CENTRAL REGION TECHNICAL ATTACHMENT 93-25

LATE SUMMER AND FALL TEMPERATURE IMPACT ON MATURITY DATE IN CORN

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1. Introduction

Corn is a warm season crop requiring both accumulated heat units and soil moisture for good yields. Growing degree days (base 50), GDD, have been used to predict maturity dates in corn. The cool growing season in 1992 led to a deficiency in the accumulation of GDD expected for some varieties to reach maturity. In some cases, corn failed to reach maturity before being killed by freezing temperatures. In other cases, maturation of plants was hastened by the cool weather, reaching maturity earlier than predicted by accumulated GDD.

2. Data

Minimum air temperatures and GDD were compared for the West Lafayette Agronomy farm located six miles northwest of the Purdue University campus. Data used were for the period 1 August 1992 through 19 October 1992. Observed air temperature minimums were from a minimum thermometer located five feet above the ground in an instrument shelter. Growing degree days (base 50) data were computed from daily maximum (Tmax) and minimum (Tmin) air temperatures for the Purdue Agronomy farm. GDD values were calculated for each day and summed for the period 20 May through 19 October as: GDD = [(Tmax + Tmin) / 2] - 50, where Tmax is set to 86°F when Tmax exceeds 86°F and Tmin is set to 50°F for readings lower than 50°F. These upper and lower temperature threshold values are used because corn growth is very slow under consistent temperatures lower than 50°F (10°C) and higher than 86°F (30°C) (Newman and Stirm, 1977). GDD accumulations were based on a corn planting date of around 20 May. Maturity date of corn was determined by observation at the West Lafayette Agronomy farm. Normal minimum air temperatures were derived by Kenneth Scheeringa, Indiana State Climatologist, from the Monthly Station Normals of Temperatures, Precipitation, and Heating and Cooling Degree Days 1961-1990 (National Climatic Data Center, 1992).

3. Observations and Analysis

Daily minimum air temperature observations and accumulated GDD are shown in Figure 1. It can be seen in Figure 1 that

minimum air temperatures began dropping to 48°F or lower during the mid and latter weeks of August. Normal minimum air temperatures for mid and late August average in the upper 50s to around 60 at West Lafayette. In fact, a low of 45 was reported on 20 August. More unseasonably low minimum temperatures were reported in September. Readings around 45°F or lower were reported nine days during the month. Minimums dropped into the mid and upper 30s on some mornings in late September. Normal lows for September range from the mid-50s early in the month to the upper 40s by late in the month. Unseasonably cold weather with lows in the 30s was again observed during the early and mid parts of October. Finally, a minimum air temperature in the upper 20s occurred on 17 October. Normals for this period are in the low to mid 40s.

Maturity in corn is defined as black layer formation in kernels--an easily observed phenomenon. GDD requirements from planting to physiological maturity over west central Indiana vary from 2,400 for early corn hybrids, to 2,650 for medium hybrids and 2,800 for full hybrids (Purdue Crop Diagnostic Training and Research Center and Purdue Pest Management Program, 1992). Assuming an average planting date of 20 May over west central Indiana, GDD accumulations would have predicted a maturity date of around 10 October for early hybrids at the Agronomy farm. Predicted dates of maturation for full season hybrids would have been after 20 October based on GDD requirements. Normal dates of first fall frost (32°F occurrence) range from the 11 to 13 October over west central Indiana. Surprisingly, observations of corn indicated that maturation of some plants occurred about 21 September, earlier than predicted by GDD accumulations. Observed and normal GDD accumulations for the West Lafayette Agronomy farm are shown in Figure 2. It can be seen that by late August and September observed GDD accumulations were lagging normals by around 250 degree days. Even though GDD accumulations for the west central crop reporting district averaged around 250 degree days behind normal, maturity still occurred much sooner than expected.

4. Conclusion

Strong meridional flow during August and September produced unseasonably cool minimum air temperatures in the mid and upper 40s. Corn growth over parts of west central Indiana ceased earlier than predicted by GDD requirements. Threshold temperature values for early maturation of corn hybrids late in the growing season appears to be in the mid 40s. GDD predicted dates of corn maturity may need to be adjusted to consider minimum air temperatures below 48°F during late summer and fall.

