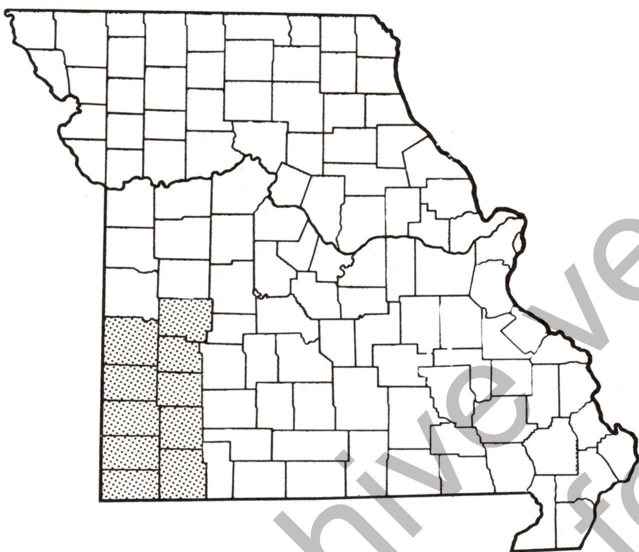

**Figure 1. Area of applicability of this guide.**

### 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.

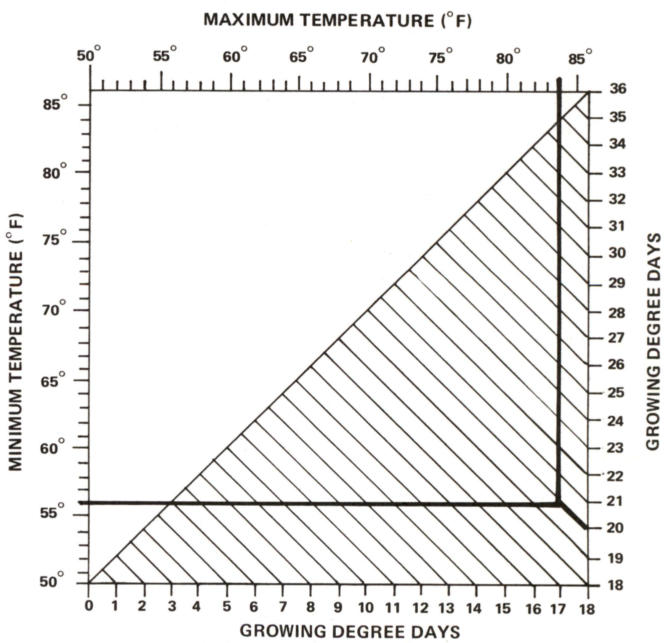


**Figure 2. Nomogram for calculating growing degree days. (by Paul Waite)**

## Source of Data

For the area of southwestern Missouri indicated in Figure 1, data from the National Weather Service's cooperative observers located in Nevada, Lamar and Neosho 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 southwestern 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 by 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 condtions of southwestern 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 4°F below normal. The GDD's were only 430, which was 100 below normal. On the other hand, in the spring of 1962 the warm southerly air mass arrived early and May averaged about 7°F above normal. The accumulated GDD's for the month were 720 or 190 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 22, he would expect that it would take 122 days to accumulate 2700 GDD's while if he planted on May 10, it would take 116 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 southwestern 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 25. And, if the corn was rated at 2700 GDD's, he would, on the average, expect the corn to reach maturity around August 23. Freezing temperatures do not occur this early in southwestern Missouri. Even if due to some circumstances planting was delayed until June 1, the farmer would expect to accumulate 2700 GDD's by September 20, which would indicate little risk of frost before his corn crop would 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 southwestern Missouri the average growing season runs from April 16 to October 20, a total of 187 days.

Table 1. AVERAGE GROWING DEGREE DAYS BY WEEK

| Week Ending | | Mean | SD* | Week Ending | | Mean | SD* |
|---|---|---|---|---|---|---|---|
| April | 11 | 70 | 28 | July | 25 | 183 | 18 |
| April | 18 | 75 | 28 | August | 1 | 185 | 14 |
| April | 25 | 97 | 26 | August | 8 | 184 | 16 |
| May | 2 | 100 | 26 | August | 15 | 176 | 20 |
| May | 9 | 107 | 33 | August | 22 | 170 | 16 |
| May | 16 | 112 | 27 | August | 29 | 166 | 19 |
| May | 23 | 126 | 27 | September | 5 | 163 | 20 |
| May | 30 | 135 | 23 | September | 12 | 146 | 21 |
| June | 6 | 145 | 25 | September | 19 | 142 | 27 |
| June | 13 | 164 | 23 | September | 26 | 129 | 22 |
| June | 20 | 163 | 24 | October | 3 | 112 | 27 |
| June | 27 | 173 | 20 | October | 10 | 105 | 27 |
| July | 4 | 178 | 15 | October | 17 | 98 | 26 |
| July | 11 | 177 | 15 | October | 24 | 85 | 24 |
| July | 18 | 181 | 18 | October | 31 | 72 | 30 |

