

Assessing paddy rice yield sensitivity to temperature and rainfall variability in Peninsular Malaysia using DSSAT model

ABSTRACT

The study assessed the seasonal potential effect of temperature and rainfall variability on MR219 using Ceres rice model v4.6.1.0 of the DSSAT modelling system. The model simulated sensibly rice yield with RMSPE OF 8.9%, with D- Index for grain yield of 0.99. However, the simulated yield positively correlates with observed yield ($r = 0.715$; $p < .05$), while the coefficient of determination ($r^2 = 0.511$). The model predicted changes in rice yield in all the three granary areas with varying degrees of gains and losses in the two seasons. The result from sensitivity analysis showed that during the main season +10C rise in the maximum temperature caused decrease in yield from -0.2 to -4.5% for MADA and KADA. A rise in maximum temperature up to +50C caused decrease in the yield ranging from -3.3 to -14.3 % for all the areas. Minimum temperature increase of +10C resulted in decrease in the yield ranging from -1.3 to -3.5%. During the off season, +10C increase in temperature caused decrease in yield from -0.5 to -2.3% for MADA and IADA. A rise in +30C maximum temperature caused decrease in the yield ranging from -2.5 to -7.5% for all the areas. While +10C rise in minimum temperature caused decrease in the yield from -3.1 to -6.6% for all the areas. Increase or decrease in the mean daily rainfall could be both beneficial as well as destructive depending on the season and location. The result showed that increase in mean daily rainfall of +1mm to +2mm decrease yield ranging from -4.0% to -51.5%. For MADA decrease in daily rainfall of 1mm to 2mm was shown to increase yield up to about 5.4%. In IADA, BLS during the main season decrease in the rainfall up to -7mm caused increased in yield from 6% to 7.2%. During the off season +1mm to +2mm increase in mean daily rainfall caused increased in yield ranging from 0.9% to 2.0%, but decrease in the mean daily rainfall caused yield to decreased ranging from -9.5% to -44.8%. For KADA, Kelantan during the main season increase or decrease in the rainfall decrease yield ranging from -4.4% to -22%. During off season, increase or decrease in the mean daily rainfall caused the yield to decrease ranging from -1.0% to -43.0%. Result from Analysis of variance revealed that under the likely changing condition, productivity in IADA will still likely be higher than in MADA, while KADA being the least will certainly continue to be more vulnerable to these changes than the other two granary areas.

Keyword: Sensitivity; Paddy rice; Vulnerability; Temperature; Rainfall variability; DSSAT model