Farm managers may not benefit by planting shorter season corn hybrids. Corn extension service agents confirm that many hybrids adjust their growth and development to account for a shortened growing season (Nielsen and Thomison, 1993). Late planted hybrids apparently mature at a faster thermal rate than when planted earlier in the spring.

In general, it was found that 1) late planted corn can mature at a faster thermal rate than is predicted by most GDD equations, 2) air temperatures lower than 48°F late in the growing season tend to shut down growth of plants.

5. Acknowledgements

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6. References

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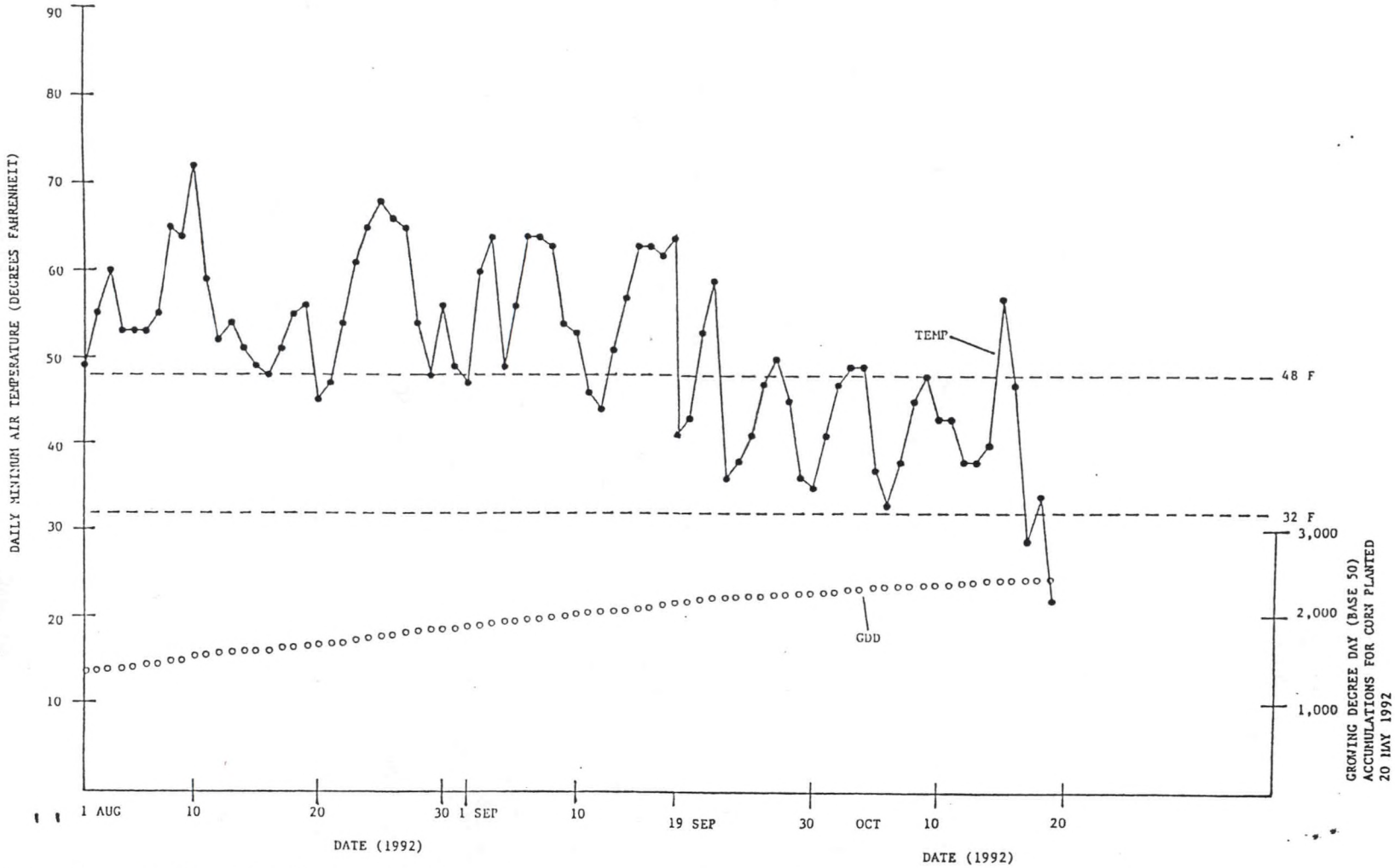

Figure 1. Daily minimum air temperature for the West Lafayette, Indiana, Agronomy farm in degrees Fahrenheit indicated by the close dotted line. Growing degree day accumulations, base 50°F, for the Agronomy farm indicated by the open dotted line. Period covered is 1 August through 19 October, 1992.

