봄철 무의 추대 시기 추정을 위한 생물계절 모형 개발
Modeling the phenological development of radish(*Raphanus sativus* L.) for predicting bolting time in spring season

신민지, 이성은, 최경산, 안정준, 오서영, 문경환*

Minji Shin, Jeong Joon Ahn, Kyoung San Choi, Seong Eun Lee, Seo Young Oh, Kyung Hwan Moon*

국립원예특작과학원 온난화대응농업연구소

Research Institute of Climate Change and Agriculture, NIHHS, RDA.

1 INTRODUCTION

Modeling the phenological development of plant is predicting the occurrence time of plant developmental stages such as emergence, flowering or maturity. The simulation of crop development is important to investigate the effects of environmental conditions, genotypes or crop management. In spring season, it is essential to predict the bolting time of radish because bolting induces poor-quality product problems.

2 MATERIALS & METHODS

In this study, two factors, temperature and vernalization, are assumed to be dominant in phenological development. We used two functions, temperature function (*tempfun*) and vernalization function (*verfun*). *Tempfun* and *verfun* represent relative development rate and vernalization value. They respond to temperature and are calucated by the daily mean temaperautre for the day. Then, each function is transformed to cumulative function by summing daily value of development rates and vernalization during days after planting. Finally, the two cumulative functions are multiplied to calculate the progress in phenological development on each day. The bolting stage when appears first visible floral bud (FVB) is predicted to occur when the multiplied value reaches 1. The radish seeds were sowned serially with four different sowing dates in the temperature gradient chamber divided into five zones to create twenty various temperature regimes. We observed periodically once every two weeks and recorded the date and number of days when FVB appears for each experiment. Parameterization was done with ten different datasets and the model performance testing was done with ten datasets which were independent from those used during the parameterization process.

(A) (B)

Fig .1. (A) Temperature Gradient Chamber , (B) Radish with four different sowing dates

3 RESULTS & DISCUSSION

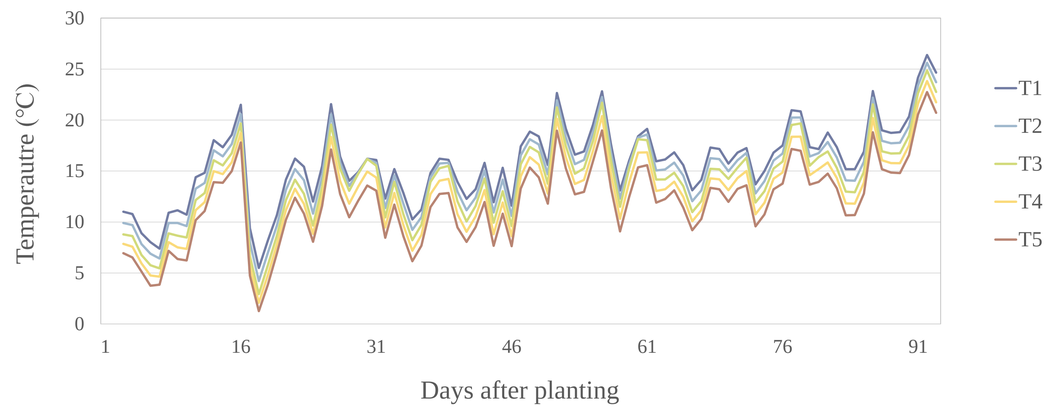

Fig . 2. Changes of temperature during developement in the TGC divided into five zones

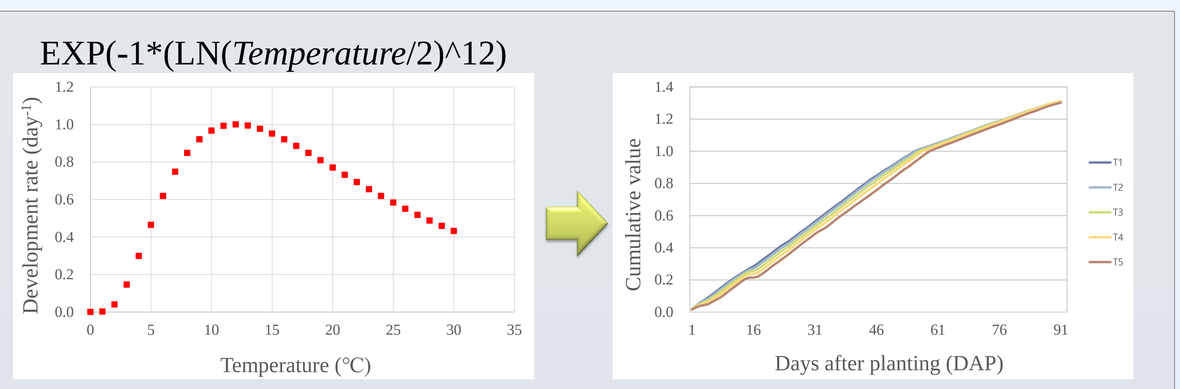

Fig .3. (A) *Temperature function*. Relative development rate responding to temperature
(B) *Temperature cumulative function* by summing the development rates during DAP

