DSSAT v4.6 User's Guide
DSSAT-Century soil organic matter module data requirements and initialization procedures

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The DSSAT-CENTURY soil organic matter model maintains three humic pools (microbial, active and stable) and two fresh organic matter pools (structural and metabolic). Accurate estimations of the correct initial proportions of organic matter in each pool is critical to modeling decomposition of organic matter and the accompanying release or immobilization of inorganic nutrients to the soil. This document summarizes the data requirements for correct initialization of organic matter pools when using the DSSAT-CENTURY model (Gijsman et al., 2002 and Parton, et al., 1992).

First, the minimum requirements for initializing the various pools of organic matter are presented. Then, a more complex methodology is presented that can be used to more precisely initialize organic matter pools using an antecedent simulation of soil conditions for a long period of time ending at the start of the experiment. This more complex methodology should be adopted when the contribution of decomposing organic matter is critical to the prediction of soil fertility.

The terms organic carbon and organic matter are sometimes used interchangeably, but in the DSSAT-CENTURY model, they are maintained separately. Static conversion factors are used when converting organic matter to organic carbon and vice versa within the model. The conversions used by the DSSAT-CENTURY model for fresh organic matter (FOM) and soil organic matter (SOM) are:

- 0.400 kg[C]/kg[FOM]
- 0.526 kg[C]/kg[SOM]

<u>Minimum data</u>

As a minimum, the DSSAT-CENTURY model must have values of total soil organic carbon and soil texture to initialize all organic matter pools. These values are read from the soil profile data as shown in Figure 1. If organic carbon has been measured in a particular field for an experiment, those data should be entered in the soil analysis section of the experiment file, as shown in Figure 2. The soil analysis values, if provided, override the more generic values in the soil file. Total soil organic carbon amounts from either source are assumed to include the carbon from both FOM and SOM. These are partitioned into the various pools of organic matter as discussed in the sections below.

The model will assume default values for organic carbon and for clay and silt content if these data are missing. However, simulation of organic matter processes will not be accurate if these default values are used. If the release of nutrients due to decomposition of organic matter is an important factor in the fertility of the soil, it is very important to have accurate measurements of these data.

```
*SUMO930002  MOROGORO, TZ SALO 100   OXISOL ISOHYPERTHEMIC, ARIDIC  TROPUSTIC

@SITE        COUNTRY           LAT    LOG  SCS FAMILY
 MOROGORO    TANZANIA         -6.5    37.3 REDDISH BROWN SAND LOAM

@ SCOM  SALB  SLUI  SLDR  SLRO  SLNF  SLPF  SMHB  SMPX  SMKE  SRGP
 2.5YR  0.12   6.0  0.50  84.0  1.00  0.80 IB001 SA005 IB001 IB003

@  SLB  SLMH  SLLL  SDUL  SSAT  SRGF  SSKS  SBDM  SLOC  SLCL  SLSI  SLCF  SLNI  SLHW  SLHB  SCEC  SADC
    10    Ap 0.091 0.227 0.382 1.000 16.56  1.55  1.13  60.0  20.0  20.0  0.06  4.56   -99  8.97   -99
    20    Ap 0.066 0.202 0.382 0.841 16.56  1.55  1.13  65.0  30.0  15.0  0.06  4.50   -99  8.89   -99
    30     E 0.104 0.240 0.399 0.499 16.16  1.50  0.76  65.0  15.0  30.0  0.05  5.38   -99  5.65   -99
    40    AB 0.125 0.261 0.365 0.338 16.56  1.60  0.76  53.0  13.0  24.0  0.06  5.50   -99  5.31   -99
    50    B1 0.088 0.224 0.382 0.166  6.98  1.55  0.70  65.0  13.0  22.0  0.05  5.69   -99  5.44   -99
    60    B2 0.165 0.301 0.347 0.134  5.98  1.65  0.70  55.0  10.0  35.0  0.04  4.59   -99  3.77   -99
    70    B2 0.053 0.189 0.417 0.019  5.98  1.45  0.40  68.0  15.0  17.0  0.04  4.23   -99  3.31   -99
    80    B2 0.159 0.295 0.417 0.016 16.55  1.45  0.33  40.0  24.0  36.0  0.05  5.14   -99  2.03   -99
    90    B3 0.154 0.290 0.434 0.012  5.99  1.40  0.33  35.0  30.0  35.0  0.05  4.46   -99  1.91   -99
   100    B3 0.089 0.225 0.472 0.003  5.99  1.29  0.30  38.0  22.0  20.0  0.03  4.61   -99  1.94   -99
```

Figure 1. Listing of sample soil profile showing total soil organic carbon (SLOC, g[C]/100g[soil]), clay content (SLCL, %) and silt content (SLSI, %)

