Emergence Timing of Winter Annual Weed Species in Nebraska

Rodrigo Werle[1], Mark L. Bernards[2], Timothy J. Arkebauer[1], and John L. Lindquist[1]

[1] University of Nebraska-Lincoln, Lincoln, Nebraska, [2] Western Illinois University, Macomb, Illinois

Introduction

Owing to lack of tillage and spring weed control, winter annual weeds are becoming more prevalent in no-till fields. Knowledge of when these species are likely to emerge is critical for planning effective weed control

Objective

Quantify the emergence pattern of several key winter annual weeds in Nebraska using thermal time models.

Materials and Methods

- Location: Lincoln Agronomy Farm (LAF, 1st year) and UNL campus (UNL, 2nd year), Lincoln, NE; Mead Agronomy Farm (MAF, both years), Mead, NE; South Central Ag. Lab. (dry land [SCALDL] and irrigated land [SCALIL], both years), Clay Center, NE.
- Years: Summer 2010 – Summer 2011 (1st year); Summer 2011 – Summer 2012 (2nd year).
- 9 winter annual weed species (Table 1).
- 15 x 20 x 6 cm cages were buried at 5 cm depth between soybean rows and planted with 1000 seeds of each species in July of each year.

Figure 1. Shepherd's purse (CAPBP) and henbit (LAMAM) seedlings, respectively, emerging during the fall on our experimental plots.

- Emerged seedlings were enumerated and removed weekly from planting until emergence ceased (August – June).
- Emergence data was converted to cumulative emergence (%) and soil temperature measured at 2 cm depth in the soil used to accumulate Thermal Time (TT, C) as:

$$TT = \sum_{i=1}^{n}(T_{mean} - Tb)$$

where T_{mean} represents daily mean soil temperature, T_b is the minimum temperature for weed emergence (0 C was used across all species), *n* and *i* represent the day when TT accumulation started (August 1) and the number of days after *n*, respectively.

- Predictive models were created by regressing cumulative emergence against TT using the Weibull model:

$$y = 100*(1-\exp(-\exp(lrc)*TT^{\wedge}(pwr))$$

where y is the cumulative emergence (%) at cumulative TT, *lrc* is the natural logarithm for the rate of increase, and *pwr* is the power to which TT is raised.

- Mean absolute error (MAE) and modeling efficiency (ME) were calculated to indicate the goodness of fit for our models:

$$MAE = \frac{1}{n}\left[\sum_{i=1}^{n}|Pi - Oi|\right] \text{ and } ME = 1 - \left[\frac{\sum_{i=1}^{n}(Oi-Pi)^2}{\sum_{i=1}^{n}(Oi-\bar{O}i)^2}\right],$$

where P*i* is the predicted, O*i* the observed, and Ō the mean observed value, and *n* is the total number of comparisons.

- The smaller the MAE value, the closer the observed values are from the predicted ones; ME values can range from - ∞ and 1, with values closer to 1 indicating more accurate predictions.

