Modeling Phenological Development of Corn: Do Corn Heat Units Work on The Prairies?

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Background

- Corn production in Canada is mainly in Ontario (62%) and Quebec (30%) while the Prairies contribute only 7.2% due to limited heat and fewer frost free days
- Recent positive trends in seasonal heat accumulation provide a possibility for expansion of corn area in the Prairies
- Corn producers require a reliable measure of corn heat requirements in order to choose suitable hybrids
- The corn heat unit (CHU) is mainly used for this assessment but this index may not be the most accurate measure of heat for corn phenology in the Prairies
- Corn phenology models are essential tools for predicting corn growth and development
- Accurate prediction of corn development enables selection of suitable hybrids in a given area, planning of operations such as seeding dates, weed control, fertilizer application and harvesting

Objectives

- Evaluate the consistency of heat unit accumulation required for different corn hybrids to reach selected phenological stages at various locations across western Canada
- Determine alternative indices that could improve the accuracy of predicting corn phenology using site-specific agrometeorology data

Materials and Methods

- **Study sites:** field study conducted at seven locations in 2015 and eight locations in 2016 (Figure 1)

➢ The experimental sites spanned a large area to provide a representative sample of weather conditions that prevail in western Canada.

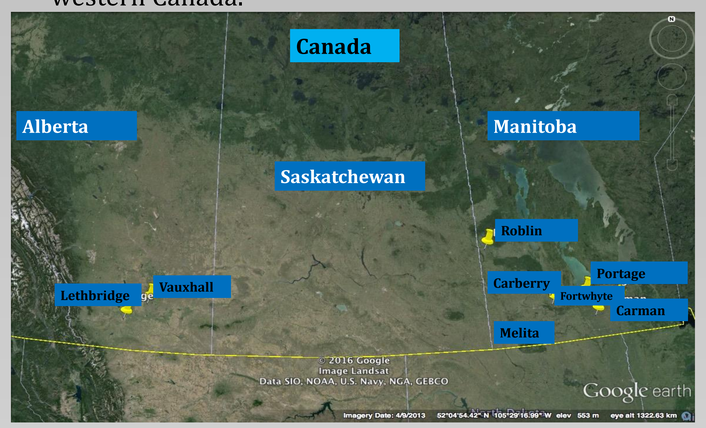

Figure 1. Prairie study sites for 2015 and 2016 growing seasons

- **Treatment materials**: The study was conducted with 3 corn hybrids in 2015 and 5 hybrids in 2016 (CHU range of 2200 to 2700)
- **Experimental design**: RCBD with seven blocks/locations and three treatments in 2015; eight blocks/locations and five treatments in 2016

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Materials and Methods

- **Agrometeorology variables:** Hourly soil and air temperature, precipitation, incident solar radiation, relative humidity and wind speed and direction from watchdog weather stations (Figure 2)

Figure 2. Model 2800 watchdog weather stations installed at each study site

- **Corn phenology data:** Obtained from timelapse camera pictures and manual observations (Figure 3)

Figure 3. Corn development showing V3, R1 and R2 stages

- Physiological maturity assumed when black layer was present at the base of kernels at moisture content of 31-35 % (Figure 4)

Figure 4. MT 808 electro-physics kernel moisture meter and corn kernels at physiological maturity (black layer)

Thermal indices evaluated:

- Corn heat unit (CHU)
- General Thermal Index (GTI)
- Growing Degree Day base 10-max 30 (GDD10,30)
- Thermal Leaf Unit (TLU)
- Duration: seeding to physiological maturity

Statistical analysis

- An ANOVA was run with SAS 9.3 using Proc glimmix
- Amount of heat required to reach a particular stage was considered as time to an event hence Gamma distribution
- Test for homogeneity of coefficient of variance (Zar, 1999) was performed for heat units required to reach each phenology stage to determine consistency of heat unit accumulation

