User Guide To Managing Harvest Residues in Crop Rotations

DSSAT Version 4.8.5
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DSSAT CSM allows a user to control the amount of yield product and by-products that are harvested, i.e., removed from the field. This is an important consideration for crop rotations where carry-over of crop residues from one season to the next can be an important factor in soil N and C dynamics and long-term sustainability of the cropping system.

There are two ways to set these amounts of harvested material in DSSAT, depending on the type of harvest that is specified. The table below lists the specification method for each harvest management method.

Harvest management code (HARVS)	Type of harvest	Specification of crop residue carryover
M	At maturity	Harvest Section
R	On reported date	Harvest Section
D	Days after planting	Harvest Section
A	Automatic	Simulation Options, Automatic Harvest section

In either case, the amount of crop removed from the field is specified separately for the yield product and for the crop by-product (i.e., the remaining above-ground biomass). Default values are 100% of yield product is removed and zero percent of by-product is removed. This document describes how to specify crop residue management in the Harvest Section of FileX and in the Simulations Options using XBuild.

Method 1: Harvest Section

In most cases, the residue management options are specified in the Harvest Section of FileX. In XBuild, select Management → Harvest and set the date of harvest and the grain harvest percentage and the byproduct takeoff percentage. These last two values describe the amount of the crop that is removed from the field for the yield product (grain harvest) and the remaining above-ground plant parts (byproduct takeoff). (Note: for "Harvest at Maturity", no date should be specified.) This harvest level must then be specified in the treatment table for the applicable crop rotations.

Figure 1 illustrates the selection in XBuild of the harvested amounts in the Harvest Section of FileX. In this example, 100% of the yield product is removed from the field and all of the byproduct is left in the field.
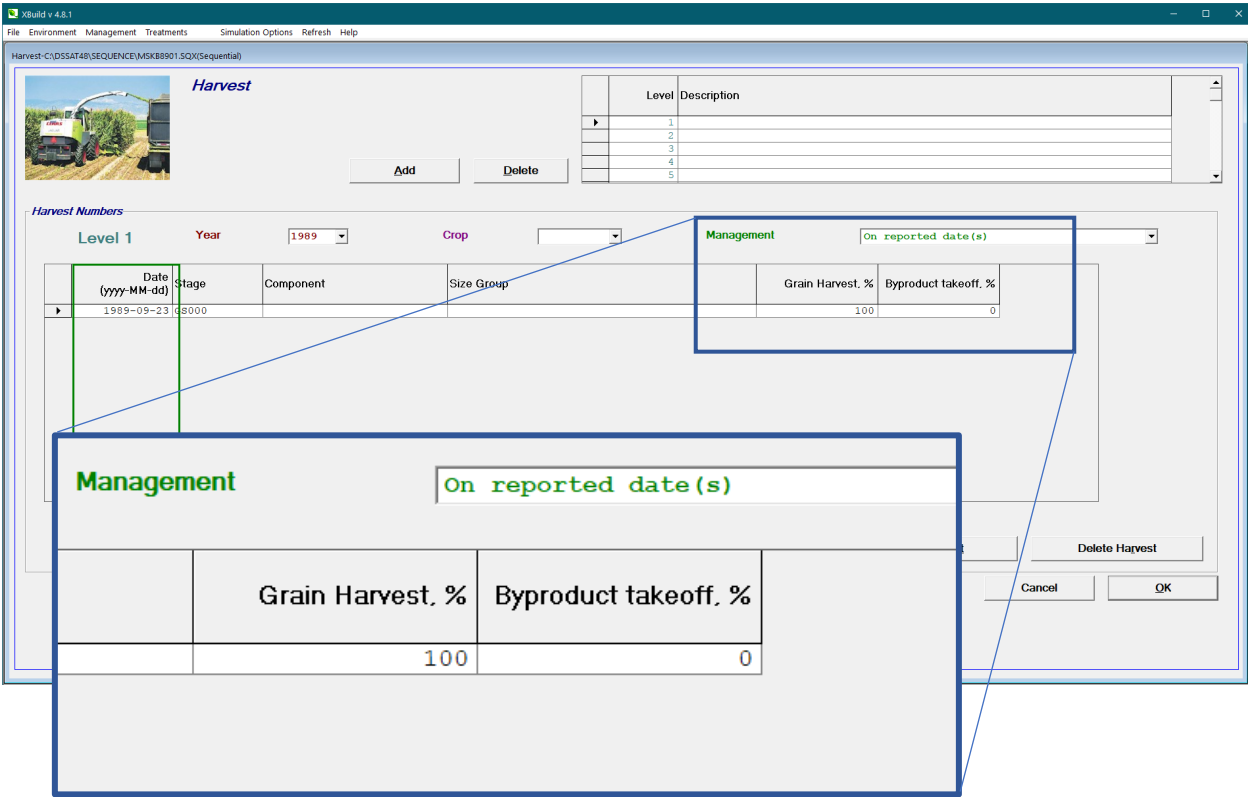