Results

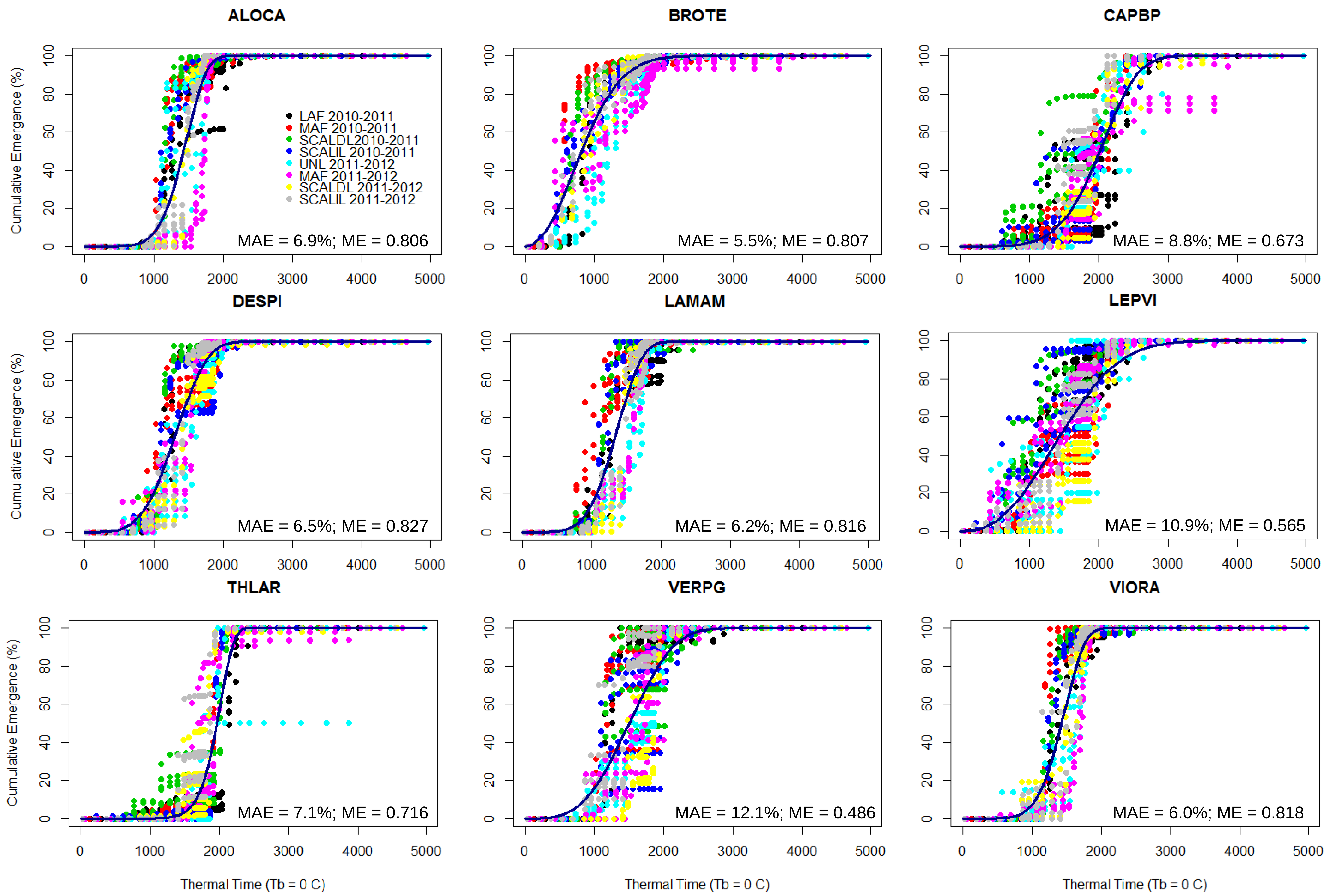

Figure 2. Emergence of winter annual weeds in Nebraska. Accumulation of TT started on August 1. Solid lines represent the Weibull model fit to data collected at four sites during two years for each species. Goodness of fit for each model is expressed as MAE and ME.

