Hydrothermal Time Models for Seedling Emergence across Field Topography

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Interpretive Summary
Hydrothermal time models explain underestimates in seedling emergence actual time by thermal models for locations and species where soil water potential falls below threshold levels of a species.

Results and Discussion

Topography. Accumulated TT did not differ across the hillslope (Fig. 2). The effect of water reduced TT accumulation for all hillslope positions. Differences in water potential among hillslope positions for portions of the season were not sufficient to create a difference in TT accumulation across the hillslope.

Soil depth. Accumulated TT was greatest at the soil surface and declined with depth (Fig. 3). The TT model showed progressively decreasing thermal accumulation with more sensitive (less negative) water potential thresholds, being most evident at or near the soil surface compared to deeper in the profile.

Methods
An experiment at Graysville MB was designed to investigate accumulated TT across topography and soil depth over a 75 day period following spring planting for two years. Spring wheat was distributed as a surrogate weed to elicit spatial differences in the seedling microsite. Topographical factors were hillslope position (summit, backslope and toeslope) (Fig. 1), and soil depth (surface and three 25-mm layers). A range of water thresholds from −1.3 to −0.1 MPa representing water insensitive to sensitive species were applied to the TT model; wheat having −0.7 MPa (El-Sharkawi and Springuel, 1977).

Emergence timing was fitted with the Gompertz model $E(t) = a \cdot \exp\left(-b \cdot \exp\left(-c \cdot t\right)\right)$ where $E(t)$ is the expected cumulative emergence at time ($t$). The model parameters $a$, $b$ and $c$ were estimated by the maximum likelihood method in the NLMIXED procedure in SAS. Common parameters for optimal model structure were indicated by the AIC statistic.

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Literature Cited