Figure 1. Specification of the harvested percentages in the Harvest Section using XBuild

Method 2: Simulation Options

For Automatic Harvest, the amounts of crop yield and byproduct harvested are specified in Simulation Options. The amounts of harvested material are specified as the "Percentage of product harvested" and the "Percentage of residue harvested". As with the harvest section, these two values describe the amount of crop material removed from the field for the yield product (product harvested) and for the remaining above-ground plant parts (residue harvested).
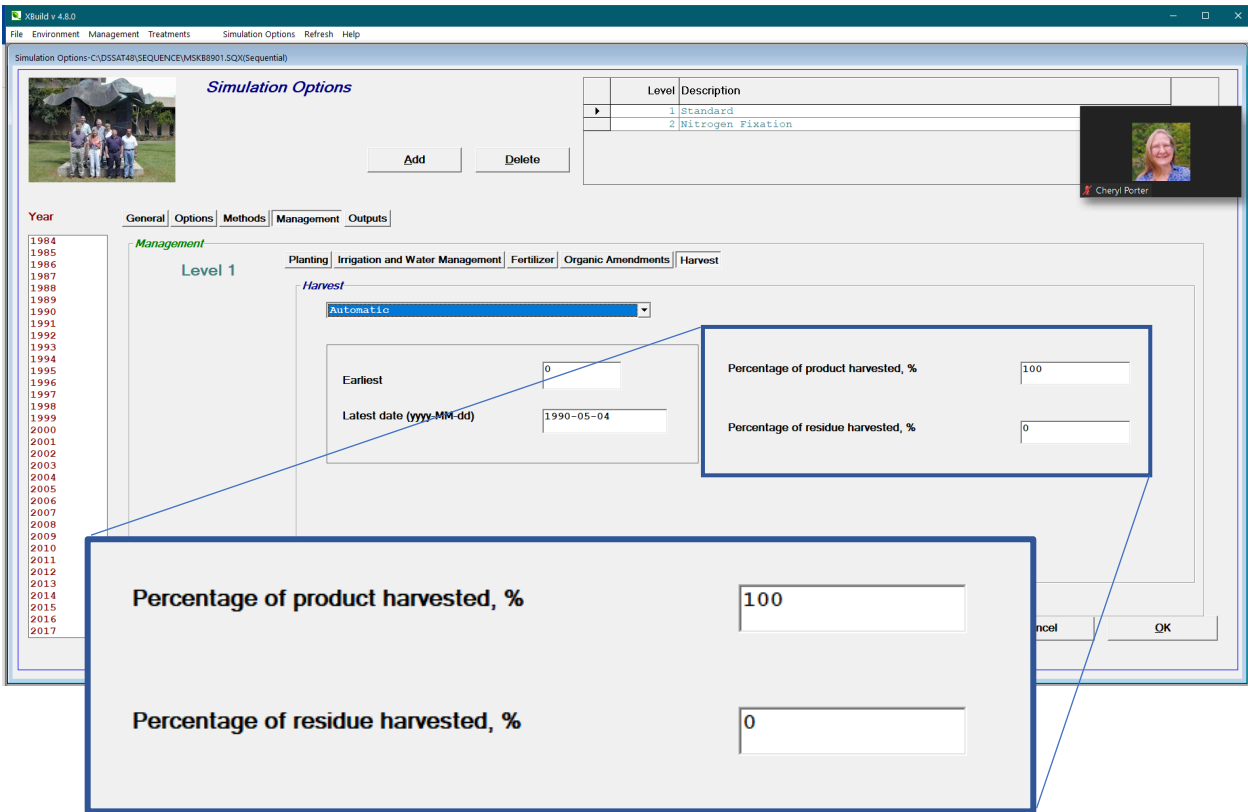

Figure 2. Specification of the harvested percentages in the Simulation Options, Automatic Harvest Section using XBuild

For Automatic Harvest, the earliest harvest date is specified as days after maturity and the latest date is specified as a date. For the automatic harvest option, the acceptable soil conditions for a harvest to occur are specified in the automatic planting section. The simulated harvest will occur on the first day within the harvest window where soil conditions are within the acceptable range.