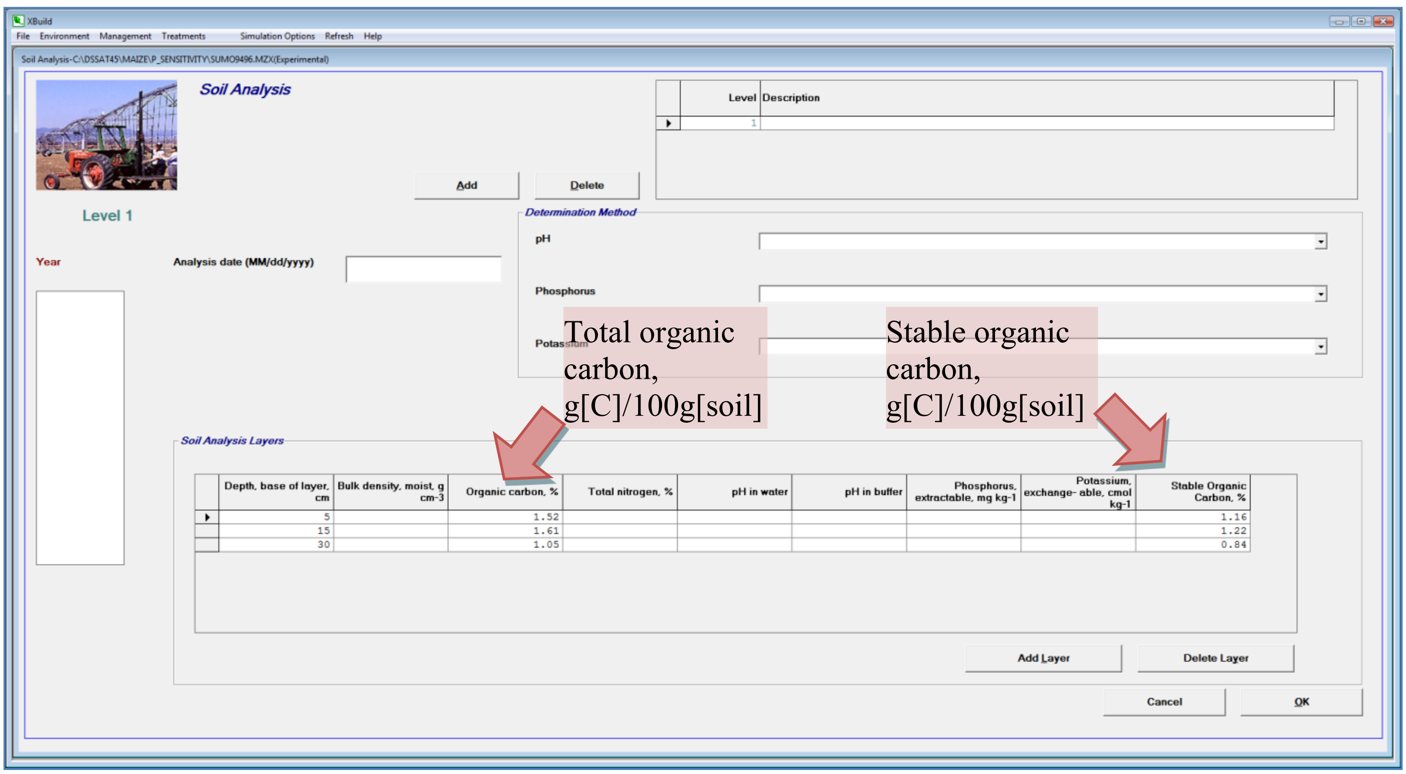

Figure 2. Sample entry in Soil Analysis section of experiment file showing measured total and stable organic carbon in g[C]/100g[soil] to a depth of 30 cm. This screen shot shows the data entry location within the Crop Management Data tool (XBuild). In this example, soil organic carbon data were measured within the top 30 cm.

Initialization of Fresh Organic Matter

FOM is initialized based on user-input values for crop residues left in the field from a previous crop. The data listed in Table 1 are specified in the "Initial Conditions" section of the experiment file. It is assumed that these initial fresh organic matter values were measured or estimated prior to any application of organic matter to the soil and that the measurements represent only residues left in the field from a previous crop. If additional organic amendments were applied to the field, those amounts should be entered in the "Residues and organic fertilizer" section of the experiment file.

Table 1. Input data for initialization of fresh organic matter in the "Initial Conditions" section of the experiment file

Input data	**Units**
Previous crop	--
Root residue weight	kg [dry matter] ha^{-1}
Nodule residue weight	kg [dry matter] ha^{-1}
Surface residue weight	kg [dry matter] ha^{-1}
N content of surface residue	%
P content of surface residue	%
Incorporation percentage of surface residue	%
Incorporation depth of surface residue	cm

If the initial root, nodule or surface residues are not specified, values of zero are assigned. The N and P contents of the residue, if not specified in the initial conditions, are read from an external file (RESCH046.SDA, see Appendix A, this document). This file lists physical and chemical characteristics crop residues and organic fertilizers, such as lignin content and water holding capacity.

The lignin fraction, obtained from the RESCH046.SDA file, is an important parameter for partitioning fresh organic matter into the easily decomposed metabolic portion and the more recalcitrant structural portion. The lignin content can have a significant impact on decomposition rates and release of N and P to the soil. Partitioning of nitrogen and phosphorus to the fresh organic matter pools also depends on the carbon partitioning and the lignin fraction.

Most users do not need to modify the RESCH046.SDA file, although if data are available on lignin content, or other characteristics, of residue in a particular field, then the file can be edited as described in Appendix A.

