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The Need for Improvement of Crop-Soil Simulation Models for their Application in Conservation Agriculture

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Abstract

Conservation agriculture (CA), a general term for a series of resource-conserving agricultural practices, has seen a tremendous worldwide spread in the last years. CA practices have been promoted for at least the last 20 years in Central and South America and in the USA, with remarkable success and benefits to the environment. One of the still "best-kept secrets" might be the adoption of CA in the Rice-Wheat systems in South Asia. Starting from a modest 3,000 ha of zero-till wheat in 1998–99, in the 2002–2003 season CA is being practised on roughly 500,000 ha in the Indo-Gangetic-Plains. Three agronomic practices seem crucial for CA: avoidance of soil disturbance (reduced / zero tillage), residue retention and crop rotation. These three components must be locally adapted based on factors such as climatic and edaphic conditions, cropping systems, type of farmer and the socio-economic situation. To guide the transition from conventional agriculture to CA, detailed knowledge is required about how a given agricultural system will respond to CA practices. While understanding of basic processes underlying CA has advanced rapidly, there is still a pressing need to refine our ability to integrate effects of climate, soils and management in a predictive fashion. Systems research tools such as crop-soil simulation (CSS) models can increase the efficiency of the necessary research by quantifying the impact of different variables on productivity and resource conservation. However, CSS models were originally developed for conventional agriculture systems. Thus, the influence of reduced tillage and residue retention on soil physical parameters, such as infiltration rate, soil evaporation, water holding capacity and soil temperature, and their effects on surface runoff / erosion, crop soil water availability and crop emergence are seldom addressed. The poster describes how soil physical parameters would be expected to be affected in the short or medium term by CA practices. The current status quo of the capability of some most common CSS models to tackle these dynamics is highlighted and scope for improvement is given. To promote collaboration in modeling CA practices, CIMMYT and USDA-ARS have started an initiative to facilitate communication between researchers worldwide active in modeling CA systems.

Keywords: Conservation agriculture, crop model, modelling procedure, soil physics, zero-tillage

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