

Predicting long term cover crop impacts using a cropping systems model

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Introduction

Our main objective is to evaluate the longer term carbon, nitrogen and water impacts of cover crops on Midwest cropping systems. We are using APSIM, the Agricultural Production Systems sIMulator, which is a cropping systems model that can simulate crop growth as well as a number of soil processes including nutrient and water cycling as well as erosion. APSIM resulted from a need for tools to address long term resource management issues of advanced systems such as cropping rotations and subsequent interactions with climate, genotype, soil and management. Therefore, APSIM is an effective tool for answering questions on the long term impact of cover crops across the CSCAP sites which include this management practice. Articulating the longer term benefits of cover crop is one step in helping overcome producer perceived shorter term risks associated with this conservation practice.

Research and producer questions related to cover crop management to be answered with APSIM

- What are the effects on corn and soybean yield after many years of cover crop incorporation?
 - How are yields impacted by planting and termination dates?
 - Would the use of shorter season corn and soybean hybrids improve cover crop growth and subsequent benefits?
- How are carbon and nitrogen dynamics impacted by cover crops?
 - Are nitrate leaching losses reduced?
 - How much soil organic matter is built over time?
- How do cover crops influence fields after extreme climate events?
 - Does the variability in yield change decrease?
 - Are erosion losses prevented in flood years?
 - How do cover crops change moisture in drought years?



Spring sampling of rye cover crop biomass



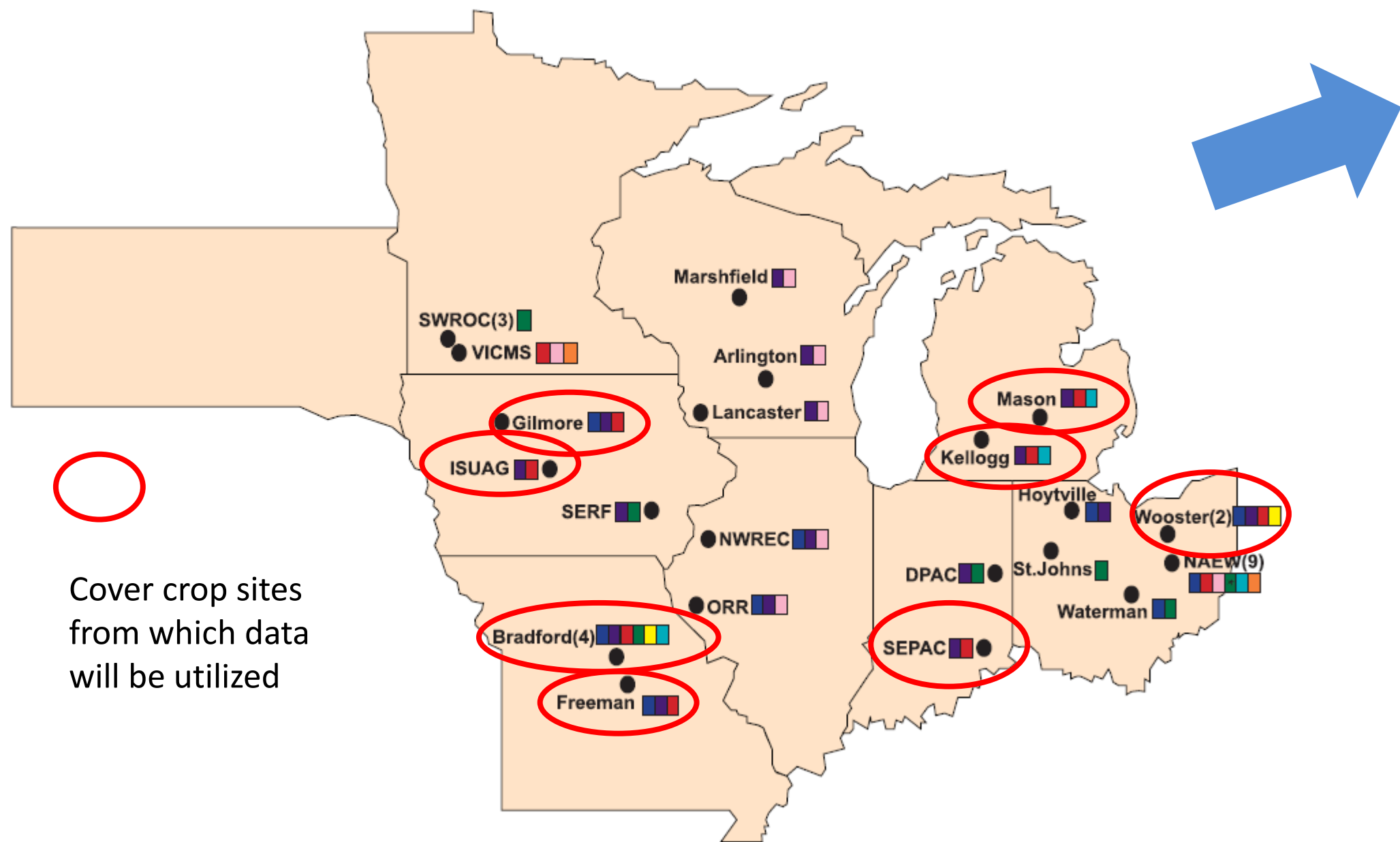
Intact soil core sampling for water retention analysis