Initialization of Soil Organic Matter

The initial total soil organic carbon is computed as the difference between total organic carbon and the carbon in the specified initial amounts of FOM. SOM is partitioned by the DSSAT-CENTURY model into three pools, SOM1 (microbial), SOM2 (active), and SOM3 (stable). Three methods are available to compute the initial proportions of the SOM pools and the method used for each soil layer depends on the quality of input data provided. The three methods, in order of preference, are:

1. Measured, or previously estimated, stable organic carbon (specified in g[C]/100g[soil]).
2. Field management history.
3. Regression equation based on soil texture data.

All three methods first estimate the proportion of stable organic matter, SOM3, as a fraction of the total SOM. Then the proportions of SOM1 and SOM2 are assumed to be 5% and 95%, respectively, of the remaining, SOM1+SOM2, portion.

<u>Method 1. Measured or previously estimated stable organic matter</u>. Direct measurement of stable organic matter is the most reliable method of partitioning organic matter. If available, these measured data are entered in the "Soil Analysis" section of the experiment file with units of g[C]/100g[soil] as shown in Figure 2. However, this measurement is seldom done due to the high cost of the analysis.

It is possible to estimate the stable organic fractions by a pre-simulation process which is described below. A user may choose to perform this "spin-up" simulation one time and then enter the computed "initial" stable carbon amount in the "Soil Analysis" section as if it were a measured value.

<u>Method 2. Field management history</u>. If stable organic C measurements are not available, then initial partitioning of SOM can be estimated using information about the field management history. In the Fields section of the experiment file, a Field history code and Field history duration can be entered as shown in Figure 3. The field history code represents a combination of the level of management (irrigation, fertilizer, residue left in field) as well as the condition of the soil at the beginning of this management regime. The field history duration represents the number of years that this management scenario has been in effect. These two values, plus the soil texture classification of each soil layer, are used to look up the stable organic matter, or SOM3, amount, expressed as a fraction of total SOM. The lookup file, SOMFR046.SDA, is located in the StandardData directory in DSSAT46 and currently contains information for five management scenarios:

- FH101 – Cultivated, good management, initial default SOM
- FH102 – Cultivated, poor management, initial default SOM
- FH201 – Cultivated, good management, initial grass or forest
- FH202 – Cultivated, poor management, initial grass or forest
- FH301 – Cultivated, good management, initial degraded land

The data in the SOMFR046.SDA file were derived from many long-term simulations using different management regimes, soil types and beginning soil carbon conditions. A listing of this file is provided in Appendix B of this document.

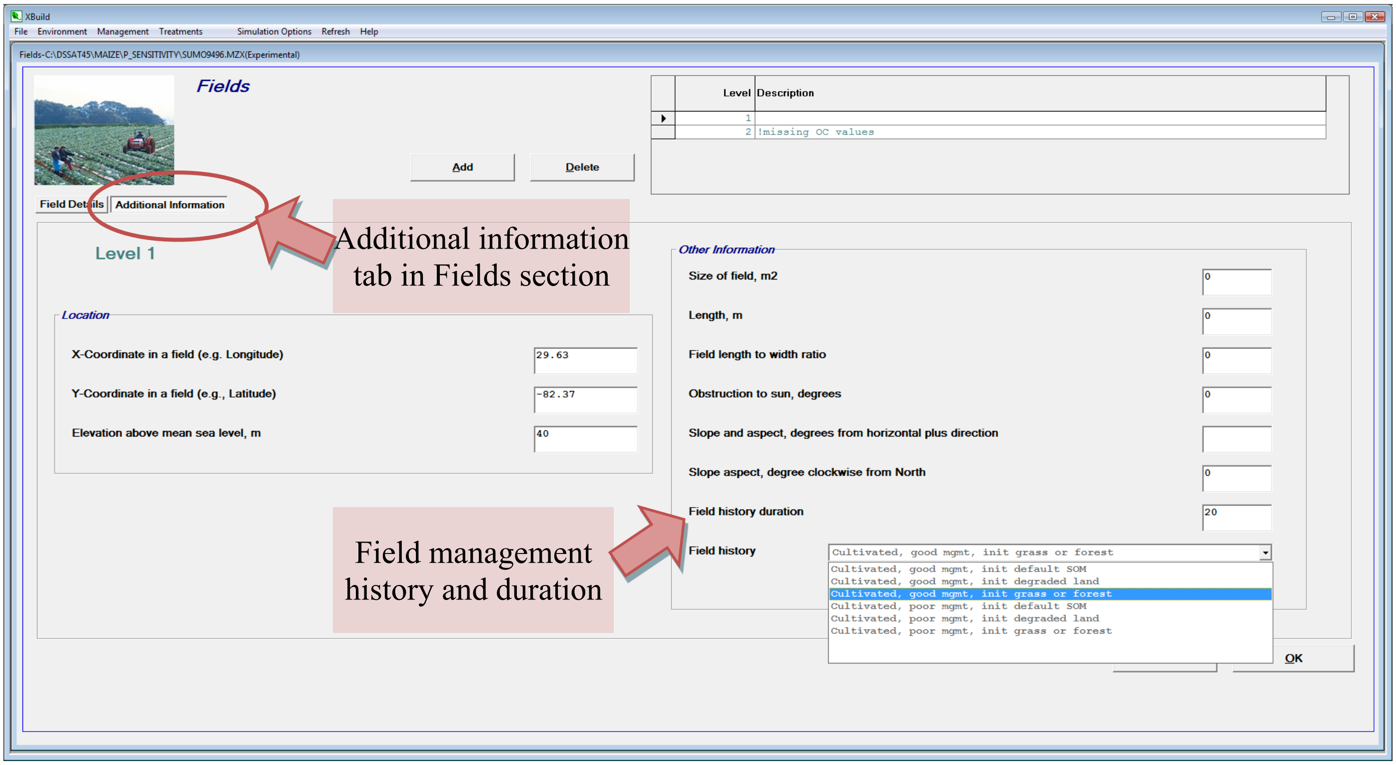

Figure 3. Sample of data entry in Fields section of experiment file showing location of entries for field management history and field history duration. This screen shot shows the data entry location within the Crop Management Data tool (XBuild).

