

CONSERVATION INNOVATION GRANTS
Final Report

Grantee Name: Oklahoma State University	
Project Title: Systems-based cropping 2.0: leveraging soil health demonstrations through web-based tools	
Agreement Number: 69-3A75-12-186	
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Period Covered by Report: September 1, 2012 to August 31, 2016	
Project End Date: 08/31/2016	

This project had three overarching objectives. While activities, results, and accomplishments are interrelated, we have attempted to sort them by objective.

Objective 1 - Demonstrate, quantify, and communicate the impact of biologically diverse crop rotations on soil chemical, biological, and physical properties conducive to soil health.

- A major emphasis of this objective was planting and maintenance of the long-term no-till rotation study at the North Central Research Station near Lahoma. This site was showcased as the backdrop for a soil health stop on the Lahoma Wheat Field Day in 2013, 2014, and 2015 and was viewed by approximately 200 stakeholders at each of these events for a total of over 600 stakeholders directly reached.

Data from the Lahoma crop rotation demonstration were presented to approximately 200 agriculture industry leaders, ranchers, and farmers at the 2014 Oklahoma Weather Symposium. The no-till data along with cover crop data were presented to demonstrate how both practices could be implemented to increase resiliency to adverse weather conditions in the southern Great Plains.

- Laboratory measurements of soil physical properties related to soil health were completed. These measurements will allow us to demonstrate the effects of crop rotation and no-till on the soil in the long-term Lahoma no-till study. An undergraduate intern from Brazil was included in this activity and was trained in field and laboratory methods for quantifying physical properties related to soil health.
- At one of our cover crop field days, Andres Patrignani, demonstrated and explained an on-farm method of assessing soil quality (VESS analysis). This included a hands on activity for attendees, and attendees were given an illustrated card including photos and instructions to use on their farm. This activity was featured in the September 16, 2013 issue of the High Plains Journal which is distributed to over 8,000 Oklahoma stakeholders and numerous additional stakeholders throughout the southern and central

Great Plains weekly.

- An *Evaluating Soil Health* in-service was offered in 2014 and 2015. Approximately 25 Extension educators participated each year. In 2016 extension educators were trained on soil health concepts via Adobe Connect online in-service.
- A farmer in southwest Oklahoma was trained in the visual soil structure assessment method and used the method to evaluate soil health on his farm and his neighbors' farms.
- A major emphasis of this project has been using television and social media to expand and enhance the number of stakeholders engaged. Our primary media outlet has been the weekly television program Sunup which airs on Saturday and Sunday mornings on Oklahoma Public Television. In addition to the weekly shows, the segments are added to the Sunup YouTube channel at <https://www.youtube.com/user/SUNUPTV> and advertised using OSU DASNR email, Twitter, and Facebook. A specific listing of topics and direct links to YouTube segments are provided below:
 - On farm assessment of soil quality 09/14/2013 - <http://youtu.be/WVz4JJC9lfg/>
 - Lahoma crop rotation demonstration and rotation benefits 05/17/2014 - https://youtu.be/_4QbHPz-dUg
 - No-till benefits and incorporation of summer crops 09/13/2014 - <https://youtu.be/XP8zGNO7xw8>
 - No-till compaction and no-till conference 02/21/2015 - <https://youtu.be/MDjQyvNCB3c>
 - No-till and water infiltration after rainfall events 05/23/2015 - <https://youtu.be/jUNZGiRPD9Q>
 - Soil compaction prevention in new no-till fields 11/14/2015 - https://youtu.be/F0YLMaUa_Dk

Objective 2 - Demonstrate and communicate the adaptability and benefits of cover crops and “cover crop cocktails” to farmers, ranchers, and Extension and NRCS personnel.

- Cool season cover crops were discussed and demonstrated at the Lahoma wheat field day in 2013, 2014, 2015, and 2016. There were approximately 200 stakeholders present at each field day for a total of over 800 stakeholders reached.
- A summer cover crop field day was held in July 2013 and 2014 and attracted approximately 50 stakeholders each year (>100 total). Presenters included OSU faculty, graduate students and NRCS personnel. Pictures from the 2013 field day are posted below







