S1. PRISMA diagram and references for literature search

|  |
| --- |
|  |
| ***Figure S1.1.*** *PRISMA diagram* (Moher et al. 2009) |

***Table S1.1.*** *References for studies included in data synthesis in alphabetical order*

1. Bernstein ER, Posner JL, Stoltenberg DE, Hedtcke JL (2011) Organically managed no-tillage rye-soybean systems: Agronomic, economic, and environmental assessment. Agron J 103:1169–1179. doi: 10.2134/agronj2010.0498
2. Cornelius CD, Bradley KW (2017) Influence of Various Cover Crop Species on Winter and Summer Annual Weed Emergence in Soybean. Weed Technol 31:503–513. doi: 10.1017/wet.2017.23
3. Crawford LE, Williams MM, Wortman SE (2018) An early-killed rye (Secale cereale) cover crop has potential for weed management in edamame (Glycine max). Weed Sci 66:502–507. doi: 10.1017/wsc.2018.5
4. Currie RS, Klocke NL (2005) Impact of a terminated wheat cover crop in irrigated corn on atrazine rates and water use efficiency. Weed Sci 53:709–716. doi: 10.1614/ws04-170r1.1
5. Davis AS (2010) Cover-Crop Roller–Crimper Contributes to Weed Management in No-Till Soybean. Weed Sci 58:300–309. doi: 10.1614/ws-d-09-00040.1
6. De Bruin JL, Porter PM, Jordan NR (2005) Use of a rye cover crop following corn in rotation with soybean in the upper Midwest. Agron J 97:587–598. doi: 10.2134/agronj2005.0587
7. Delate K, Cwach D, Chase C (2012) Organic no-tillage system effects on soybean, corn and irrigated tomato production and economic performance in Iowa, USA. Renew Agric Food Syst 27:49–59. doi: 10.1017/S1742170511000524
8. Fisk JW, Hesterman OB, Shrestha A, et al (2001) Weed suppression by annual legume cover crops in no-tillage corn. Agron J 93:319–325. doi: 10.2134/agronj2001.932319x
9. Forcella F (2014) Short- and full-season soybean in stale seedbeds versus rolled-crimped winter rye mulch. Renew Agric Food Syst 29:92–99. doi: 10.1017/S1742170512000373
10. Gallagher RS, Cardina J, Loux M (2003) Integration of cover crops with postemergence herbicides in no-till corn and soybean. Weed Sci 51:995–1001. doi: 10.1614/p2002-062
11. Gieske MF, Wyse DL, Durgan BR (2016) Spring- and Fall-Seeded Radish Cover-Crop Effects on Weed Management in Corn. Weed Technol 30:559–572. doi: 10.1614/wt-d-15-00023.1
12. Hoffman ML, Regnier EE, Cardina J (1993) Weed and corn (Zea mays) responses to a hairy vetch (Vicia villosa) cover crop. Weed Technol 7: 594-599. Doi:10.1017/S0890037X00037398
13. Mock VA, Creech JE, Ferris VR, et al (2012) Influence of Winter Annual Weed Management and Crop Rotation on Soybean Cyst Nematode ( Heterodera glycines ) and Winter Annual Weeds: Years Four and Five . Weed Sci 60:634–640. doi: 10.1614/ws-d-11-00192.1
14. Werle R, Burr C, Blanco-Canqui H (2017) Cereal rye cover crop suppresses winter annual weeds. Can J Plant Sci 98:498–500. doi: 10.1139/CJPS-2017-0267
15. Williams MM, Mortensen DA, Doran JW (1998) Assessment of weed and crop fitness in cover crop residues for integrated weed management. Weed Sci 46:595–603. doi: 10.1017/s0043174500091153