Results and Discussion

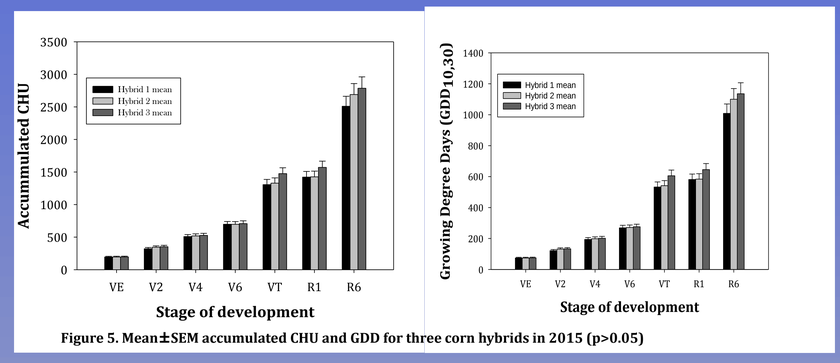

Figure 5. Mean±SEM accumulated CHU and GDD for three corn hybrids in 2015 (p>0.05)

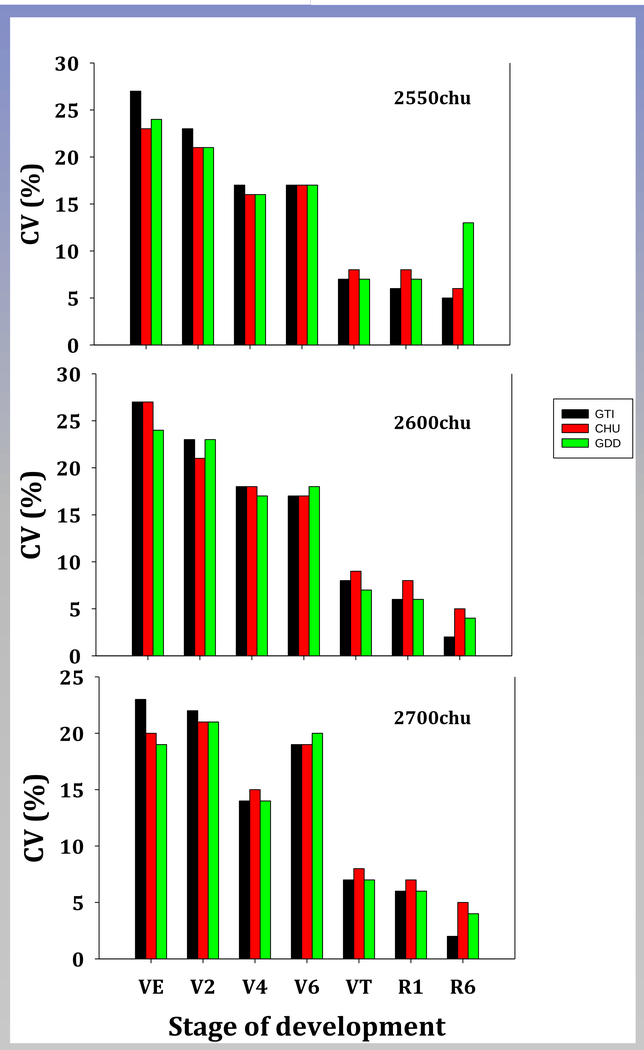

Figure 6. Changes in C.Vs among three cumulative heat units and three corn hybrids at various stages of development

- No significant differences in heat unit accumulation among treatments across all sites in 2015 (Figure 5)
- Higher C.Vs (Figure 6) from seeding to emergence (VE) caused by differences in seeding dates between sites and low soil temperatures at seeding
- Other heat units, especially GTI, may provide a more consistent measure of heat requirements for corn development on the prairies, especially planting to maturity.

Acknowledgements

- The authors are thankful for funding provided by University of Manitoba Graduate Fellowship, Manitoba Corn Growers Association, Western Grains Research Foundation, Manitoba Agriculture Research Development Initiative
- Thanks to our collaborators at research sites across the Prairies for significant assistance in establishment and management of experimental plots and academic advice from Dr D. Flaten and Dr Y. Lawley