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Effect of Soil Temperature and Soil Moisture on Soil Respiration of Ungrazed Grassland in Loess Plateau , Gansu

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Effect of soil temperature and soil moisture on soil respiration of ungrazed grassland in Loess Plateau, Gansu

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Key words: soil respiration, soil temperature, soil moisture, grassland, Loess Plateau

Introduction Soil respiration (SR) is a major component of greenhouse gas emission and is a crucial pathway of the C cycle. The potential increase of SR caused by global warming may present a positive feedback effect on atmospheric CO_2 and climate change (Kirschbaum, 1995). However, the factors that control the exchange of CO_2 between soil and atmosphere in Loess Plateau, Gansu are not well understood. The results in this paper represent a preliminary exercise in studying SR variations and its correlation with soil temperature (Ts) and soil moisture (Ms).

Materials and methods Monthly measurements of SR were made from August 2006 to July 2007 in a fenced *Stipa. bungeana* grassland (free from grazing since Oct. 2005) which located in the Semi-Arid Climate and Environment Observatory Station of Lanzhou University (35° 57′ N, 104° 09′ E). The measurements of SR were made by using a LICOR 6400 portable photosynthesis system fitted with a soil respiration chamber (LICOR, Inc., Lincoln NE). SR was measured between 8:00～10:00. 12 PVC collars that held the SR chamber were set 24 hours before SR measuring. Ts at 2, 5cm depths and Ms down to 10cm were measured simultaneously.

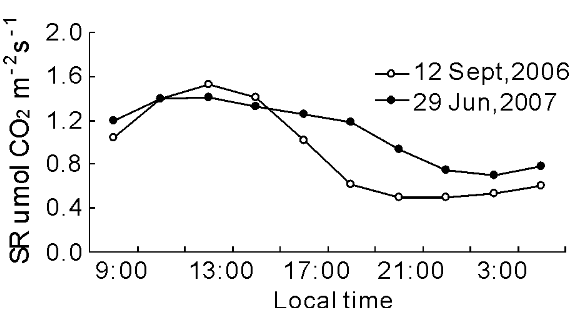

Figure 1 *Diurnal variations of SR.*

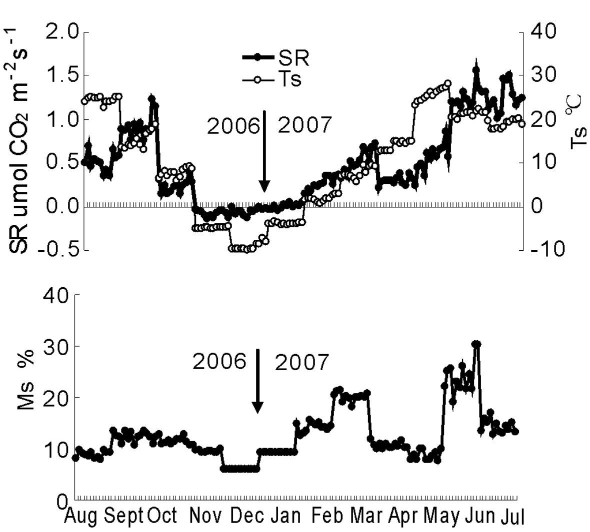

Figure 2 *Seasonal variations of SR, Ts and Ms.*

Results Diurnal variations of SR could be expressed as one-humped curves, reaching to the maximum around 13:00 and falling to the minimum between 0:00～3:00 in different growing periods. Ts at 5cm depth was the dominant factor controlling SR ($P < 0.001$). Ms had relatively little effect on diurnal SR variation as it changed little within one day. Seasonal SR variation was dominated by Ts-Ms interaction and root biomass. The maximum of SR was observed in Jun, 2007, while the minimum in Nov, 2006. Negative CO_2 efflux was observed from Nov, 2006 to Jan, 2007. The correlation between Ts at 2cm, 5cm depths and SR were much remarkable($R^2 = 0.54$ and $R^2 = 0.56$, $P < 0.001$). Ms was secondary factor controlling SR variation at seasonal scale. The single Ms effect on SR was examined by normalizing SR at a reference value of 20℃, and the correlation was significant ($R^2 = 0.39$, $P < 0.001$). When both Ts and Ms effects on SR were considered, SR could be given better simulations:
$SR = 0.024T + 0.039Ms - 0.26$ ($R^2 = 0.73$, $P < 0.001$).

Conclusions Ts was dominant factor controlling diurnal SR variation when Ms was relatively stable. Both Ts and Ms effects on SR could better reveal SR variation at seasonal scale, thus the predictive capacity of the model about SR variation has been improved.

Reference

Kirschbaum, M.U.F., 1995. The temperature dependence of soil organic matter decomposition, and the effect on global warming on soil organic C storage. *Soil Biol. Biochem.* 27, 753-760.