S2. Supplementary Information on SALUS simple model calibration

# Systems Approach to Land-Use Sustainability (SALUS) model overview

SALUS (Basso and Ritchie 2015) is a cropping systems simulation platform that allows estimating the impact of diverse agricultural management strategies on various processes within the soil–plant–atmosphere continuum. The platform contains a suite of interconnected processed-based models derived from the well-validated CERES (Crop Estimation through Resource and Environment Synthesis) model, providing simulation of crop growth and development, and carbon, water, nitrogen, and phosphorus cycling dynamics on a daily time step. The model uses as input daily values of incoming solar radiation (MJ m−2), maximum and minimum air temperature (°C), and rainfall (mm), as well as information on soil characteristics and management. SALUS has been tested extensively for its ability to simulate various soil-crop processes including: soil carbon dynamics (Senthilkumar et al. 2009; Basso et al. 2018), crop yield (Basso et al. 2007), plant N uptake and phenology (Basso et al. 2010, 2011; Albarenque et al. 2016), nitrate leaching (Giola et al. 2012; Syswerda et al. 2012; Basso et al. 2016), water use efficiency (Ritchie and Basso 2008) and transpiration efficiency (Basso and Ritchie 2012). A general description on SALUS is provided by Basso and Ritchie (2015).

In SALUS, crop growth can be simulated following a *complex* or a *simple* modeling approach. In this study, we used the simple modeling approach. The *simple* crop model (SALUS-Simple henceforth) represents a ‘generic’ crop model with 20-25 predefined crop parameters, which can be easily adapted to characterize growth of many annual crops. SALUS-Simple follows the same approach used by ALMANAC (Agricultural Land Management Alternatives with Numerical Assessment Criteria, Kiniry et al., 1992). Briefly, the model uses crop parameters to calculate potential leaf area index (LAI) and radiation use efficiency (RUE) curves as function of thermal time, which in turn are used to estimate daily crop resource acquisition and potential crop growth. When run with water and nutrient limitations, the model calculates water and nutrient stress factors based on a daily supply-demand balance, which then are applied to reduce the rate of potential biomass growth. For a detailed description of the SALUS-Simple crop model, we refer the reader to Dzotsi et al. (2013).

# Data sources and model set up

We assembled a dataset of published literature studies conducted within the Corn Belt to set up and calibrate the SALUS-simple model. All of these studies reported measurements of winter rye cover crop biomass at termination, as well as cover crop planting and termination dates. This dataset contains observations from 12 studies, 6 of which also were included in our original meta-analysis dataset and the rest were available from a literature search from a previous study (Martinez-Feria et al. 2016). In total, the dataset included observations from 15 sites, amounting to 52 site-year combinations (Figure S2.1). We used 60% of the data for model training and 40% for model testing. The assembled dataset is shown in Table S2.1.

|  |  |
| --- | --- |
|  | ***Figure S2.1.*** *Geographical location of the experiments used for model calibration.* |

For each of the 15 sites, we retrieved daily weather data from the North American Land Data Assimilation System project phase 2 (NLDAS-2) dataset (Xia et al. 2012) using the single-pixel (0.125° resolution) extraction tool and formatter for SALUS (<https://salusmodel.ees.msu.edu/NLDAS/>). Soil information for each site was retrieved from the Soil SURvey GeOgraphic database (SSURGO; Soil Survey Staff), from which we selected data for the predominant soil series (map unit key) at each location.

Simulation for each experiment were run independently, from Jan-1 to June-30 of the following year, meaning that each simulation comprised a period of 18 months. We assumed both water- and N-limited rye cover crop growth. To provide for realistic initial conditions for soil water at cover crop planting, we simulated a maize crop, prior to cover crop planting. In the model, maize was planted in early May, fertilized with 150 kg N ha-1 at planting and harvested 10 days before the prescribed cover crop planting date. Planting density for rye cover crop was assumed at 300 plants m-2, 1.0 cm depth and 20 cm row spacing. No fertilizer was applied to rye in the model.

