CHAPTER 6

DISCUSSION

Results of the field experiment obviously illustrated the response of daylength to the photoperiod sensitive variety of rice i.e., NSPT and KDML105. Heading dates of both NSPT and KDML105 occured in October and the maturity dates occured in November regardless of the planting date. The growing season (sowing to maturity) becomes shorter as planting dates were shifted from July planting dates to September (Table 7). Similar results have been reported from many studies (Somrith and Awakul, 1979; Rurkviree et al., 1981 and Jintrawet, 1991). Rice Research Institute in Thailand (1986) reported that the panicle initiation stage of KDML105 will begins when the photoperiod falls below 11.87 hours. In contrast, the planting date does not considerably affect the growth duration (days from sowing to maturity) of RD7 which is so-called high yielding photoperiod insensitive variety. Growth and duration from sowing to maturity of RD7 take about 122-129 days (Table 7) regardless of planting date.

Using the set of genetic coefficients in this study, the model demonstrates good capability in simulating the phenology of both photoperiod sensitive and photoperiod insensitive varieties. Statistical results show that regardless of varieties and planting dates, the t-test of 1:1 (observed:simulated) regression line of both heading and maturity dates show insignificant difference from test of the zero intercept and unity slope. The simulation of heading date agreed well with observed results which indicates that the genetic coefficients P1, P2O and P2R are well estimated. The model also shows good simulation of duration of grain filling which indicated good estimation of the genetic coefficient P5. Thus, this indicates that the P coefficients are well estimated and acceptable for the varieties used in this study.

Since the model was able to simulated phenology satisfactory for all varieties, generally speaking the model passed the first step in model testing, and was eligible for further testing for accuracy in predicting growth of the rice plant. This is because rice plant phenology is the factor that influences the growth as well as grain yield and yield components. Jintrawet (1991), stated that rice model, as in other models, the rule of thumb is to achieve accuracy in predicting phenology before attempting to develop accuracy in predicting growth and yield.

Comparison of field observation and simulation results for growth of the three varieties indicate that the model greatly overestimates tiller numbers across varieties and planting dates, (Figures 9, 10 and 11). The large discrepancy between observed and simulated tiller numbers are probably because the results of the simulation are the potential capacity of tillering numbers of the rice plant but the full tillering capacity is not usually reached under field conditions (Vergara, 1979). Nevertheless, the observed and simulated tillering numbers of the three varieties are follow the same pattern. That is, after the short recovery period following transplanting, number of tiller increase then become quite stable after heading. The model simulated tiller numbers of RD7 closer to the observed results than NSPT and KDML105 when judging by standardize bias

(R) and standardize mean square error (V). The observed tiller numbers of RD7 is greater than KDML105 and the observed tiller numbers of KDML105 is also greater than NSPT. Consequently, the model also simulated tiller numbers of RD7 is greater than both KDML105 and NSPT.

The model provides a good simulation of leaf area index (LAI) for RD7 across planting dates and NSPT and KDML105 for PD4 and PD5 (Figures 13 and 14). This is supported by t-test of the 1:1 (observed : simulated) regression line, which shows insignificant difference for test of the zero intercept and unity slope. The model greatly overestimates LAI especially for PD1 and PD2 of NSPT and KDML105 which the simulated LAI is greater than 10. This is probably due to the positive relationship between LAI and tiller numbers. That is the model greatly overestimates tiller numbers during vegetative phase. However, the model underestimate LAI of the late planting date (PD5) of both NSPT and KDML105 which could be the results of low tiller numbers during vegetative phase. The model shows good simulation of LAI at August planting date (PD4) when judging by standardized bias (R) and standardized mean square error (V) of both varieties. Generally, the farmer will grow rice both NSPT and KDML105 during July to August which is the appropriate time for traditional photoperiod sensitive variety in the wet season (Prek et al., 1980). Nevertheless, the simulated and observed LAI of all varieties tend to follow the same pattern, i.e., the maximum LAI of all varieties and planting dates would reach maximum LAI during booting stage then decline after heading. This indicates that after heading, carbohydrates would translocate from leaf to panicle (Ponglux, 1978). Similar results was found from the study of the movement of C^{14} labeled assimilator in the developing wheat plant, which showed that translocation of carbohydrates from leaf to grain occurred after heading, with LAI decline corresponding with panicle dry masses increase (Lupton, 1969).

The model underestimates total above-ground biomass for all varieties and planting dates. This is probably because the model greatly underestimates stem dry masses but slightly overestimates leaf and panicle dry masses. In addition , the model does not permit partitioning of assimilate to stem after heading as the simulation results illustrates that stem dry masses decrease sharply after heading. In contrast, the observed stem dry masses still continue to increase until harvested or some slightly decrease after heading. This indicates that rice plant reserved carbohydrate at the stem (Ponglux, 1978). Similar results have been found in RD1, RD3, RD7 and RD9 by Ponglux (1978).

The model overestimates panicle numbers m^{-2} across varieties and planting dates, is partly because the model overestimates tiller numbers m^{-2}. The model underestimates spikelet numbers m^{-2} across planting dates for RD7, NSPT, and KDML105 at PD4 and PD5. In contrast, the spikelet numbers of NSPT and KDML105 at PD1, PD2 and PD3 are overestimated; this is especially marked for PD1 and PD2, for which the model greatly overestimates spikelet numbers. This is probably there is the relationship between simulated LAI and spikelet m^{-2}. That is the simulated LAI of NSPT and KDML105 at PD1, PD2, and PD3 is remarkably high.

The model greatly overestimates grain yield across varieties and planting dates except for PD5 of NSPT and KDML105. This could be due to the positive relationship between LAI and grain yield. Generally, LAI is closely related to grain production because physiologically active leaves contribute to the photosynthesis of the plant (Ritchie et al., 1986). The large discrepancy between simulated and observed grain yield is mainly due to: i) great overestimate of panicle numbers by model; ii) the model assumes that all spikelets formed will develop into grain which will eventually be harvested. This implies that the naturally occurring percentage of unfilled spikelet is not taken into account; iii) Field observation shows that crop lodging was found in NSPT and KDML105 for the early planting dates (PD1, PD2 and PD3) and there is also yield loss due to rats, birds and shattering.

Results from the validation of CERES-Rice model show that the model is capable of simulating the phenological events, both heading date and maturity date relatively well across varieties and years. Simulated grain yield shows similar results as the model testing at the Multiple Cropping Centre Experiment Station in which the simulated grain yield is much higher than the observed. This indicates that the estimated genetic coefficients resulted the model consistency perform for the varieties studied.

In conclusion, the overall performance of the CERES-Rice model illustrate satisfactory simulation of phenological events. This could help rice grower in managing time schedule for crop management such as the application time for fertilizer or pesticide, drainage, and harvesting time. However, the model needs further test and validate for the nitrogen and water management prior to the application of this model in strategies evaluation for rice grower of various locations. In addition, it will be more helpful for the rice grower in grain yield forecast if the model can take into account of losses from pest, lodging and shattering.