Method 3. Regression equation. If only soil texture data are available for an experiment, then the soil texture is used to estimate the carbon in stable organic matter based on a relationship developed by Samuel Adiku (Porter et al., 2009).

$$StableC = 0.15 * (Clay + Silt) + 0.69$$

Where StableC = stable organic C in g/kg
Clay = soil clay content in %
Silt = soil silt content in %

These values represent the physically protected soil carbon and may underestimate stable soil carbon for some clay soil types which also contain significant portions of biochemically protected soil carbon. The estimate should be more reliable for sandy soils where the biochemically protected C is negligible.

Table 2 summarizes input data used for initialization of SOM pools.

Table 2. Summary of input data used for initialization of soil organic matter

Input data requirements	Data location File	Data section
All methods:		
Total organic C, g[C]/100g[soil]	Soil file, or	Soil layer data
	Experiment file	Soil analysis, profile data
Method 1: measured stable C input		
Stable organic C, g[C]/100g[soil]	Experiment file	Soil analysis, profile data
Method 2: Field history		
Field history	Experiment file	Field
Field history duration, years	Experiment file	Field
Method 3: Regression equation		
Clay content, %	Soil file	Soil layer data
Silt content, %	Soil file	Soil layer data

The INFO.OUT file, generated during a DSSAT v4.6 simulation, contains details about how soil organic matter pools were initialized for each soil layer and the methods that were used in the calculations. Users are encouraged to open this file, found in the data directory (e.g., C:\DSSAT46\Maize), to review computation methods, input data used and the computed organic matter components. Figure 4 lists a sample of output information from the INFO.OUT file regarding estimation of initial soil organic matter data.

```
SOMINI  YEAR DOY = 1994  63
 Initial SOM fractions (fraction of total soil organic matter):
                      SAND   TOC   FOMC  SOMC  SOM1  SOM2  SOM3
  Lyr Dep Texture       %     %     %     %   frac  frac  frac Method
   1   5 Clay         20.0 1.520 0.004 1.516 0.012 0.223 0.765 Measured data
   2  15 Clay         12.5 1.610 0.003 1.607 0.012 0.229 0.759 Measured data
   3  30 Clay         15.0 1.050 0.002 1.048 0.010 0.188 0.802 Measured data
   4  45 Clay         30.0 0.740 0.001 0.739 0.001 0.019 0.980 Regression eqn
   5  60 Clay         30.7 0.700 0.001 0.699 0.001 0.019 0.980 Regression eqn
   6  80 Clay         26.5 0.365 0.001 0.364 0.001 0.019 0.980 Regression eqn
   7 100 ClayLoam     37.5 0.315 0.000 0.315 0.001 0.019 0.980 Regression eqn
```

Figure 4. Partial listing of INFO.OUT file showing initialization data for soil organic carbon pools

Antecedent simulation of estimating initial carbon pool partitioning

A method has been developed which can more precisely estimate the proportions of carbon in each organic matter pool in a way which provides information specific to a particular site and experiment. The method involves iterative simulations of crop rotations and soil processes for a period of from 5 to 20 years leading up to the start of the experiment. Figure 4 shows the procedure as a flowchart.

At the beginning of the antecedent simulation, initial total soil carbon and fresh organic matter are estimated. The proportions of SOM pools are estimated using the regression method which uses soil texture information. Management and crop rotations for the antecedent simulation should represent typical management scenarios for the field for the simulated antecedent time period. If weather data are not available for the entire antecedent simulation period, the method can still be applied by repeating data for the weather years that are available at that site. Even repeating a single year of weather data for the 20 years can result in an adequate estimation of soil organic matter processes over the long period of time.

With each iteration, the estimate of initial total soil carbon at the start of the antecedent simulation is refined until the measured value of soil carbon at the start of the experiment (i.e., the end of antecedent simulation) is adequately predicted. At this point, the stable organic C can be noted and used as input in the "Soil Analysis" section of the experiment file, as if it were a measured value.

The fresh organic matter that was assumed at the beginning of the simulation has a relatively short time constant and will not affect organic matter values much at the end of the simulation. Therefore, only initial total organic carbon need be modified in the iterations to generate reasonable estimates of the SOM proportions at the beginning of the simulation.