- Information on cover crops and cover crop management was presented to over 150 agricultural retailers, Extension professionals, and certified crop advisors at the 2013 and 2014 OSU Winter Crop Schools
- Approximately 200 agriculture industry leaders, ranchers, and farmers at the 2014 Oklahoma Weather Symposium. The no-till data along with cover crop data were presented to demonstrate how both practices could be implemented to increase resiliency to adverse weather conditions in the southern Great Plains.
- A major emphasis of this project has been using television and social media to expand and enhance the number of stakeholders engaged. Our primary media outlet has been the weekly television program Sunup which airs on Saturday and Sunday mornings on Oklahoma Public Television. In addition to the weekly shows, the segments are added to the Sunup YouTube channel at <https://www.youtube.com/user/SUNUPTV> and advertised using OSU DASNR email, Twitter, and Facebook. A specific listing of topics and direct links to YouTube segments are provided below:
 - Cover crops featured at annual wheat field day 06/18/2013 - <https://youtu.be/MwMmAfodNQc>
 - Cover crops field day and nitrogen recovery from legume cover crops 09/14/2013 - <https://youtu.be/scjb9HJMN4E>

- Grazing cover crops 08/02/2014 - <https://youtu.be/dqksxKgMRNs>
- Cover crops, soil health, and grazing cover crops 10/17/2015 - <https://youtu.be/JIRj2Cacmvo>
- Dr. Warren delivered the extension presentation *Potential use of Cover Crops* to stakeholder groups at Goodwell, Watonga, Buffalo, and Alva, Oklahoma.
- Dr. Warren shared findings from our studies at the Southern Plains Cover Crop Symposium at Hays, KS.
- Dr. Warren presented *Utilizing Cover Crops in No-till Systems* at the 2014 Women in Ag. Conference.
- Additional extension presentations by team members related to cover crops include:
 - Warren, J. 2014. Utilizing Cover Crops in No-Till Systems. Presented at the Oklahoma Ag Expo. Midwest City, OK. 3-5 Nov.
 - Warren, J. 2014. No-till soil management. Presented at No-till Field day. Pauls Valley, OK 8 Oct.
 - Warren, J. and B. Jones. 2015. Impact of Canola Management on Soil Health. Presented at the Canola College. Enid, OK. 19 Feb.
 - Warren, J. 2015. Summary of Cover Crop Research in Oklahoma. Presented at the No-till Oklahoma Conference. Norman, OK. 3-4 Mar.
 - Warren, J., C. Godsey, and R. Taylor. 2015. Short Term No-Till Research. Presented at the No-till Oklahoma Conference. Norman, OK 3-4 Mar.
 - Warren, J. 2015. Cover Crop Research in Oklahoma and BMP's Presented at the No-till Forage and Cover Crop Conference. Enid, OK 12 Mar

Objective 3 - Develop a web-based plant available water estimator that will provide stakeholder utility beyond the life of the project and increase visibility of Extension and NRCS services

- Funding from this CIG project was leveraged with subsequent grants from the Oklahoma Cooperative Extension Service and the OSU Technology and Business Development program to create three complementary and interrelated tools to serve producers as described below.
- The Oklahoma Cooperative Extension Service grant supported the development and release of “Canopeo”, an app for iOS and Android mobile devices which is designed to let producers easily and rapidly measure green canopy cover in the field. The app also enables users to conveniently record additional field-specific, in season crop data (e.g. plant height and planting date) and to submit those data to a server for later viewing and reporting. This app has been installed by thousands of users around the world and is being used by producers, crop consultants, and researchers to monitor crop progress and cover crop performance. To download the app visit <http://canopeoapp.com/>.

