

## Tillage and Irrigation Effects on Soil Aggregation and Carbon Pools in the Indian Sub-Himalayas

Ranjan Bhattacharyya,\* S. C. Pandey, J. K. Bisht, J. C. Bhatt, H. S. Gupta,  
M. D. Tuti, D. Mahanta, B. L. Mina, R. D. Singh, S. Chandra, A. K. Srivastva, and S. Kundu

### ABSTRACT

Carbon retention is a critical issue in arable farming of the Indian Himalayas. This study, conducted from 2001 through 2010 on a sandy clay loam soil, evaluated the effect of tillage alterations (conventional tillage [CT] and zero tillage [ZT]) and selected irrigation treatments (I1: pre-sowing, I2: pre-sowing + active tillering or crown root initiation, I3: pre-sowing + active tillering or crown root initiation + panicle initiation or flowering, and I4: pre-sowing + active tillering or crown root initiation + panicle initiation or flowering + grain filling), applied at the critical growth stages to rice (*Oryza sativa* L.) and wheat (*Triticum aestivum* L.) on soil organic C (SOC) retention and its pools, soil aggregation, and aggregate-associated C contents in the 0- to 30-cm soil layer. Results indicate that the plots under ZT had nearly 17 and 14% higher total SOC and particulate organic C contents compared with CT (~9.8 and 3.6 g kg<sup>-1</sup> soil) in the 0- to 5-cm soil layer after 9 yr of cropping, despite similar mean aboveground biomass yields of both crops on both CT and ZT plots. Tillage had no effect on C pools in the subsurface layers. Irrigation had positive impact on SOC content in the 0- to 5- and 5- to 15-cm layers. Although the labile pools of SOC were positively affected by ZT, the recalcitrant pool was not. Plots under ZT and I4 also had higher large and small macroaggregates and macroaggregate-associated SOC. Thus, adoption of ZT is the better management option for soil C improvement than CT, and irrigation generally enhances the positive impacts.