Swiss chard: not a cover crop but green and delicious

Methodology

Field trials



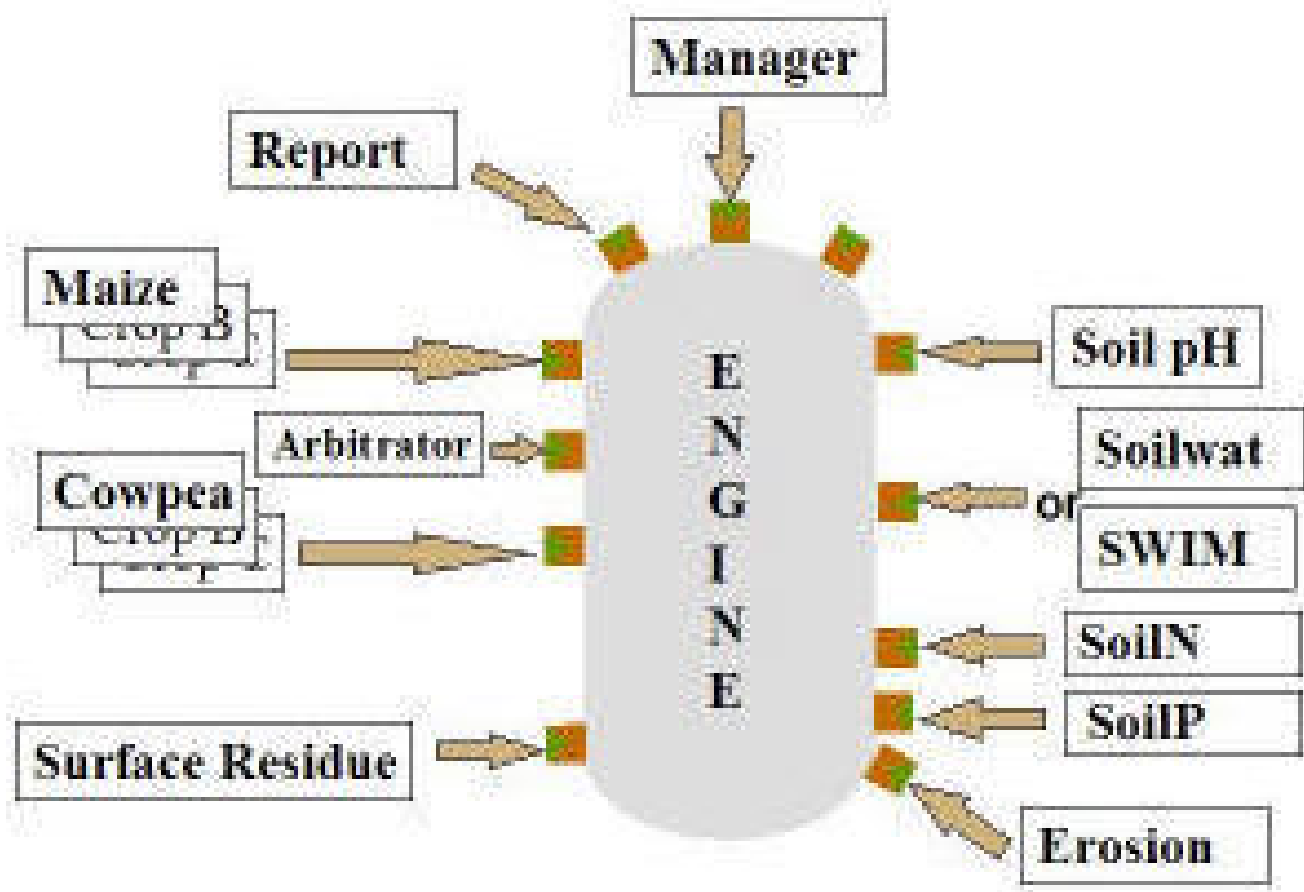
Database: Required Model Inputs

- Climate Data
- Soil Information
- Agronomic Data
- Management

Outputs: Model Predictions

- Yields
- Soil Organic Carbon
- Soil Water
- Nitrate Leaching

Cropping Systems Model



From:
<http://www.apsim.info/Wiki/Default.aspx>

Objective: Improve estimates of long term cover crop impacts on carbon, nitrogen, water and cash crop yields in Midwest Cropping Systems

Preliminary Simulations with Long Term Field Data

In order to properly calibrate APSIM to simulate cover crop dynamics, it is ideal to work with long term data. Proper calibration must be complete before beginning simulations of CSCAP sites. Therefore, we are working with an additional corn-soybean research plot in Iowa that has been cover crop management since 2000.

Collected data to be utilized in simulations

- Cover crop fall and spring biomass
- Corn and soybean yields
- Cover crop n uptake
- Annual nitrate load
- Hourly soil moisture at 5cm, 15cm, 30cm (since 2008)
- Inorganic nitrogen at end of season
- Volumetric water content at field capacity, permanent wilting point and saturation
- Soil texture
- Soil bulk density

	Observed Value	Predicted Value
Corn yield no cover crop (Mg/ha)	12.9	11.8
Corn yield with cover crop (Mg/ha)	12.6	12.2
Soybean yield no cover crop (Mg/ha)	2.9	2.9
Soybean yield with cover crop (Mg/ha)	2.8	3.0
Rye cover crop biomass (Mg/ha)	1.5	2.0
Nitrate leaching no cover crop (kg/ha)	48.5	48.1
Nitrate leaching with cover crop (kg/ha)	21.5	37.4

Predicted and observed average values for preliminary APSIM simulations of the corn-soybean-winter rye research site over a nine year period from 2002-2010.