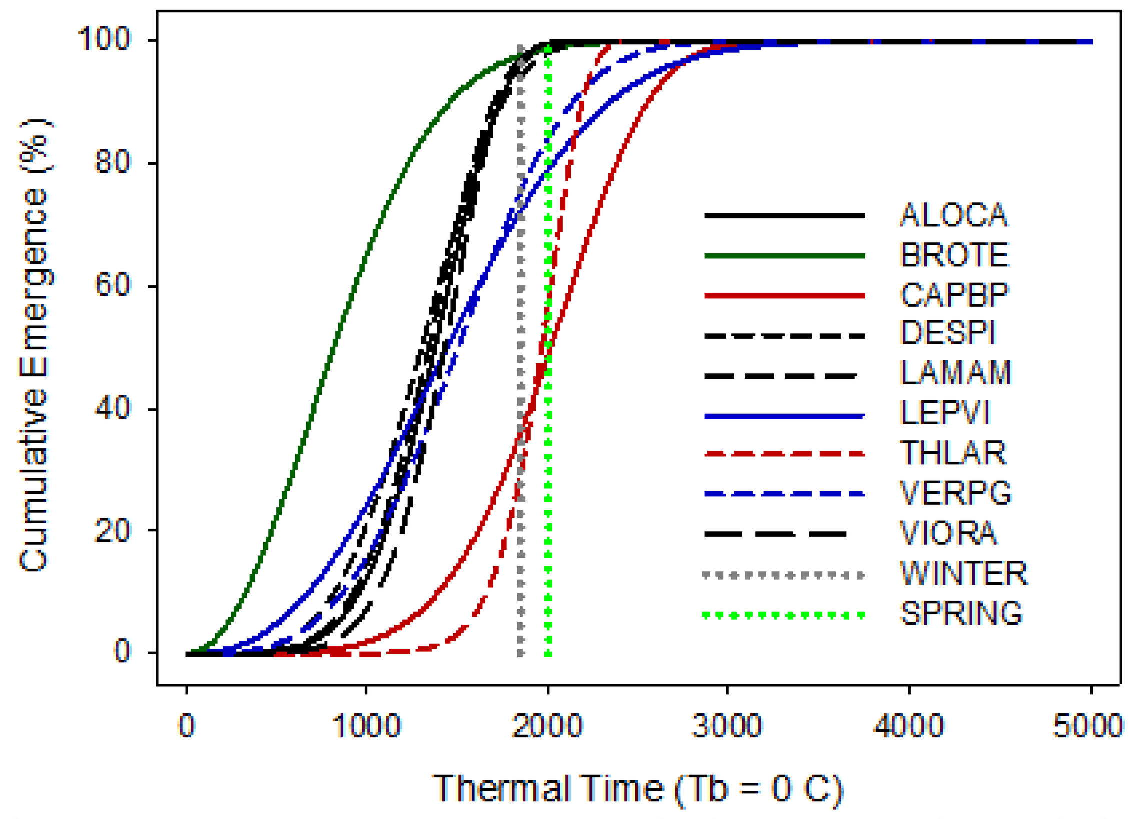

Figure 3. Emergence sequence of winter annual weeds in Nebraska. Accumulation of TT started on August 1. Green, black, blue, and red represent the early-fall, mid-fall, late-fall, and spring emergers, respectively. WINTER and SPRING represent the beginning of each season.

Table 1. Parameters for the Weibull models used to predict cumulative emergence (%) of nine winter annual weed species and the time when the majority of the seedlings emerged.

Bayer codes	Common name	*lcr*	*pwr*	Time*
ALOCA	Carolina foxtail	-37.9336	5.1994	Mid-fall
BROTE	Downy brome	-14.2493	2.0710	Early-fall
CAPBP	Shepherd's purse	-39.1470	5.0970	Spring
DESPI	Tansy mustard	-29.4958	4.0620	Mid-fall
LAMAM	Henbit	-36.7810	5.0569	Mid-fall
LEPVI	Virginia pepperweed	-18.4166	2.4815	Late-fall
THLAR	Field pennycress	-85.4195	11.2153	Spring
VERPG	Purslane speedwell	-25.3617	3.4168	Late-fall
VIORA	Field pansy	-45.5454	6.2188	Mid-fall

* Green, black, blue, and red represent the early-fall, mid-fall, late-fall, and spring emergers, respectively.

Figure 4. Field infested with winter annual weeds during early spring in Nebraska.

Conclusions

- In general winter annual weed species presented a consistent emergence pattern across sites and years.
- The majority of the winter annual weed species emerged primarily in the fall, indicating that this time would be ideal to manage these weeds.
- Models based on TT were good predictors of winter annual weed emergence.

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