An evaluation of meta-analyses of greenhouse gas emissions and crop yield under conservation tillage practices

Agricultural activities contribute significantly to greenhouse gas (GHG, carbon dioxide - CO_2, methane - CH_4, and nitrous dioxide - N_2O) emissions, accounting for 12% of all GHG emissions. Conservation tillage practices, such as no-tillage (NT) and reduced tillage (RT), are considered as climate-smart strategies to mitigation GHG emissions without compromising crop yield. Despite numerous meta-analysis studies on the adaptation of conservation tillage, results remain inconclusive. To rectify this concern, we performed a mega-analysis, synthesizing data from 30 meta-analysis studies to provide a comprehensive quantification of the impacts of NT and RT on GHG emissions and crop yield. Results showed that while NT and RT individually had no effect on CH_4 emissions but studies with combined (NT+RT) showed a decrease of CH_4 emission by 6%. NT increased both CO_2 and N_2O emissions by 10.5% and 8.7%, respectively, whereas RT did not influence N_2O emissions. In term of crop yield, both NT+RT and RT exhibited no effect, while NT resulted in a 3.3% decrease. Our mega-analysis provides a comprehensive estimation than individual meta-analyses, offering insights into the impacts of conservation tillage practices on GHG emissions and crop yield. This study is supported by the NSF and USDA CBG projects.