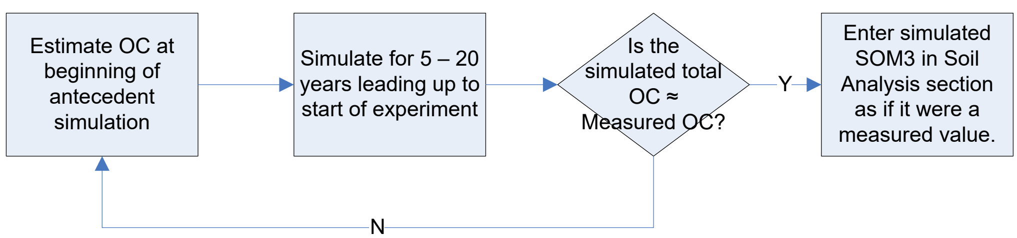

Figure 4. Iterative procedure to estimate SOM3 fraction for an experiment with measured total organic C, using an antecedent "spin-up" simulation.

References

Gijsman, A.J., G. Hoogenboom, W.J. Parton, P.C. Kerridge. 2002. Modifying DSSAT crop models for low-input agricultural systems using a soil organic matter-residue module from CENTURY. Agron. J. 94:462-474.

Parton, W.J., B. McKeown, V. Kirchner and D.S. Ojima. 1992. CENTURY Users Manual. NREL Publication. CSU, Fort Collins, CO, USA.

Porter, C.H., J.W. Jones, S. Adiku, A.J. Gijsman, O. Gargiulo, J.B. Naab. 2009. Modeling organic carbon and carbon-mediated soil processes in DSSAT v4.5. Oper. Res. Int. J. DOI 10.1007/s12351-009-0059-1.

Appendix A. Listing of the RESCH046.SDA file:

The previous crop code, in the FIELDS section of the experiment file, is used to look up residue characteristics for initial conditions. Similarly, the residue type code is used to look up characteristics of applied organic matter.

```
*Organic Matter Application PARAMETER FILE - DSCSM046 Model
@VERSION
 4.6.0.0

! Model parameter file which externalizes many of the
! coefficients needed for simulating the composition
! of soil organic matter.
!RETYP  Residue type code
!CR     Crop type (if applicable)
!AM     Area covered per unit dry weight of residue (cm2/g = ha/kg*10^5)
!WATFAC Saturation water content of surface mulch (kg[H2O]/kg[DM] = mm-ha/kg * 10^4)
!EXTFAC Mulch layer light extinction coefficient
!PSLIG  Proportion of lignin in surface residue (fraction)
!SCN    N content of initial surface (shoots) residue (%)
!SCP    P content of initial surface (shoots) residue (%)
!PRLIG  Proportion of lignin in subsurface residue (fraction)
!RCN    N content of initial subsurface (roots) residue (%)
!RCP    P content of initial subsurface (roots) residue (%)

*CHARACTERISTICS
!Res Crop |---------------- Surface ----------------| |-- Sub-surface --|
!Type  ID   Cover  Satur.  Evapor  Lignin  Nitr  Phos  Lignin  Nitr  Phos
@RETYP CR      AM  WATFAC  EXTFAC   PSLIG   SCN   SCP   PRLIG   RCN   RCP Description
!Generic Crops
 RE001 --      37     3.8    0.80    0.10  1.10  0.20    0.15  0.90  0.09 Generic crop residue
 RE101 --      32     3.8    0.50    0.12  1.20  0.25    0.18  0.75  0.06 Generic legume residue
 RE201 --      37     3.5    0.85    0.08  1.10  0.32    0.10  0.90  0.16 Generic cereal crop
residue
 RE301 --      40     3.5    0.80    0.07  1.10  0.13    0.11  0.90  0.06 Generic grass
 RE999 DC      32     3.8    0.80    0.20  0.40  0.04    0.30  0.25  0.02 Decomposed crop residue

!Manure/compost
!RETYP CR      AM  WATFAC  EXTFAC   PSLIG   SCN   SCP   PRLIG   RCN   RCP Description
 RE002 --      70     3.8    0.50    0.08  4.00  0.25     -99   -99   -99 Green manure
 RE003 --      10     3.8    0.80    0.07  4.80  0.67     -99   -99   -99 Barnyard manure
 RE004 --     140     3.8    0.50    0.02  5.00  1.60     -99   -99   -99 Liquid manure
 RE005 --      32     3.8    0.80    0.10  1.00  0.17     -99   -99   -99 Compost
 RE006 --       4     1.0    0.94    0.20  0.40  0.04     -99   -99   -99 Bark

!Legumes
!RETYP CR      AM  WATFAC  EXTFAC   PSLIG   SCN   SCP   PRLIG   RCN   RCP Description
 RE102 CP      32     3.8    0.50    0.12  1.20  0.27    0.18  0.75  0.06 Cowpea residue
 RE103 MC      32     3.8    0.50    0.08  3.00  0.70    0.12  2.00  0.18 Mucuna residue
 RE104 PN      32     3.8    0.50    0.12  1.20  0.25    0.18  0.75  0.06 Peanut residue
 RE105 PP      32     3.8    0.50    0.16  3.60  0.25    0.25  2.00  0.18 Pigeon Pea residue
 RE106 SB      32     3.8    0.50    0.13  1.20  0.70    0.21  0.75  0.18 Soybean residue
 RE107 AL      32     3.8    0.50    0.08  3.60  0.21    0.10  2.40  0.06 Alfalfa residue
 RE108 CH      32     3.8    0.50    0.12  1.20  0.25    0.18  0.75  0.06 chickpea forage
 RE109 FB      32     3.8    0.50    0.10  1.90  0.40    0.15  1.20  0.09 Faba bean
 RE110 PE      32     3.8    0.50    0.09  1.90  0.40    0.13  1.20  0.09 Pea residue
 RE111 --      69     3.8    0.50    0.08  3.20  0.60    0.12  2.00  0.14 Hairy vetch

!Cereals
!RETYP CR      AM  WATFAC  EXTFAC   PSLIG   SCN   SCP   PRLIG   RCN   RCP Description
 RE202 ML      30     3.5    0.85    0.09  1.10  0.32    0.10  0.90  0.16 Pearl millet residue
 RE203 MZ      30     3.5    0.86    0.10  1.10  0.32    0.10  0.90  0.16 Maize residue
 RE204 SG      30     3.5    0.85    0.06  1.10  0.20    0.10  0.90  0.10 Sorghum residue
 RE205 WH      45     5.0    0.85    0.06  0.59  0.16    0.10  0.50  0.08 Wheat residue
 RE206 BA      40     3.8    0.85    0.03  1.90  0.54    0.06  1.50  0.27 Barley
 RE207 RI      40     3.8    0.85    0.04  0.75  0.10    0.07  0.60  0.10 rice
 RE208 --      42     3.8    0.81    0.03  2.00  0.55    0.06  1.50  0.27 rye

!Grasses
!RETYP CR      AM  WATFAC  EXTFAC   PSLIG   SCN   SCP   PRLIG   RCN   RCP Description
```

```
 RE302 BH      40      3.5     0.80     0.07  1.10  0.13    0.11  0.90  0.06 Bahiagrass
 RE303 BG      40      3.5     0.80     0.07  1.10  0.13    0.11  0.90  0.06 Bermudagrass
 RE304 SI      40      3.5     0.80     0.10  1.10  0.13    0.16  0.90  0.06 Switchgrass
 RE305 BR      40      3.5     0.80     0.05  1.10  0.13    0.08  0.90  0.06 brachiaria
 RE306 --      40      3.5     0.80     0.10  1.10  0.13    0.16  0.90  0.06 forage grasses

!Other
!RETYP CR      AM  WATFAC  EXTFAC   PSLIG   SCN   SCP   PRLIG   RCN   RCP Description
 RE401 BF      40      3.5     0.80     0.16  1.10  0.19    0.24  0.90  0.09 Bush fallow residue
 RE402 SC      40      3.5     0.80     0.07  0.34  0.03    0.11  0.30  0.01 Sugarcane
 RE403 PI      30      3.5     0.80     0.10  0.88  0.08    0.15  0.90  0.04 Pineapple
```

