**10.1071/CP14009_AC**


**Supplementary Material: *Crop & Pasture Science*, 2014, 65(12), 1267–1277.**

# CERES-Rice model-based simulations of climate change impacts on rice yields and efficacy of adaptive options in Northeast China

*Wenxiang Wu*[A,C], *Qian Fang*[A,B], *Quansheng Ge*[A], *Mengzi Zhou*[B] *and Yumei Lin*[A,B]

[A]Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences, 11A Datun Road, Beijing 100101, China.

[B]University of Chinese Academy of Sciences, 19A Yuquan Road, Beijing 100049, China.

[C]Corresponding author. Email: wuwx@igsnrr.ac.cn

## S1. Relative references on impact assessments and adaptation simulation on rice production in China

| | Crop model | Climate model | Study area | Sites | $CO_2$ fertilisation | Adaptation options | Conclusion |
|---|---|---|---|---|---|---|---|
| **Jin et al. (1995)** | CERES-Rice V 3.0 | GCMs: GFDL, GISS, UKMO | South China | 9 | Yes | New rice cultivars, different planting dates, changes in both cultivars and planting dates, and improvements in irrigation systems | Rainfed yields decreased 10~78% (GISS), 7~35% (GFDL) and 6~33% (UKMO) from the baseline yields |
| **Lin et al. (2005)** | CERES-Rice v 3.5 | PRECIS (A2 and B2) | China | | Yes | | Without $CO_2$ fertilization, climate change could reduce rice yield. $CO_2$ fertilization effectively offsets yield decreases caused by shorter growth duration due to higher temperatures. |
| **Yao et al. (2007)** | CERES-Rice v 4.0 | PRECIS (B2) | Middle and South China | 8 | Yes | | Without the $CO_2$ direct effect, frequency for low yield would increase and it reverses for high yield, and the variance for rice yield would increase. With the $CO_2$ direct effect, rice yield increase in all selected sites. |
| **Xiong et al. (2001)** | CERES-Rice V 3.5 | GCMs HadCM 2, ECHAM 4 | China | 32 | No | | Rice yield in main rice production areas of China will reduce, especially in Northeast of China; if $CO_2$ emission reduction |

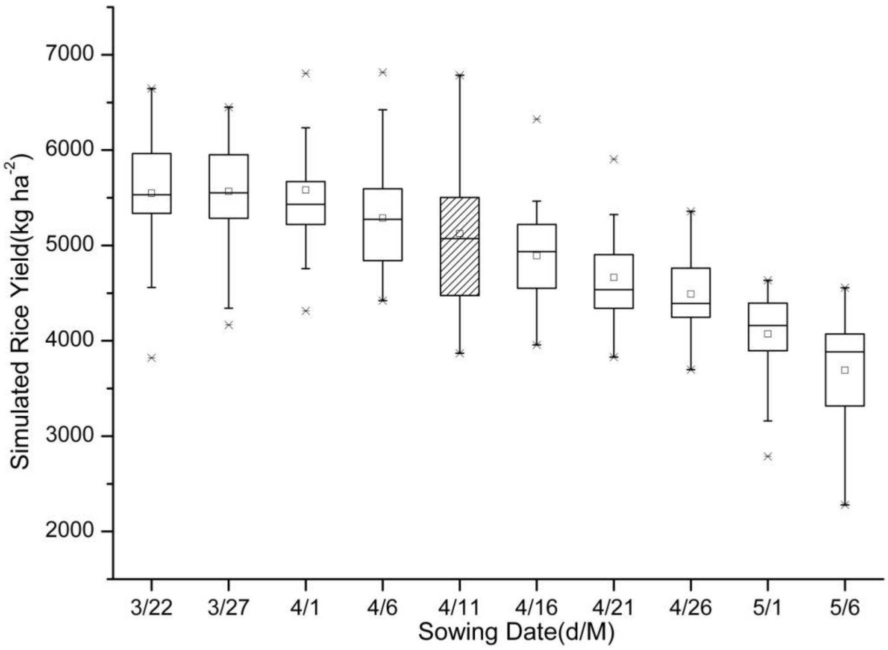
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | measures adopted, rice yield reduction wouldn’t have major change; rice will show a trend of increasing yield in the Southwestern China. |
| **Tao et al. (2008)** | CERES-Rice v 4.0 | Probabilistic scenarios | China | 6 | Yes | | When $CO_2$ fertilization effects are not considered, the rice yields would be reduced with 100% probability. Elevation $CO_2$ could increase rice yield 6.1%~31.6%. |
| **Zhu & Jin (2008)** | CERES-Rice v 4.0 | GCMs: GFDL, GISS, UKMO | Northern China | 19 | Yes | | Climate change would be favorable for soybean and rice production, especially in the northern cold zone and eastern wet zone, but unfavorable for both maize and spring wheat. With increasing of CV, not only the yields reduced compared with the control, but also the yield stabilities for the rainfed crops. |
| **Our study** | CERES-Rice v 4.5 | PRECIS | Northeast China | 7 | Yes | Adjusting planting dates, breeding new rice varieties and transplanting rice varieties | Rice yield would decrease without considering $CO_2$ fertilization effects. $CO_2$ fertilization effects may partly offset the negative impacts of climate change on rice yields. Adverse impacts of climate change on rice yields could be mitigated by advancing planting dates, cultivating new rice cultivars with high thermal requirements, and introducing mid-late maturing rice varieties. |