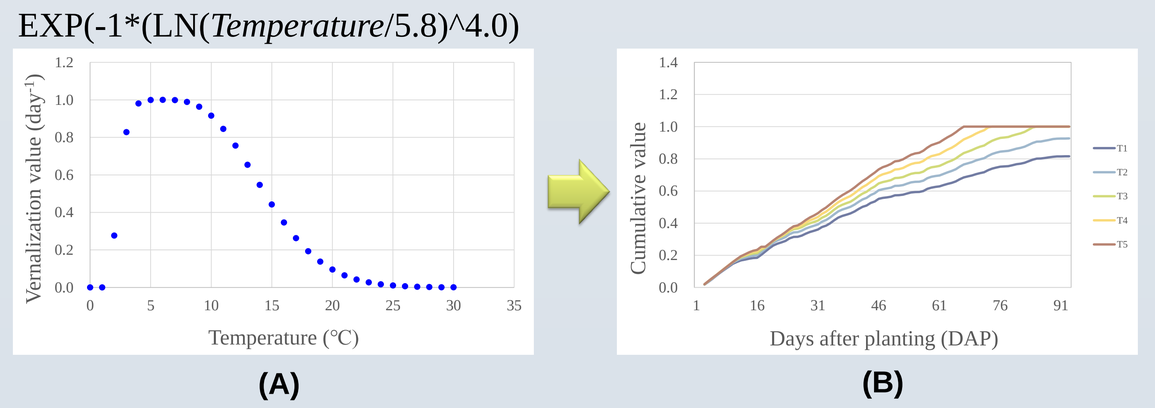

Fig .4. (A) *Vernalizaiton function*. Vernalization value responding to temperature
(B) *Vernalization cumulative function* by summing the vernalization value during DAP

Multiply two functions
(*Temperature cumulative function* and *vernalization cumulative function*)

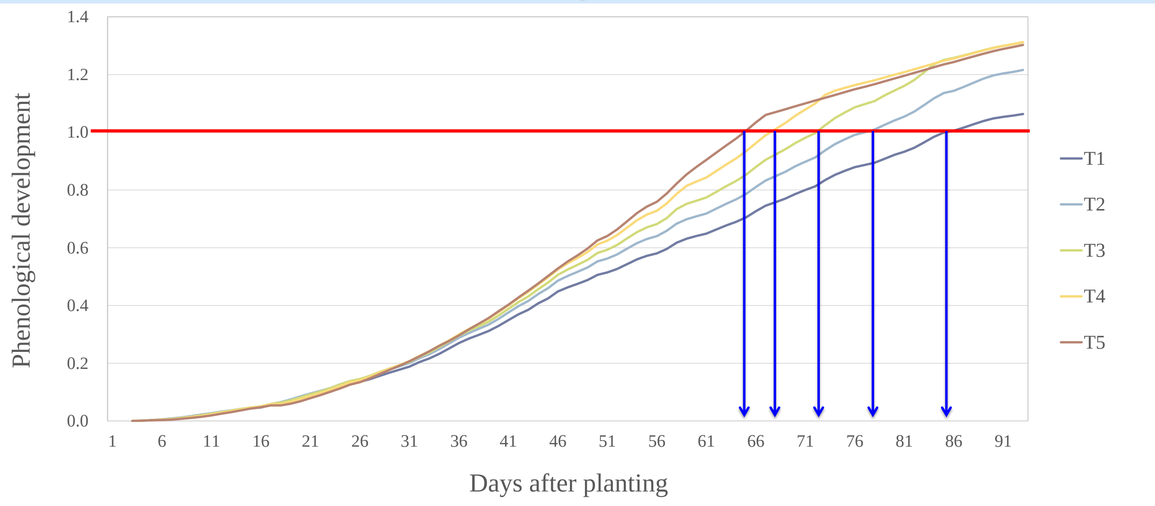

Fig .4. Predicting transition date to the bolting stage using phenological development model in radish

The optimum temperature for development (*tempfun* parameter value) was 12 ℃ and for vernalization (*verfun* parameter value) was 5.8 ℃. The model perfomed with little discrepancies. Future model improvements would benefit from experiments under field conditions and cultivar-specific calibration.

REFERENCES

1. Soltani, A. and Sinclair, T.R. (2012) *Modeling Physiology of Crop Development, Growth and Yield*, CABI