How to modify residue characteristics or add a new residue type:

The RESCH046.SDA file is editable by the user if measurements of a particular crop residue are available or if additional residue types must be added. The file is located in the StandardData directory of DSSAT46. If an additional residue type is added, the name and residue type code must also be entered in the “Residues and Organic Fertilizer” section of the Detail.CDE file in the DSSAT46 directory. After changes are made to these files, the database in XBuild (the DSSAT Crop Management Data tool) must be refreshed before the new entries can be used by that tool.

Appendix B. Listing of the SOMFR046.SDA file

```
*SOMFR046.SDA Stable SOM fractions - DSCSM046 Model

!=========================================================================================================
! Initial SOM fractions are based on previous land use / management,
!   soil type, number of years under this management and on initial
!   carbon composition.
!
! Values in these tables represent the fraction of total organic C (OC)
!   that is stable (SOM3). Intermediate (SOM2) and microbial (SOM1) SOM
!   are estimated in the DSSAT-CENTURY model based on these stable SOM
!   fractions as follows:
!      SOM1 = 0.05 * (1.0 - SOM3).
!      SOM2 = 1.0 - SOM3 - SOM1
!=========================================================================================================

@FH101 Cultivated with good management practices, initially cultivated land
!100 yr continuous simulation approach, irrigated, high N application rate
!Initial conditions: 44% stable C
!Years this mgmt ->|---0 yrs----|----5 yrs----|---10 yrs----|---20 yrs----|---60 yrs----|-Steady State|
!Soil depth (cm) ->| 0-20  20-40|  0-20  20-40|  0-20  20-40|  0-20  20-40|  0-20  20-40|  0-20  20-40|
@ L  TEXTURE        S3_T0  S3_D0  S3_T5  S3_D5 S3_T10 S3_D10 S3_T20 S3_D20 S3_T60 S3_D60 S3_TSS S3_DSS
  1  Sand            0.44   0.44   0.49   0.60   0.48   0.69   0.41   0.75   0.31   0.78   0.29   0.78
  2  LoamySand       0.44   0.44   0.55   0.63   0.60   0.75   0.62   0.84   0.60   0.88   0.60   0.88
  3  SandyLoam       0.44   0.44   0.50   0.60   0.52   0.70   0.50   0.78   0.44   0.82   0.43   0.82
  4  SiltyLoam       0.44   0.44   0.49   0.57   0.49   0.64   0.47   0.72   0.44   0.79   0.43   0.79
  5  Silt            0.44   0.44   0.49   0.56   0.48   0.64   0.46   0.71   0.43   0.77   0.43   0.77
  6  Loam            0.44   0.44   0.52   0.59   0.56   0.70   0.57   0.79   0.56   0.85   0.55   0.85
  7  SandClayLoam    0.44   0.44   0.57   0.60   0.65   0.72   0.72   0.83   0.75   0.91   0.75   0.91
  8  SiltClayLoam    0.44   0.44   0.52   0.56   0.55   0.65   0.58   0.74   0.60   0.83   0.60   0.83
  9  ClayLoam        0.44   0.44   0.54   0.58   0.59   0.67   0.64   0.78   0.68   0.87   0.68   0.87
 10  SandyClay       0.44   0.44   0.56   0.60   0.64   0.71   0.70   0.82   0.74   0.90   0.74   0.90
 11  SiltyClay       0.44   0.44   0.51   0.56   0.54   0.64   0.56   0.72   0.57   0.81   0.57   0.82
 12  Clay            0.44   0.44   0.53   0.57   0.59   0.66   0.63   0.76   0.67   0.85   0.67   0.86


@FH102 Cultivated with poor management practices, initially cultivated land
!100 yr continuous simulation approach, non-irrigated, non-fertilized
!Initial conditions: 44% stable C
!Years this mgmt ->|---0 yrs----|----5 yrs----|---10 yrs----|---20 yrs----|---60 yrs----|-Steady State|
!Soil depth (cm) ->| 0-20  20-40|  0-20  20-40|  0-20  20-40|  0-20  20-40|  0-20  20-40|  0-20  20-40|
@ L  TEXTURE        S3_T0  S3_D0  S3_T5  S3_D5 S3_T10 S3_D10 S3_T20 S3_D20 S3_T60 S3_D60 S3_TSS S3_DSS
  1  Sand            0.44   0.44   0.54   0.68   0.58   0.83   0.69   0.95   0.89   0.98   0.93   0.98
  2  LoamySand       0.44   0.44   0.56   0.66   0.59   0.81   0.62   0.93   0.86   0.98   0.94   0.98
  3  SandyLoam       0.44   0.44   0.53   0.64   0.54   0.78   0.54   0.91   0.76   0.98   0.89   0.98
  4  SiltyLoam       0.44   0.44   0.52   0.60   0.53   0.72   0.53   0.85   0.65   0.95   0.74   0.97
  5  Silt            0.44   0.44   0.51   0.60   0.52   0.72   0.52   0.84   0.64   0.95   0.73   0.96
  6  Loam            0.44   0.44   0.53   0.62   0.55   0.76   0.56   0.88   0.70   0.97   0.80   0.98
  7  SandClayLoam    0.44   0.44   0.56   0.62   0.62   0.75   0.67   0.88   0.81   0.97   0.85   0.98
```

```
  8  SiltClayLoam    0.44   0.44   0.53   0.59   0.56   0.70   0.59   0.83   0.71   0.95   0.77   0.96