***Table S2.1.*** *Dataset of published estimates of rye cover crop biomass at terminations which was used for model training and testing*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Obs. ID** | **Used for** | **Source** | **Location** | **Planting** | **Termination** | **Biomass** |
| **(Mg ha-1)** |
| 1 | Training | Cornelius and Bradley, 2017 | Columbia, MO | 2012-9-11 | 2013-4-25 | 2.89 |
| 2 | 2013-9-12 | 2014-5-2 | 2.19 |
| 3 | 2014-9-10 | 2015-4-23 | 1.15 |
| 4 | Moberly, MO | 2013-9-12 | 2014-5-2 | 1.39 |
| 5 | 2014-9-10 | 2015-4-23 | 3.93 |
| 6 | Davis, 2010 | Urbana, IL | 2004-10-1 | 2005-5-13 | 7.10 |
| 7 | 2005-10-1 | 2006-5-12 | 6.00 |
| 8 | 2006-10-1 | 2007-5-11 | 6.00 |
| 9 | Bruin et al., 2005 | Rosemont, MN | 2001-10-25 | 2002-5-1 | 0.49 |
| 10 | 2001-10-25 | 2002-5-8 | 0.73 |
| 11 | 2001-10-25 | 2002-5-15 | 1.03 |
| 12 | 2001-10-25 | 2002-5-22 | 1.80 |
| 13 | 2002-11-1 | 2003-5-13 | 0.15 |
| 14 | 2002-11-1 | 2003-5-23 | 0.41 |
| 15 | 2002-11-1 | 2003-6-2 | 1.42 |
| 16 | 2002-11-1 | 2003-6-17 | 2.93 |
| 17 | Waseca, MN | 2001-10-18 | 2002-5-1 | 0.38 |
| 18 | 2001-10-18 | 2002-5-8 | 0.85 |
| 19 | 2001-10-18 | 2002-5-20 | 2.19 |
| 20 | 2001-10-18 | 2002-5-28 | 3.77 |
| 21 | 2002-10-11 | 2003-5-1 | 0.15 |
| 22 | 2002-10-11 | 2003-5-7 | 0.22 |
| 23 | 2002-10-11 | 2003-5-14 | 0.52 |
| 24 | 2002-10-11 | 2003-5-20 | 0.99 |
| 25 | Feyereisen et al., 2006 | St. Paul, MN | 2000-9-18 | 2001-5-25 | 5.90 |
| 26 | Forcella, 2014 | Stevens county, MN | 2009-9-2 | 2010-6-9 | 6.00 |
| 27 | 2010-9-20 | 2011-6-14 | 6.00 |
| 28 | Kaspar et al., 2007 | Ames, IA | 2001-9-20 | 2002-4-17 | 2.43 |
| 29 | 2002-9-10 | 2003-5-6 | 2.50 |
| 30 | 2003-10-2 | 2004-4-16 | 1.48 |
| 31 | 2004-10-6 | 2005-4-25 | 2.74 |
| 32 | Testing | Kaspar et al., 2012 | Ames, IA | 2005-9-30 | 2006-4-21 | 2.44 |
| 33 | 2006-10-24 | 2007-5-10 | 0.61 |
| 34 | 2007-9-28 | 2008-4-29 | 1.26 |
| 35 | 2008-10-29 | 2009-5-21 | 0.50 |
| 36 | 2009-9-28 | 2010-4-19 | 1.73 |
| 37 | Martinez-Feria et al., 2016 | Kelley, IA | 2008-10-21 | 2009-5-6 | 0.37 |
| 38 | 2009-11-6 | 2010-5-5 | 1.18 |
| 39 | 2010-10-4 | 2011-5-10 | 1.53 |
| 40 | 2011-10-10 | 2012-4-18 | 2.50 |
| 41 | 2012-10-15 | 2013-5-11 | 0.50 |
| 42 | Ruffo and Bollero, 2003 | Brownstown, IL | 1998-10-3 | 1999-4-28 | 4.73 |
| 43 | 1999-10-2 | 2000-4-29 | 2.92 |
| 44 | Urbana, IL | 1998-10-1 | 1999-5-2 | 4.02 |
| 45 | 1999-10-5 | 2000-5-4 | 3.16 |
| 46 | Strock et al., 2004 | Lamberton, MN | 1998-10-1 | 1999-4-30 | 2.70 |
| 47 | 1999-9-29 | 2000-4-11 | 1.00 |
| 48 | 2000-10-4 | 2001-5-16 | 0.50 |
| 49 | Werle et al., 2018 | North Platte, NE | 2016-9-20 | 2017-4-18 | 4.08 |
| 50 | 2016-10-17 | 2017-4-18 | 3.77 |
| 51 | Williams et al., 1998 | Ithaca, NE | 1994-9-20 | 1995-6-6 | 6.31 |
| 52 | 1995-9-20 | 1996-5-23 | 2.89 |

