United States Department of Agriculture
**Agricultural Research Service**

Assessing Soybean-Winter Wheat Sequences using the DSSAT-CSM in the Southern Great Plains

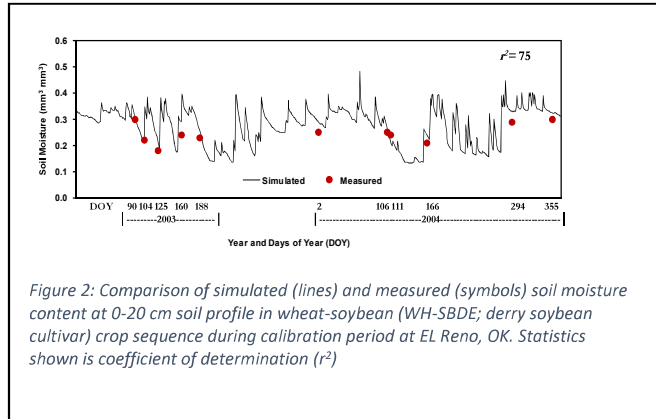Grazinglands Research Laboratory, El Reno, Oklahoma   May 2017

Rationale: Growing legume-cereal crops in succession has been practiced in the U.S. Southern Great Plains (SGP) to provide food for humans and feeds for livestock. The rise in costs of commercial fertilizer has increased interest to include legume crops in rotation with winter wheat as a source of nitrogen (N) and to build soil health. In addition, growing legumes-cereal sequences is expected to help reduce soil erosion, surface runoff, and pollution of surface water during summer rainfall events. In the SGP where animal production is a major economic activity, legume crops could serve as a source of late summer forage for stocker cattle. However, there is always a concern that growing legumes could potentially reduce available soil moisture for winter wheat and thereby affect its yield. Numerous studies conducted in the SGP demonstrated mixed results with some showing a reduction and others indicating no significant impact on yield of subsequent crops.

Decision Support System for Agrotechnology Transfer (DSSAT) Cropping System Model (CSM) is a widely used tool and capable of simulating the crop growth stage, development, and yield in response to variable weather conditions, crop management practices, and soil properties, including soil moisture. A well calibrated DSSAT-CSM model using field data is useful to evaluate crop responses under various sets of growing conditions, which ultimately assists decision making. Various researchers used calibrated DSSAT-CSM for evaluating soil, tillage, land use, and water management practices under spatially and temporally variable climate conditions.
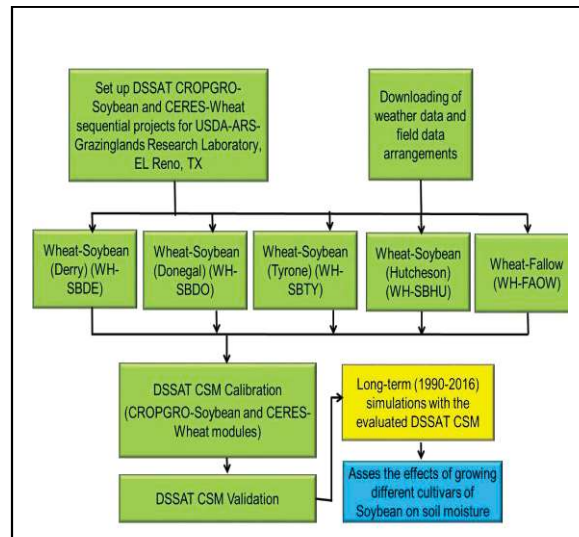
Objective: (i) Calibrate and validate DSSAT-CERES-Wheat and DSSAT-CROPGRO-Soybean modules within the DSSAT-CSM for the Southern Great Plains using measured crop rotations data during 2001-2008 at the USDA-ARS Grazinglands Research Laboratory, El Reno, Oklahoma (ii) Assess the effects of growing legumes crops on soil moisture availability and winter wheat yield during wet, normal, and dry years.

What we are doing: Different sequential DSSAT projects were created using CROPGRO-Soybean and CERES-Wheat modules. Measured crop management data including tillage, planting and harvesting dates, rate and timing of fertilizer application, grain yield, above ground biomass of both winter wheat and soybean (four cultivars - Derry, Donegal, Tyrone, Hutcheson), and soil moisture during crop growing seasons 2001-2002, 2002-2003, and 2003-2004 were used for model calibration. Similar data collected during 2004-2005, 2005-2006, 2006-2007, and 2007-2008 cropping seasons were used for model validation. These calibrated and

Figure 2: Comparison of simulated (lines) and measured (symbols) soil moisture content at 0-20 cm soil profile in wheat-soybean (WH-SBDE; derry soybean cultivar) crop sequence during calibration period at EL Reno, OK. Statistics shown is coefficient of determination (r^2)

validated modules will help to simulate future crops yield and assists in crop management decision making process.

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