  9  ClayLoam        0.44   0.44   0.54   0.60   0.58   0.72   0.62   0.85   0.73   0.96   0.79   0.96
 10  SandyClay       0.44   0.44   0.55   0.61   0.60   0.74   0.65   0.87   0.79   0.97   0.83   0.97
 11  SiltyClay       0.44   0.44   0.52   0.59   0.55   0.69   0.57   0.82   0.66   0.94   0.73   0.95
 12  Clay            0.44   0.44   0.54   0.59   0.58   0.71   0.63   0.84   0.75   0.95   0.80   0.96

@FH201 Cultivated with good management practices, initially grassland/forest
!100 yr continuous simulation approach, irrigated, high N application rate
!Initial conditions: 34% stable C
!Years this mgmt ->|---0 yrs----|----5 yrs----|---10 yrs----|---20 yrs----|---60 yrs----|-Steady State|
!Soil depth (cm) ->| 0-20  20-40|  0-20  20-40|  0-20  20-40|  0-20  20-40|  0-20  20-40|  0-20  20-40|
@ L  TEXTURE       S3_T0  S3_D0  S3_T5  S3_D5 S3_T10 S3_D10 S3_T20 S3_D20 S3_T60 S3_D60 S3_TSS S3_DSS
  1  Sand            0.34   0.34   0.43   0.55   0.43   0.66   0.39   0.74   0.31   0.78   0.29   0.78
  2  LoamySand       0.34   0.34   0.49   0.58   0.56   0.72   0.60   0.83   0.60   0.88   0.60   0.88
  3  SandyLoam       0.34   0.34   0.44   0.54   0.48   0.67   0.48   0.77   0.44   0.82   0.43   0.82
  4  SiltyLoam       0.34   0.34   0.42   0.50   0.45   0.60   0.45   0.71   0.44   0.79   0.43   0.79
  5  Silt            0.34   0.34   0.42   0.49   0.44   0.59   0.44   0.69   0.43   0.77   0.43   0.77
  6  Loam            0.34   0.34   0.46   0.53   0.52   0.66   0.55   0.78   0.56   0.85   0.56   0.85
  7  SandClayLoam    0.34   0.34   0.50   0.54   0.61   0.68   0.70   0.82   0.75   0.91   0.75   0.91
  8  SiltClayLoam    0.34   0.34   0.45   0.49   0.51   0.60   0.56   0.72   0.60   0.83   0.60   0.83
  9  ClayLoam        0.34   0.34   0.47   0.51   0.55   0.63   0.62   0.76   0.68   0.87   0.68   0.87
 10  SandyClay       0.34   0.34   0.50   0.53   0.59   0.67   0.69   0.81   0.74   0.90   0.74   0.90
 11  SiltyClay       0.34   0.34   0.45   0.49   0.49   0.59   0.53   0.70   0.57   0.81   0.57   0.82
 12  Clay            0.34   0.34   0.47   0.50   0.54   0.62   0.61   0.74   0.67   0.85   0.67   0.86

@FH202 Cultivated with poor management practices, initially grassland/forest
!100 yr continuous simulation approach, non-irrigated, non-fertilzed
!Initial conditions: 34% stable C
!Years this mgmt ->|---0 yrs----|----5 yrs----|---10 yrs----|---20 yrs----|---60 yrs----|-Steady State|
!Soil depth (cm) ->| 0-20  20-40|  0-20  20-40|  0-20  20-40|  0-20  20-40|  0-20  20-40|  0-20  20-40|
@ L  TEXTURE       S3_T0  S3_D0  S3_T5  S3_D5 S3_T10 S3_D10 S3_T20 S3_D20 S3_T60 S3_D60 S3_TSS S3_DSS
  1  Sand            0.34   0.34   0.46   0.62   0.51   0.80   0.62   0.94   0.87   0.98   0.93   0.98
  2  LoamySand       0.34   0.34   0.49   0.61   0.54   0.78   0.58   0.92   0.85   0.98   0.94   0.98
  3  SandyLoam       0.34   0.34   0.46   0.58   0.48   0.75   0.50   0.89   0.75   0.98   0.89   0.98
  4  SiltyLoam       0.34   0.34   0.45   0.54   0.47   0.68   0.49   0.83   0.65   0.96   0.76   0.97
  5  Silt            0.34   0.34   0.44   0.53   0.47   0.67   0.49   0.82   0.64   0.95   0.75   0.96
  6  Loam            0.34   0.34   0.46   0.56   0.50   0.72   0.53   0.87   0.70   0.97   0.82   0.98
  7  SandClayLoam    0.34   0.34   0.49   0.55   0.57   0.71   0.65   0.86   0.81   0.97   0.87   0.98
  8  SiltClayLoam    0.34   0.34   0.46   0.52   0.51   0.65   0.56   0.81   0.70   0.95   0.78   0.96
  9  ClayLoam        0.34   0.34   0.47   0.53   0.53   0.67   0.59   0.82   0.73   0.96   0.80   0.96
 10  SandyClay       0.34   0.34   0.48   0.54   0.56   0.70   0.63   0.85   0.79   0.97   0.85   0.97
 11  SiltyClay       0.34   0.34   0.45   0.51   0.49   0.64   0.54   0.79   0.66   0.94   0.74   0.95
 12  Clay            0.34   0.34   0.47   0.52   0.53   0.66   0.60   0.82   0.75   0.95   0.82   0.96


@FH301 Cultivated with good management practices, initially degraded
!100 yr continuous simulation approach, irrigated, high N application rate
!Initial conditions: Stable C from 100 year continuous simulations for FH102
!Initial conditions: previously degraded land, use initial SOM from transient simulation scenarios
!Years this mgmt ->|---0 yrs----|----5 yrs----|---10 yrs----|---20 yrs----|---60 yrs----|-Steady State|
!Soil depth (cm) ->| 0-20  20-40|  0-20  20-40|  0-20  20-40|  0-20  20-40|  0-20  20-40|  0-20  20-40|
```

