

## How well can we predict corn growth stages?

### Summary

- Growth stages are a valuable way to track crop progress and plan for field operations like herbicide, fungicide and nitrogen applications.
- There is significant natural variation in Growing Degree Units (GDU's) required to reach a given growth stage from location to location and year to year.
- There are several inputs into the crop model that can impact growth stage prediction. While daily temperature information is the largest driver, moisture stress (too much/too little), and nutrient availability is reflected in the crop model and can impact expected development.
- Hybrid specific inputs are currently used in the model for Pioneer® brand products and include GDU's and number of leaves per plant. For competitive hybrids, we use the average of the values for Pioneer hybrids of similar maturity.
- Even with these improvements, predictions for R1 within +/- 2-4 days should be considered typical. Variations of even 4-5 days from the expected would usually not significantly impact crop N needs relative to the nitrogen recommendations.

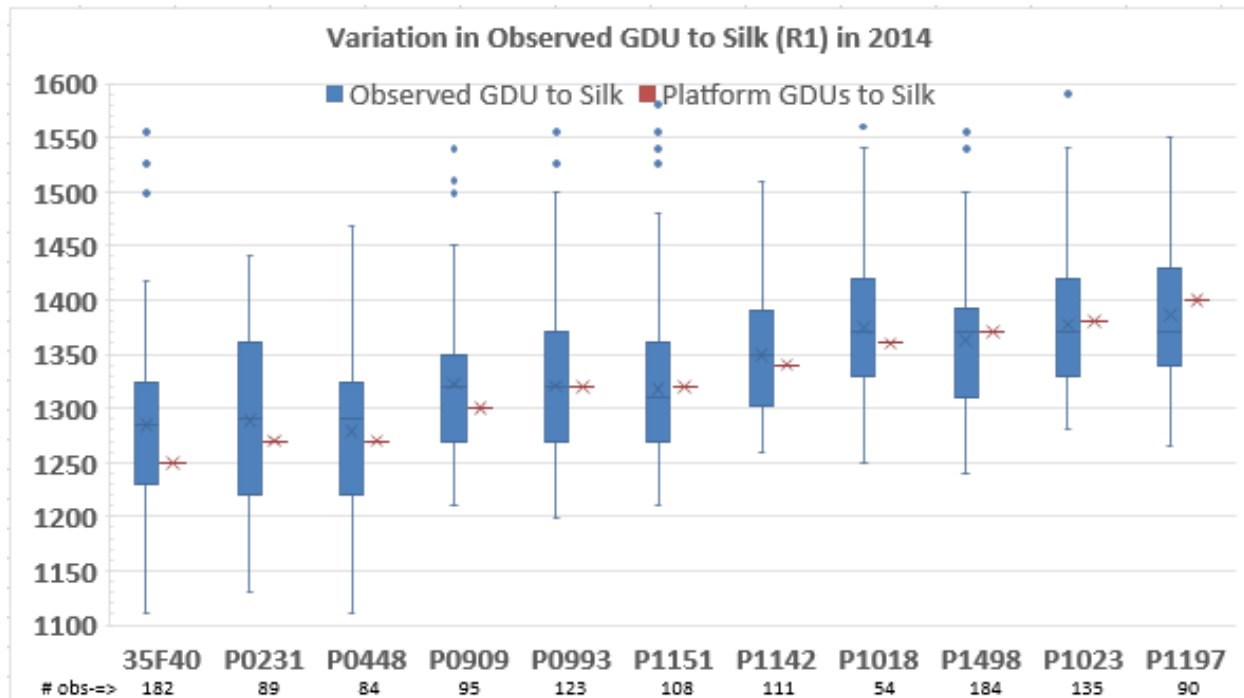
### Introduction

GDU's are a common way to track crop development. A similar approach called Crop Heat Units (CHU) is used in Canada with slightly different calculations. Of course we all realize that estimating a future date means that you are relying on weather forecasts and/or historical averages to make those estimates, which may not reflect conditions for your location in a given year.

While hybrid data is often published with a certain number of GDUs silk or black layer, there can be great variation across locations and years for a given hybrid. The example below illustrates the variation in silk date across several locations in the same year for multiple hybrids.

Data is from the research experiments that are used to establish the GDU to silk in the published hybrid characteristics for Pioneer® brand corn hybrids.

- Researchers check field plots and record the GDU's from planting when they observe R1 (50% silk) occurred.
  - The blue box represents the range of the middle 50% of the data.
  - The whiskers at each end of the box represent the range of the middle 75% of the data.
  - The red line beside each box is what Pioneer says the GDU to silk is.
  - The numbers across the bottom are the number of observations per hybrid.
  - This is data from a single year (2014). The range is even larger when comparing across years.
- In these examples 50% of the observed values are within +/- 50 GDU's (about +/- 2-3 days) of the average.
- 75% of the observations are within about +/- 125-150 GDU or about +/- 5-7 days.
- 25 % of locations have observed silk dates greater than +/- 5-7 days of what GDU's would suggest.
- In looking at predictions for maturity date, expect the amount of variation to roughly double from that shown for silk date (data not shown).



- Leaves per plant is part of this variation.
  - 85 CRM hybrids may typically have ~15 leaves.
  - 100 CRM hybrids will have ~17 leaves.
  - 113 CRM hybrids usually have ~20 leaves.
  - 120 CRM hybrids have about 21-22 leaves.
  - From location to location, the total number of leaves for a given hybrid sometimes varies by one or two leaves, depending on growing condition.
  - Each later stage leaf takes about 45-50 GDU's to emerge, equal to about 2 days.

## Conclusions

- In testing example Encirca locations in 2018, most of the Encirca estimates of silk date are within +/- 25-50 GDU (1-2 days) of the published GDU silk calculated using a simple GDU model with the temperature data from that location.
- Our crop model incorporates additional environmental and management information to improve the estimation of growth stages.
- The accuracy of weather data and other parameters input into a growth stage model will impact the quality and accuracy of the output estimates.
- The best that any model - whether a simple GDU model or sophisticated crop model - can accomplish is to predict dates within the range of observed values.
- For 2018 Pioneer Research is taking additional in field observations of growth stages to be used in model improvements.
- Pioneer Agronomy Sciences has a significant effort to collect growth stage information that will serve as an additional data source for making improvements.