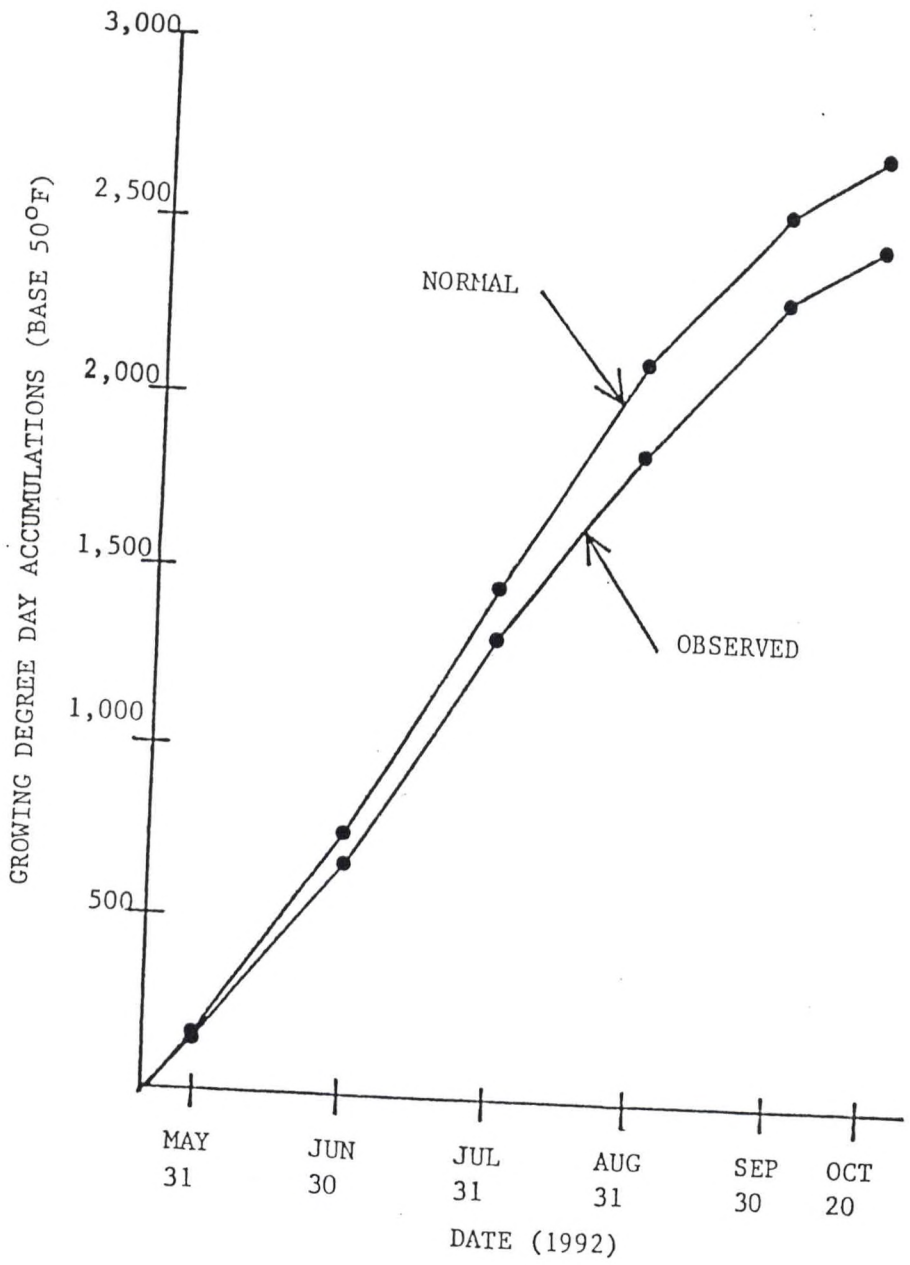

Figure 2. Normal and observed (1992) growing degree day accumulations, base 50°F, for the West Lafayette, Indiana Agronomy farm. Period covered is 20 May through 20 October.