@ L	TEXTURE	S3_T0	S3_D0	S3_T5	S3_D5	S3_T10	S3_D10	S3_T20	S3_D20	S3_T60	S3_D60	S3_TSS	S3_DSS
1	Sand	0.93	0.98	0.82	0.91	0.69	0.85	0.51	0.80	0.32	0.78	0.29	0.78
2	LoamySand	0.94	0.98	0.89	0.94	0.82	0.91	0.72	0.88	0.62	0.88	0.60	0.88
3	SandyLoam	0.89	0.98	0.84	0.92	0.74	0.88	0.60	0.83	0.45	0.82	0.43	0.82
4	SiltyLoam	0.74	0.97	0.78	0.90	0.68	0.85	0.56	0.81	0.45	0.79	0.43	0.79
5	Silt	0.73	0.96	0.77	0.89	0.67	0.85	0.54	0.80	0.43	0.77	0.43	0.77
6	Loam	0.80	0.98	0.83	0.92	0.75	0.89	0.66	0.86	0.56	0.85	0.56	0.85
7	SandClayLoam	0.85	0.98	0.88	0.95	0.84	0.93	0.79	0.92	0.76	0.91	0.75	0.91
8	SiltClayLoam	0.77	0.96	0.82	0.91	0.75	0.88	0.67	0.85	0.61	0.83	0.60	0.83
9	ClayLoam	0.79	0.96	0.84	0.93	0.79	0.90	0.73	0.88	0.68	0.87	0.68	0.87
10	SandyClay	0.83	0.97	0.87	0.94	0.83	0.93	0.78	0.91	0.74	0.90	0.74	0.90
11	SiltyClay	0.73	0.95	0.80	0.91	0.73	0.88	0.65	0.84	0.57	0.82	0.57	0.82
12	Clay	0.80	0.96	0.84	0.92	0.78	0.90	0.72	0.87	0.67	0.86	0.67	0.86