Developing a mechanistic foliar stage model adapted to wheat diseases decision tools

Fety Andrianasolo, Jean-Charles Deswarte, Amaury Jorant

Developing a mechanistic foliar stage model adapted to wheat diseases decision tools

Andrianasolo Fety[1] (f.andrianasolo@arvalis.fr), Deswarte Jean-Charles[2], Jorant Amaury[1]

[1] *Arvalis Institut du Végétal, Boigneville, France*; [2] *Arvalis Institut du Végétal, Villiers-le-Bâcle, France*

Introduction

Phenological stages are widely used in crop models as starting points for most processes based on leaf, biomass and yield growth. In soft wheat in particular, the appearance of the last leaf on the main shoot is a mandatory stage for crop protection strategy, since this stage alone, contributes to up to half of the carbon allocated to the grain. We propose to build a mechanistic model for simulating flag leaf appearance stage (FLAS) in soft wheat, consisting in three main steps ; (1) estimation of floral transition stage, that we assumed to be the stage corresponding to the moment when primordia are determined as future spikelets or leaves ; (2) computation of a dynamic phylochron along crop cycle, based on photoperiod and thermal time scales ; and (3) calculation of all leaf stages from pre-formed primordia to the last leaf to appear (FLAS).

Materials and Methods

This model was constructed using agronomic trials data, located in 53 sites in France and more than 20 years of experiments (+ 200 varieties), for floral transition stage, final leaf number and FLAS calibration and evaluation ; another database composed of regular leaf counts (Villiers-le-Bâcle, 2005 to 2016, France) was used for phylochron optimization. Cross-validation per year was carried out on both datasets, and indicators of error of prediction (RMSEP) and model efficiency (EF) were computed.

Results and Discussion

Results showed that the global error of the model was 5.9 days (EF = 0.6) (Figure 1). Adjusted mean value of phylochron was lower than those found in literature (90 versus 100 to 130 degrees-days per leaf respectively). There was likely a compensation phenomenon between overestimated floral transition date and underestimated final leaf number (compared to literature) ; nonetheless, these could neither be measured nor evaluated in the data we used. We discuss the potential of our approach compared to other existing leaf stage models in the context of crop protection and system decision tool usage.

Conclusions

Our newly phylochron-based soft wheat model provided similar predictive performance as compared to existing models, and could be further enriched with nitrogen and water stress effects for optimizing crop protection decisions.

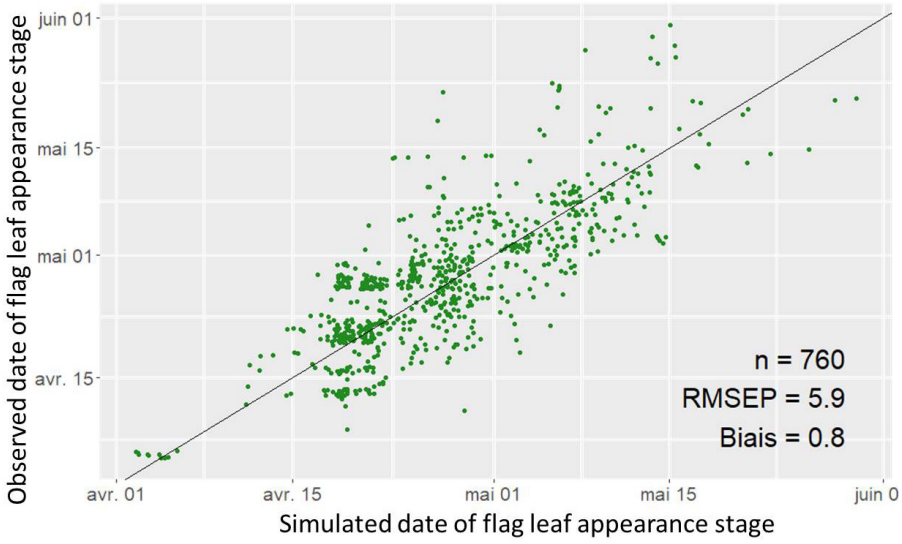

Figure 1. Comparison of observed and simulated dates of flag leaf appearance stage (FLAS) in soft wheat

Keywords: floral transition, phylochron, photoperiod, final leaf number, soft wheat.