# Model calibration and performance

To calibrate the SALUS-simple model for simulating rye cover crop biomass, we first compared simulated values to data from the testing dataset (Table S2.1). To quantify model fit to the observed data we computed the Nash-Sutcliffe model efficiency (NSE) and root-mean-squared error (RMSE). The RMSE is a measure of model error (the closer to zero, the better), while NSE is a measure of model precision compared to an arithmetic mean (a value of 1 indicates perfect fit). The equation for these two measures can be seen in Archontoulis and Miguez (2013). Model fit was also evaluated visually by means of plotting the observed vs. simulated values, with the regression line as measure of model bias.

We used as a starting point the rye crop species parameters available in the ALMANAC model (Kiniry and Spanel, 2009; Table S2.2). Using this parameterization, however, the model tended to overestimate fall growth, which resulted in premature senescence in the spring. Therefore, we evaluated increasing the length of the growth cycle (TTtoMatr from 1200 to 1800 °C-day) and adjusting phenology (relTT\_P1, relTT\_Sn) and LAI curve parameters (relLAI\_P2). Additionally, because the model tended to overpredict biomass growth in the spring, we decreased maximum potential radiation use efficiency (RUEmax) from 3.0 to 2.0 g MJ (PAR)-1. A list of parameter values derived from the model training step are included in Table S2.2, and a model fit to the training data set is shown in Figures S2.2 and S2.3.

***Table S2.2.*** *Calibrated SALUS-simple parameters used to simulate winter rye cover crop growth.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | **Description** | **Units** | **Value** | |
| **ALMANAC (original)** | **Calibrated\*** |
| relTT\_P1 | Relative development thermal time at point 1 | °C-day °C-day-1 | 0.3 | 0.25 (0.05-0.45) |
| relLAI\_P1 | Relative LAI at point 1 | m2 m-2 | 0.01 | - |
| relTT\_P2 | Relative development thermal time at point 2 | °C-day °C-day-1 | 0.5 | - |
| relLAI\_P2 | Relative LAI at point 2 | m2 m-2 | 0.95 | 0.9 (0.9-0.99) |
| LAImax | Maximum leaf area index | m2 m-2 | 3 | - |
| RUEmax | Maximum potential radiation use efficiency | g MJ (PAR)-1 | 3 | 2 (1-3.5) |
| relTT\_Sn | Relative development thermal time at senescence | °C-day °C-day-1 | 0.8 | 0.5 (0.5-0.85) |
| SnParLAI | Parameter for RUE decline after senescence | unitless | 1 | - |
| SnParRUE | Parameter for RUE decline after senescence | unitless | 1 | - |
| TbaseDev | Base temperature for development | °C | 0 | - |
| ToptDev | Optimal temperature for development | °C | 15 | - |
| TTtoGerm | Development thermal time to germinate | °C-day | 20 | - |
| TTtoMatr | Development thermal time to mature | °C-day | 1200 | 1800 (1200-2500) |
| EmgInter | Intercept of emergence time calculation | leaf eq. | 15 | - |
| EmgSlope | Slope of emergence time calculation | leaf eq. cm-1 | 6 | - |
| HrvIndex | Harvest index | Mg Mg-1 | 0.42 | - |
| PlntN\_Em | Optimal N in plant at emergence | g g-1 | 0.0226 | - |
| PlntN\_Hf | Optimal N in plant halfway to maturity | g g-1 | 0.018 | - |
| PlntN\_Mt | Optimal N in plant at maturity | g g-1 | 0.014 | - |
| GrnN\_Mt | Optimal N in grain at maturity | g g-1 | 0.023 | - |
| CHeight | Approximate height of crop | m | 1.0 | - |
| \*Values within parenthesis show the range explored in the calibration | | | | |