- The OSU Technology and Business Development grant supported the prototyping of “FieldCaster”, an innovative crop forecasting service for mobile devices. Using the FieldCaster app (Android only), producers in Oklahoma can obtain site-specific in-season forecasts of winter wheat yield potential, crop growth stages, and probability of freezing. The FieldCaster app interfaces seamlessly with the Canopeo app to obtain in field green canopy cover estimates which enable more accurate forecasts. The FieldCaster app prompts users to specify the planting date for their wheat field and obtains the geolocation from the user’s mobile device. The canopy cover, planting date, and geolocation are submitted to a custom-built crop forecast system housed at the OSU High Performance Computing Center. The forecast system retrieves site-specific soil data from the NRCS SSURGO database based on the user’s geolocation. The system also retrieves ~20 years of weather data from the nearest Oklahoma Mesonet station. The soil and weather data drive a custom-built crop model that estimates the current status of the crop and the plant available water in the root zone. The crop status estimate is updated using the green canopy cover measurement obtained in the field using Canopeo. The system then generates probabilistic forecasts for crop yield, timing of next growth stage, and probability of freezing by running an ensemble of >15 years of weather sequences from the current date to the estimated date of harvest. These weather sequences are real sequences observed in prior years at the nearest Mesonet station. In subsequent efforts members of the project team plan to further develop the FieldCaster service and deliver it to end users.
- Building upon the knowledge, skills, models, and cyber-infrastructure from the two projects described above, members of the project team used CIG funding to develop a web-based plant available water estimation system for Oklahoma wheat cropland, and that system is now live at <http://soilmoisture.okstate.edu/fieldcaster/>. This web-based plant available water estimator uses the FieldCaster server and model, but unlike the Android app for Fieldcaster, the web-based tool does not require input from the Canopeo app. The web page features an interactive map that allows users to select any wheat field of interest within the state of Oklahoma. The user then specifies the planting date for that wheat crop and requests a forecast. The planting date and location are then passed to the FieldCaster forecasting system which returns a site-specific estimate of the plant available water in the root zone in inches. The web page also displays the estimated Normalized Difference Vegetative Index (NDVI) for the crop, the probability of freezing temperatures in the next 7 days based on historical data, and the next crop growth stage and the probability of reaching that stage in the next 7 days.
- The project team plans to develop a press release to inform stakeholders about this new tool and to work with SunUp to have the tool featured on the weekly television broadcast. The project team is also willing to work with NRCS staff to develop additional press releases or promotional materials to spread the word regarding the one-of-a-kind plant available water estimator produced under this CIG project.

Print and web-based materials produced as a result of this grant include:

- Warren, J., K. Meeks, and J. Edwards 2013. Benefits of Using Cover Crops in Oklahoma No-Till. Okla. State Univ. Fact Sheet PSS-2161
- Lollato, R.P., A. Patrignani, J.T. Edwards and T.E. Ochsner. 2013. Modeling plant available water for winter wheat in the southern Great Plains. ASA, CSSA, & SSSA International Annual Meetings. Tampa, Florida.
- Patrignani, A. and T.E. Ochsner. 2013. Real-time model-data synthesis for soil moisture. ASA, CSSA, & SSSA International Annual Meetings. Tampa, Florida.
- Patrignani, A., T.E. Ochsner and J. Beehler. 2013. Green canopy analyzer tool using Matlab. ASA, CSSA, & SSSA International Annual Meetings. Tampa, Florida.
- Patrignani, A. and T.E. Ochsner. 2015. Canopeo: A Powerful New Tool for Measuring Fractional Green Canopy Cover. *Agron. J.* 107: 2312-2320. doi:10.2134/agronj15.0150.
- Warren, J., T. Wilson, and J. Edwards. 2014. Using sunn hemp as a cover crop in Oklahoma. OSU Extension Facts, PSS-2273. Oklahoma State Univ., Coop. Ext. Service, Stillwater, OK.
- Edwards, J., J. Warren, and D. Redfearn. 2014. Sod-seeding small grains into bermudagrass pasture. OSU Fact Sheet PSS-2071. Oklahoma State Univ., Coop. Ext. Service, Stillwater, OK.
- Kochenower, R., and J.T. Edwards. 2014. Starter fertilizer effect on wheat grain yield following strip-till corn. Production Technology Report. Okla. State Univer. Dept. Plant Soil Sci.
- Edwards, J. and B Hunger. 2013. Fusarium head blight (head scab) of wheat: questions and answers. OSU Fact Sheet PSS-2145. Oklahoma State Univ., Coop. Ext. Service, Stillwater, OK.
- Warren, J., and R. Taylor. 2014. Managing Soil Compaction. PSS-2244. Oklahoma State University, Stillwater. Aug.
- Lollato, R., J. Edwards, and H. Zhang. 2015. Effectiveness of in-furrow pelletized lime for winter wheat grown in lo soil pH. OSU Extension Facts, PSS-2164. Oklahoma State Univ., Coop. Ext. Service, Stillwater, OK.
- Edwards, J., F. Epplin, B. Hunger, A. Post, T. Royer, R. Taylor, J. Warren, and H. Zhang. (rev.) 2015, 2006. No-till wheat production in Oklahoma. OSU Extension Facts, PSS-2132. Oklahoma State Univ., Coop. Ext. Service, Stillwater, OK.