EFFECTIVENESS OF RZWQM FOR SIMULATING ALTERNATIVE GREAT PLAINS CROPPING SYSTEMS

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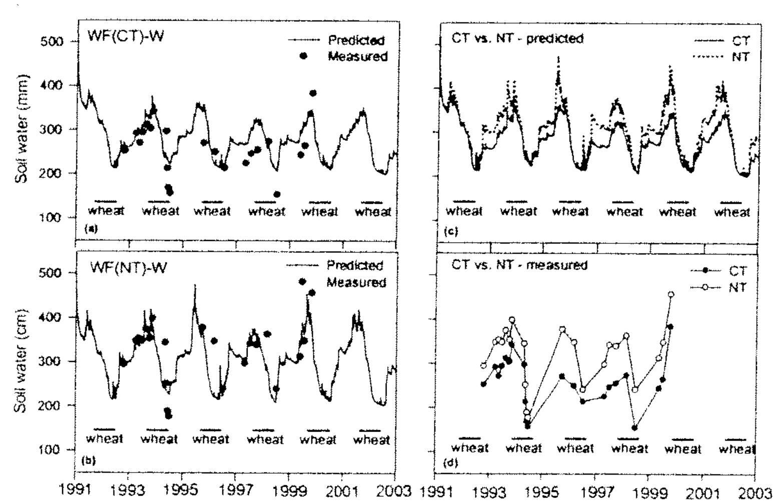
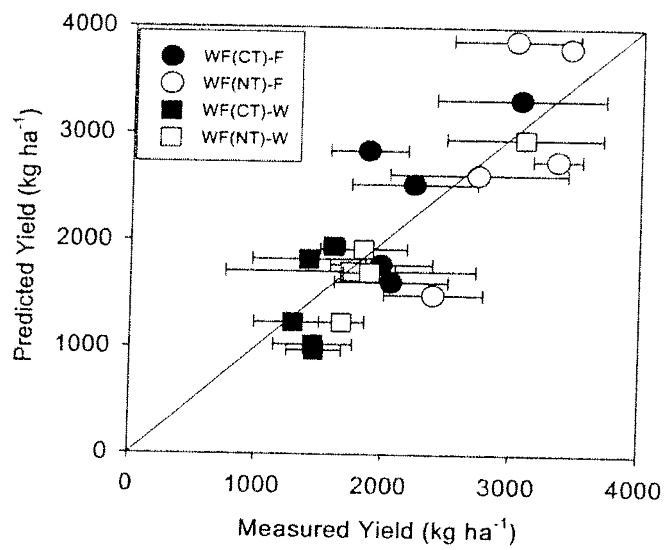
Cropping systems incorporating summer fallow can store soil water and reduce the chance for subsequent crop failure. Winter wheat with summer fallow under conventional tillage systems [WF(CT)] dominated agriculture in the Great Plains during the 20th century. The WF(CT) cropping system in the semiarid Great Plains can have serious adverse impacts on the soil environment due to increased potential for wind and water erosion and subsequent losses of soil organic matter and productivity. Studies oriented toward amelioration of adverse impacts of WF(CT) on soil quality and productivity increased substantially throughout the Great Plains in recent years. To develop environmentally sound cropping systems as alternatives to WF(CT), field experiments were established in 1990 on a Weld silt loam soil (fine, smectitic, mesic Aridic Argiustolls) at the Central Great Plains Research Station at Akron, Colorado. About 20 crop rotations under both CT and NT practices are currently being investigated. To effectively extend research results obtained in those experiments to other soils and climates of the region and to ascertain production risk in highly variable climates such as found in the Great Plains, tools are needed to synthesize and quantify the overall response.

The Root Zone Water Quality Model (RZWQM) is a comprehensive agricultural system model with the capacity to predict crop-environmental response to varying soil and crop management systems. Our objective was to evaluate RZWQM for its ability to simulate a two-year winter wheat (*Triticum aestivum* L.) - fallow rotation and a more complex wheat-corn (*Zea mays* L.)-fallow rotation under tilled and no-till conditions on a Weld



Measured and predicted (RZWQM) total profile (180 cm) soil water under wheat fallow (WF) for the beginning wheat data set. (a) conventional tillage (CT), (b) no-till (NT), (c)comparison of predicted soil water under WF(CT) and WF(NT), (d) comparison of measured soil water under WF(CT) and WF(NT).

silt loam soil in semi-arid northeastern Colorado. Measured data from all phases of both rotations were compared with simulated values using root mean square error (RMSE) values to quantify the agreement. Soil water in different layers, total soil profile (180 cm) water contents, and grain yield were accurately predicted with RMSEs ranging between 0.055 and 0.061 $m^3 m^{-3}$, 4.6 and 7.1 cm, and 244 and 867 kg ha^{-1}, respectively. Leaf Area Index (LAI), evapotranspiration (ET), and biomass predictions were less accurate with RMSEs between 0.7 and 1.6 $m^2 m^{-2}$, 5.5 and 9.7 cm, and 1027 and 2714 kg ha^{-1}, respectively. Greater soil water and crop yield measured for no-tillage (NT) compared with conventional tillage (CT) were simulated reasonably well. Predicted soil organic carbon (SOC) was greater in the surface 0.10 m for NT compared with CT after 11 years. Although the crop growth component of RZWQM needs improvement, especially with regard to LAI, we conclude that the model has reasonable potential for quantifying and synthesizing research findings from alternative crop rotation system experiments in the Great Plains and for extending the results to other soils, climates, and management practices. Another potential application for RZWQM in this region may be to predict viable cropping opportunities for evolving conservation programs such as the Conservation Security Program (CSP).



Comparison of measured and predicted (RZWQM) wheat grain yields for the wheat- fallow (WF) cropping systems in beginning fallow (WF-F) and beginning wheat (WF-W) data sets. Error bars show one standard deviation about the mean of measured yield.

Keywords: Root Zone Water Quality Model; Alternative crop rotations, Great Plains, conventional tillage, no tillage.