|  |
| --- |
|  |
| ***Figure S2.2.*** *Example of rye cover crop spring growth as simulated by the SALUS-simple crop model. The data for the experiments shown here were obtained from Bruin et al. (2005).* |

Having calibrated the SALUS-Simple crop model to simulate rye growth, the next step was to compare the simulated values to the independent measurement in the testing dataset. Considering that set-up and model training was largely based on limited (i.e. publicly available) data and literature values, the SALUS-simple model was able to satisfactorily reproduce the measured cover crop biomass at termination in the testing dataset. Biomass across all sites in the testing dataset were simulated with a RMSE of 1.2 Mg ha-1. This was about the same compared to the training dataset (1.1 Mg ha-1), which suggest no overfitting of the training data. The model did tend to overpredict the rye biomass in the testing dataset compared to the training, especially in the high yielding environments. This translated to lower NSE compared to the training data (0.74 vs. 0.39), although it was still within acceptable ranges. Based on these results we deemed this model calibration appropriate for estimating rye biomass growth as a function of weather, soils and management across the US Corn Belt.

|  |  |
| --- | --- |
|  | ***Figure S2.3.***  *SALUS simple model fit to the training and testing datasets. NSE = Nash-Sutcliffe model efficiency; RMSE = root mean squared error.* |

S3. Model fitting results

# References

Albarenque SM, Basso B, Caviglia OP, Melchiori RJM (2016) Spatio-temporal nitrogen fertilizer response in maize: Field study and modeling approach. Agron J 108:2110–2122. doi: 10.2134/agronj2016.02.0081

Archontoulis S V, Miguez FE (2013) Supplemental Materials for Nonlinear for Nonlinear Regression Models and Applications in Agricultural Research. Agron J 13:1–13. doi: 10.2134/agronj2012.0506

Basso B, Bertocco M, Sartori L, Martin EC (2007) Analyzing the effects of climate variability on spatial pattern of yield in a maize-wheat-soybean rotation. Eur J Agron. doi: 10.1016/j.eja.2006.08.008

Basso B, Cammarano D, Troccoli A, et al (2010) Long-term wheat response to nitrogen in a rainfed Mediterranean environment: Field data and simulation analysis. Eur J Agron. doi: 10.1016/j.eja.2010.04.004

Basso B, Dumont B, Maestrini B, et al (2018) Soil Organic Carbon and Nitrogen Feedbacks on Crop Yields under Climate Change. Ael 3:0. doi: 10.2134/ael2018.05.0026

Basso B, Giola P, Dumont B, et al (2016) Tradeoffs between Maize Silage Yield and Nitrate Leaching in a Mediterranean Nitrate-Vulnerable Zone under Current and Projected Climate Scenarios. PLoS One 11:e0146360. doi: 10.1371/journal.pone.0146360

Basso B, Ritchie JT (2012) Assessing the impact of management strategies on water use efficiency using soil-plant-atmosphere models. Vadose Zo J. doi: 10.2136/vzj2011.0173

Basso B, Ritchie JT (2015) Simulating Crop Growth and Biogeochemical Fluxes in Response to Land Management Using the SALUS Model

Basso B, Ritchie JT, Cammarano D, Sartori L (2011) A strategic and tactical management approach to select optimal N fertilizer rates for wheat in a spatially variable field. Eur J Agron 35:215–222. doi: 10.1016/J.EJA.2011.06.004

