- Modeling the LAI growth and testing of SIMWINC -

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1. Introduction

We have been developing a model to SIMulate the growth and yield of WINter Cereals (SIMWINC) and parameterizing it with data of field-grown wheat crops in Adana, Turkey. We have already developed the sub-models of phenology, biomass production and yield formation processes and reported the general structure of SIMWINC, although we have not yet made a LAI (Leaf area index) growth sub-model.

We examine the performance of SIMWINC with using the growth dynamics of biomass and LAI of field-grown wheat crops in Adana in this report, after describing the LAI growth sub-model.

2. Structure of a LAI growth model

LAI growth is described as a function of *LAI*, daily mean air temperature *(T)*, development stage *(DVS)* and development rate *(DVR)* (equation (1) and (2)). *DVS* and *DVR* were defined and described in our previous report (Nakagawa et al., 2004). r_{max}, LAI_{max}, μ, k and T_c are parameters, which were fitted to observed dynamics of LAI of Adana99 wheat grown in Adana during 2003/2004 and 2004/2005 with two cropping seasons under irrigated conditions.

3. Field data of wheat crops in Adana

Field experiments of Adana-99 wheat were conducted at the experimental field of the University of Çukurova in Adana, Turkey during 2003/2004 and 2004/2005. Adana-99 was grown under rainfed (RF) and irrigated (IR) conditions at two growth seasons (normal growth season with the current sowing date in Adana, NS; late growth seasons with higher temperature regimes, LS) in each year.

The dynamics of biomass, LAI and phenology of wheat crops were monitored with meteorological observations. Soil moisture was also monitored periodically. Detail description on the experiments and data were reported in Koç et al. (2004).

$$\frac{dLAI}{dt}=\begin{cases} LAI\cdot r_{\max}\cdot f(T)\cdot\left\{1-\left(\dfrac{LAI}{LAI_{\max}}\right)^{\mu}\right\}, & (DVS<0.7)\\ LAI\cdot r_{\max}\cdot f(T)\cdot\left\{1-\left(\dfrac{LAI}{LAI_{\max}}\right)^{\mu}\right\}\cdot\dfrac{0.8-DVS}{0.1}, & (0.7\le DVS<0.8)\\ -LAI_{0.8}\cdot DVR\cdot\dfrac{DVS-0.8}{(1-0.8)\cdot 1.1}, & (0.8\le DVS<1.0)\\ -LAI_{0.8}\cdot DVR/1.1, & (DVS\ge 1.0)\end{cases} \tag{1}$$

$$f(T)=1-\exp\{-k(T-T_c)\} \tag{2}$$

4. Testing of SIMWINC

LAI growth of NS-IR and LS-IR plots was well simulated by SIMWINC under irrigated conditions in 2003/2004 (Fig. 1) and 2004/2005. LAI growth showed little difference between irrigated and rainfed conditions until anthesis in both years, although leaf senescence in RF plots was a little bit faster than that in IR plots. The LAI sub-model of SIMWINC does not

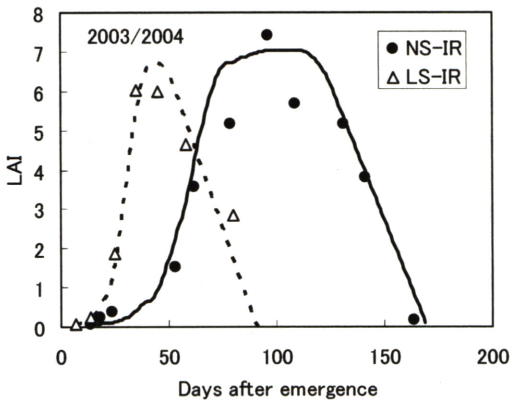

Fig. 1. Dynamics of LAI of Adana-99 wheat grown with normal (NS) and late (LS) sowing dates under irrigated conditions in Adana, Turkey in 2003/2004. Symbols and curves indicate observed and simulated LAI, respectively.

include the effects of water deficit on LAI dynamics, but it well simulated LAI growth of RF plots, also. However, we had better to include the effects of water deficit on leaf senescence into the model, if water deficit would be very severe in the target regions.

Biomass growth was also well simulated by SIMWINC for four different growth conditions in 2003/2004 (Fig. 2) and 2004/2005. These results demonstrated the ability of SIMWINC to simulate LAI and biomass dynamics of wheat crops under Mediterranean environments.

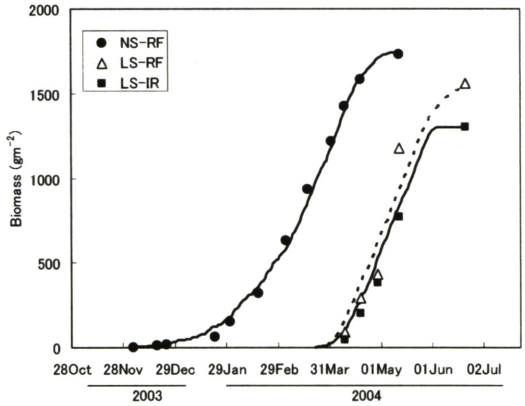

Fig. 2. Dynamics of biomass of Adana-99 wheat grown with normal (NS) and late (LS) sowing dates under irrigated (IR) and rainfed (RF) conditions in Adana, Turkey in 2003/2004. Symbols and curves indicate observed and simulated biomass, respectively. Data of NS-IR plot were omitted in the figure, for the difference between NS-IR and NS-RF plots was negligible.

5. References

Nakagawa,H., Kobata,T., Adachi,F., Kozaka,Y., Yano,T., Koç,M., Barutçular,C., Watanabe,T., 2004: Modeling the impact of climate change on wheat production in the Mediterranean environments. Incorporation of the frost damage on grain setting and parameterization of phenology sub-model. Proc. of the International Workshop for the Research Project on the Impact of Climate Change on Agricultural Production System in Arid Areas (ICCAP), RIHN, Kyoto, Japan, pp. 160-163.

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