**S2. Average changes in surface air temperature, precipitation, and $CO_2$ concentrations under SRES A2 and B2 scenarios in the Northeast China according to the simulation of PRECIS model relative to baseline values (1961~1990)**

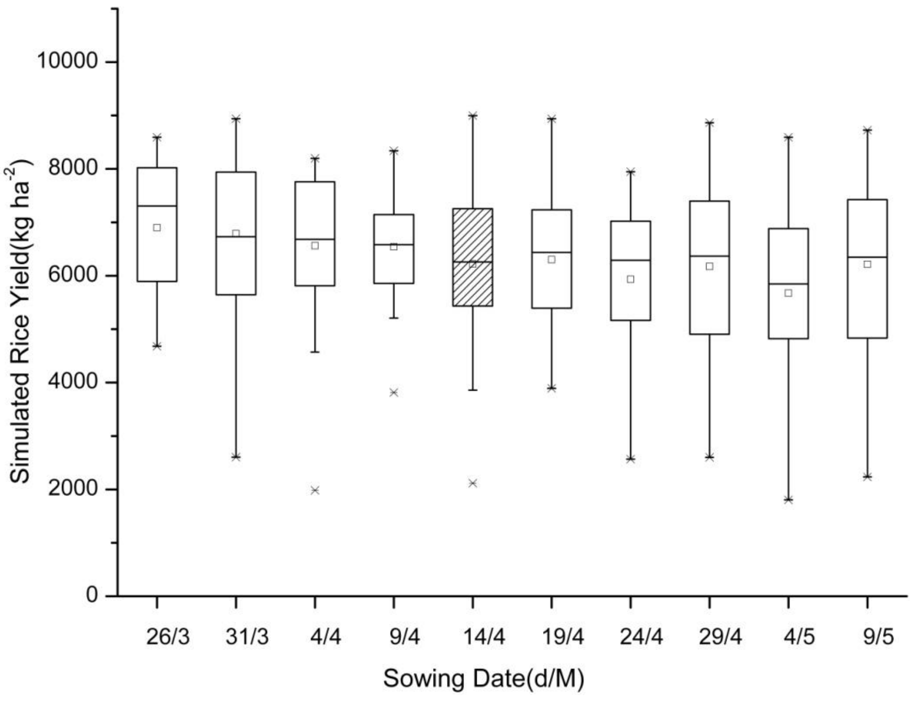
| **Periods** | **A2** | | | **B2** | | |
|---|---|---|---|---|---|---|
| | Temp ($^{o}C$) | Rain (%) | $CO_2$ (ppm) | Temp ($^{o}C$) | Rain (%) | $CO_2$ (ppm) |
| **2020s (2011~2040)** | 1.4 | 3.3 | 440 | 0.9 | 3.7 | 429 |
| **2050s (2041~2070)** | 2.6 | 7.0 | 559 | 1.5 | 7.0 | 492 |
| **2080s (2071~2100)** | 3.9 | 12.9 | 721 | 2.0 | 10.2 | 561 |

**S3. Cultivar-specific parameters in the DSSAT CERES-Rice model[46]**

| Coefficient | Definition |
|---|---|
| P1 | The thermal units required to complete the juvenile stage |
| P2O | Critical photoperiods or the longest day length (in hours) at which the development occurs at a maximum rate |
| P2R | The extent to which phasic development leading to panicle initiation is delayed for each hour increase in photoperiod above the critical photoperiod |
| P5 | The thermal units for the grain filling period |
| G1 | The number of spikelets per unit drymatter of the main culm |
| G2 | The single grain weight under ideal growing conditions |
| G3 | The relative tillering potential |
| G4 | The tolerance coefficient for the thermal environment |




(a)




(b)

**S4.** The simulated yield changes of rice varieties in different sowing dates in the 2080s under B2 scenario (a-Wuchang; b-Tonghua).