Bernstein ER, Posner JL, Stoltenberg DE, Hedtcke JL (2011) Organically managed no-tillage rye-soybean systems: Agronomic, economic, and environmental assessment. Agron J 103:1169–1179. doi: 10.2134/agronj2010.0498

Cornelius CD, Bradley KW (2017a) Influence of Various Cover Crop Species on Winter and Summer Annual Weed Emergence in Soybean. Weed Technol 31:503–513. doi: 10.1017/wet.2017.23

Cornelius CD, Bradley KW (2017b) Carryover of Common Corn and Soybean Herbicides to Various Cover Crop Species. Weed Technol 31:21–31. doi: 10.1614/wt-d-16-00062.1

Crawford LE, Williams MM, Wortman SE (2018) An early-killed rye (Secale cereale) cover crop has potential for weed management in edamame (Glycine max). Weed Sci 66:502–507. doi: 10.1017/wsc.2018.5

Currie RS, Klocke NL (2005) Impact of a terminated wheat cover crop in irrigated corn on atrazine rates and water use efficiency. Weed Sci 53:709–716. doi: 10.1614/ws04-170r1.1

Czapar GF, William Simmons F, Bullock DG (2002) Delayed control of a hairy vetch (Vicia villosa Roth) cover crop in irrigated corn production. Crop Prot 21:507–510. doi: 10.1016/S0261-2194(01)00141-7

Davis AS (2010) Cover-Crop Roller–Crimper Contributes to Weed Management in No-Till Soybean. Weed Sci 58:300–309. doi: 10.1614/ws-d-09-00040.1

De Bruin JL, Porter PM, Jordan NR (2005) Use of a rye cover crop following corn in rotation with soybean in the upper Midwest. Agron J 97:587–598. doi: 10.2134/agronj2005.0587

Deen W, Cousens R, Warringa J, et al (2003) An evaluation of four crop : weed competition models using a common data set. Weed Res 43:116–129. doi: 10.1046/j.1365-3180.2003.00323.x

Delate K, Cwach D, Chase C (2012) Organic no-tillage system effects on soybean, corn and irrigated tomato production and economic performance in Iowa, USA. Renew Agric Food Syst 27:49–59. doi: 10.1017/S1742170511000524

Dieleman JA, Mortensen DA, Martin AR (1999) Influence of velvetleaf ( *Abutilon theophrasti* ) and common sunflower ( *Helianthus annuus* ) density variation on weed management outcomes. Weed Sci 47:81–89. doi: 10.1017/S004317450009069X

Dzotsi KA, Basso B, Jones JW (2013) Development, uncertainty and sensitivity analysis of the simple SALUS crop model in DSSAT. Ecol Modell 260:62–76. doi: 10.1016/j.ecolmodel.2013.03.017

Feyereisen GW, Wilson BN, Sands GR, et al (2006) Potential for a rye cover crop to reduce nitrate loss in southwestern Minnesota. Agron J 98:1416–1426. doi: 10.2134/agronj2005.0134

Fisk JW, Hesterman OB, Shrestha A, et al (2001) Weed suppression by annual legume cover crops in no-tillage corn. Agron J 93:319–325. doi: 10.2134/agronj2001.932319x

Forcella F (2014) Short- and full-season soybean in stale seedbeds versus rolled-crimped winter rye mulch. Renew Agric Food Syst 29:92–99. doi: 10.1017/S1742170512000373

Gallagher RS, Cardina J, Loux M (2003) Integration of cover crops with postemergence herbicides in no-till corn and soybean. Weed Sci 51:995–1001. doi: 10.1614/p2002-062

Gieske MF, Wyse DL, Durgan BR (2016) Spring- and Fall-Seeded Radish Cover-Crop Effects on Weed Management in Corn. Weed Technol 30:559–572. doi: 10.1614/wt-d-15-00023.1

Giola P, Basso B, Pruneddu G, et al (2012) Impact of manure and slurry applications on soil nitrate in a maize-triticale rotation: Field study and long term simulation analysis. Eur J Agron. doi: 10.1016/j.eja.2011.12.001