*SD = Standard Deviation of Mean

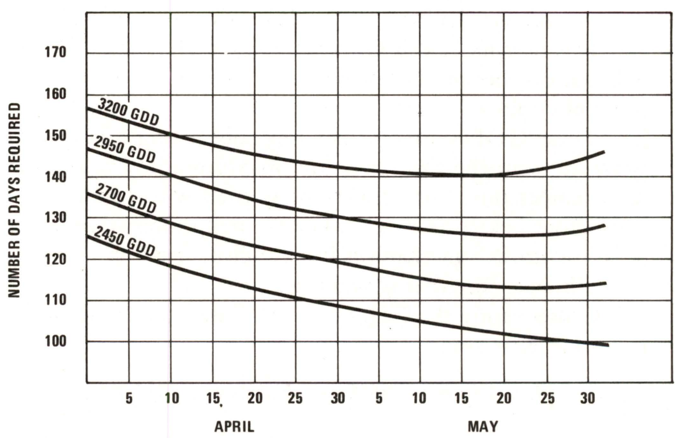


**Figure 3. The average number of days required to accumulate a specified number of growing degree days for various planting dates.**

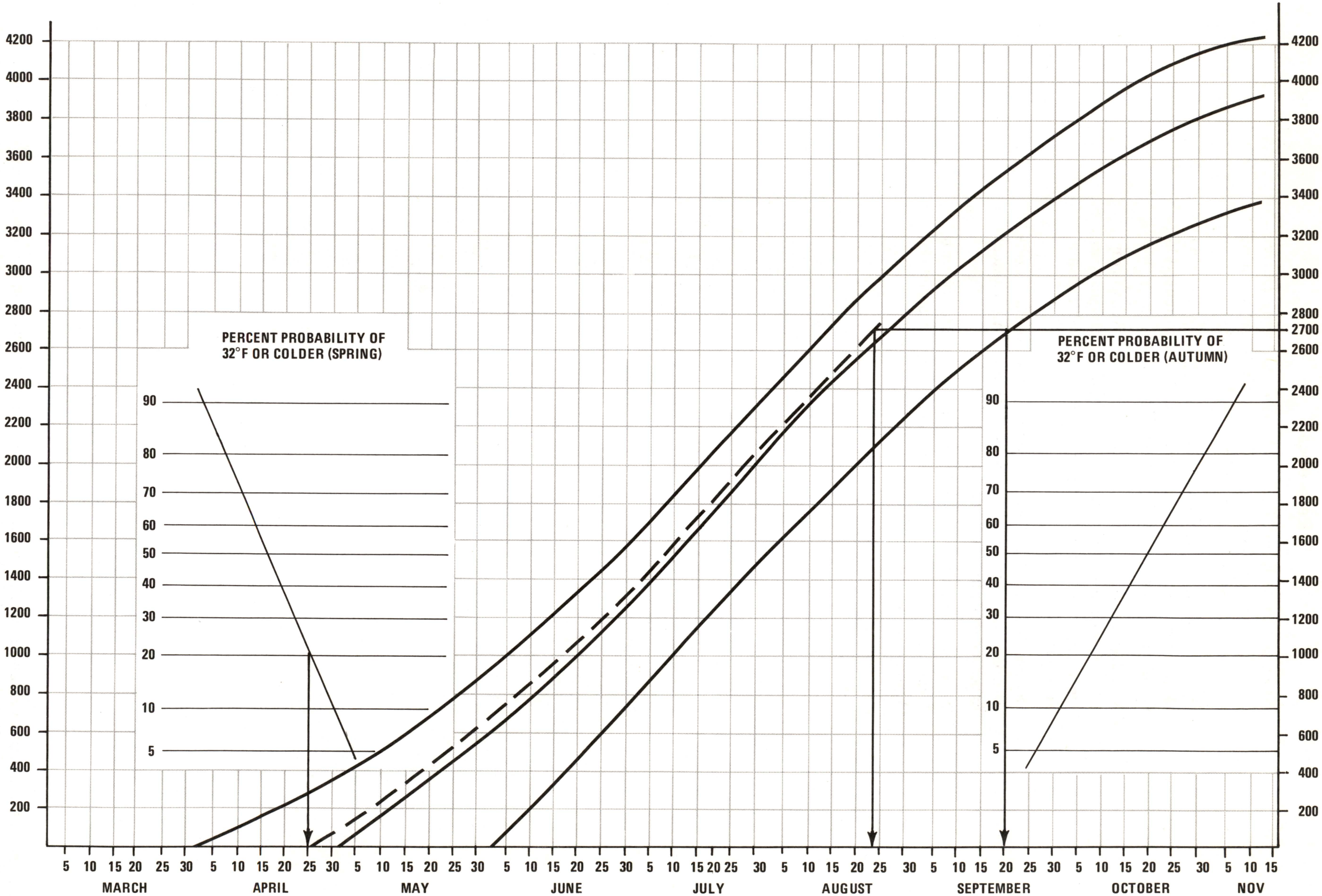


Figure 4. Average seasonal growing degree day accumulation and freeze probabilities.

## References

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