Hayden ZD, Brainard DC, Henshaw B, Ngouajio M (2012) Winter Annual Weed Suppression in Rye–Vetch Cover Crop Mixtures. Weed Technol 26:818–825. doi: 10.1614/wt-d-12-00084.1

Kaspar TC, Jaynes DB, Parkin TB, et al (2012) Effectiveness of oat and rye cover crops in reducing nitrate losses in drainage water. Agric Water Manag 110:25–33. doi: 10.1016/j.agwat.2012.03.010

Kaspar TC, Jaynes DB, Parkin TB, Moorman TB (2007) Rye cover crop and gamagrass strip effects on NO3 concentration and load in tile drainage. J Environ Qual 36:1503–1511. doi: 10.2134/jeq2006.0468

Kiniry JR, Spanel DA (2009) ALMANAC User Guide and References: Manual for the Agricultural Land Management Alternatives with Numerical Assessment Criteria Model

Martinez-Feria RA, Dietzel R, Liebman M, et al (2016) Rye cover crop effects on maize: A system-level analysis. F Crop Res 196:145–159. doi: 10.1016/j.fcr.2016.06.016

Mock VA, Creech JE, Ferris VR, et al (2012) Influence of Winter Annual Weed Management and Crop Rotation on Soybean Cyst Nematode ( Heterodera glycines ) and Winter Annual Weeds: Years Four and Five . Weed Sci 60:634–640. doi: 10.1614/ws-d-11-00192.1

Moher D, Liberati A, Tetzlaff J, et al (2009) Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. Ann. Intern. Med. 151:264–269

Ritchie JT, Basso B (2008) Water use efficiency is not constant when crop water supply is adequate or fixed: The role of agronomic management. Eur J Agron 28:273–281. doi: 10.1016/j.eja.2007.08.003

Ruffo ML, Bollero GA (2003) Modeling rye and hairy vetch residue decomposition as a function of degree-days and decomposition-days. Agron J 95:900–907. doi: 10.2134/agronj2003.9000

Senthilkumar S, Basso B, Kravchenko AN, Robertson GP (2009) Contemporary evidence of soil carbon loss in the U.S. corn belt. Soil Sci Soc Am J. doi: 10.2136/sssaj2009.0044

Shackelford GE, Kelsey R, Dicks L V. (2019) Effects of cover crops on multiple ecosystem services: Ten meta-analyses of data from arable farmland in California and the Mediterranean. Land use policy 88:. doi: 10.1016/j.landusepol.2019.104204

Soil Survey Staff Soil Survey Geographic (SSURGO) Database

Strock SJ, Porter PM, Russelle MP (2004) Cover cropping to reduce nitrate loss through subsurface drainage in the northern U.S. corn belt. J Environ Qual 33:1010–1016. doi: 10.2134/jeq2004.1010

Syswerda SP, Basso B, Hamilton SK, et al (2012) Long-term nitrate loss along an agricultural intensity gradient in the Upper Midwest USA. Ecosyst Environ 149:10–19. doi: 10.1016/j.agee.2011.12.007

Werle R, Burr C, Blanco-Canqui H (2017) Cereal rye cover crop suppresses winter annual weeds. Can J Plant Sci 98:498–500. doi: 10.1139/CJPS-2017-0267

Werle R, Burr C, Blanco-Canqui H (2018) Cereal rye cover crop suppresses winter annual weeds. Can J Plant Sci 98:498–500. doi: 10.1139/cjps-2017-0267

Williams MM, Mortensen DA, Doran JW (1998) Assessment of weed and crop fitness in cover crop residues for integrated weed management. Weed Sci 46:595–603. doi: 10.1017/s0043174500091153

Xia Y, Mitchell K, Ek M, et al (2012) Continental-scale water and energy flux analysis and validation for the North American Land Data Assimilation System project phase 2 (NLDAS-2): 1. Intercomparison and application of model products. J Geophys Res Atmos. doi: 10.1029/2011JD016048