Sample Crop Rotation FileX

Box 1 presents a portion of a sequence FileX showing both methods of harvest residue specification. Rotation 2 (maize rotation) uses Method 1: Harvest Section. From the treatment table, this rotation uses harvest level 2, which specifies that 95% of the yield is removed from the field and 75% of the by-product is removed from the field. Rotation 4 (soybean) uses Method 2: Simulation Options. From the

treatment table, simulation options level 2 is used, which specifies the Automatic harvest method. In this case, 100% of the yield and 50% of the byproduct is removed from the field.

Box 1. Sample FileX

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*EXP.DETAILS: SMPL8901SQ based on MSKB8901SQ

*TREATMENTS                          ------------FACTOR LEVELS------------
@N R O C TNAME.................... CU FL SA IC MP MI MF MR MC MT ML MH SM
 1 1 1 0 Fallow before maize        1  1  0  1  0  0  0  0  0  0  0  1  1
 1 2 1 0 Maize                      2  1  0  0  2  0  0  0  0  0  0  2  1
 1 3 1 0 Fallow before soybean      1  1  0  0  0  0  0  0  0  0  0  3  1
 1 4 1 0 Soybean                    3  1  0  0  4  0  0  0  0  0  0  0  2

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*HARVEST DETAILS
@H HDATE  HSTG  HCOM HSIZE   HPC   HBPC HNAME
 1 89123 GS000  -99   -99   -99    -99 FA before MZ
 2 89266 GS000  -99   -99    95     75 MZ
 3 90148 GS000  -99   -99   -99    -99 FA before SB

*SIMULATION CONTROLS
@N GENERAL       NYERS NREPS START SDATE RSEED SNAME.................... SMODEL
 1 GE               4     1     S 89001  2150 Maize harvest @ maturity
@N OPTIONS       WATER NITRO SYMBI PHOSP POTAS DISES  CHEM  TILL   CO2
 1 OP                Y     Y     N     N     N     N     N     N     M
@N METHODS       WTHER INCON LIGHT EVAPO INFIL PHOTO HYDRO NSWIT MESOM MESEV MESOL
 1 ME                M     M     E     R     S     C     R     1     P     S     2
@N MANAGEMENT    PLANT IRRIG FERTI RESID HARVS
 1 MA                R     N     R     N     R
@N OUTPUTS       FNAME OVVEW SUMRY FROPT GROUT CAOUT WAOUT NIOUT MIOUT DIOUT VBOSE CHOUT OPOUT
 1 OU                Y     Y     Y     1     Y     Y     Y     Y     Y     N     Y     N     Y

@  AUTOMATIC MANAGEMENT
@N PLANTING      PFRST PLAST PH2OL PH2OU PH2OD PSTMX PSTMN
 1 PL           89117 89131    40   100    30    40    10
@N IRRIGATION   IMDEP ITHRL ITHRU IROFF IMETH IRAMT IREFF
 1 IR              30    50   100 GS000 IR001    10     1
@N NITROGEN      NMDEP NMTHR NAMNT NCODE NAOFF
 1 NI              30    50    25 FE001 GS000
@N RESIDUES      RIPCN RTIME RIDEP
 1 RE             100     1    20
@N HARVEST       HFRST HLAST HPCNP HPCNR
 1 HA               0 90124   100     0

@N GENERAL       NYERS NREPS START SDATE RSEED SNAME.................... SMODEL
 2 GE               4     1     S 89060  2150 Soybean auto harvest
@N OPTIONS       WATER NITRO SYMBI PHOSP POTAS DISES  CHEM  TILL   CO2
 2 OP                Y     Y     Y     N     N     N     N     N     M
@N METHODS       WTHER INCON LIGHT EVAPO INFIL PHOTO HYDRO NSWIT MESOM MESEV MESOL
 2 ME                M     M     E     R     S     C     R     1     P     S     2
@N MANAGEMENT    PLANT IRRIG FERTI RESID HARVS
 2 MA                R     N     R     N     A
@N OUTPUTS       FNAME OVVEW SUMRY FROPT GROUT CAOUT WAOUT NIOUT MIOUT DIOUT VBOSE CHOUT OPOUT
 2 OU                Y     Y     Y     1     Y     Y     Y     Y     Y     N     Y     N     Y

@  AUTOMATIC MANAGEMENT
@N PLANTING      PFRST PLAST PH2OL PH2OU PH2OD PSTMX PSTMN
 2 PL           89117 89131    40   100    30    40    10
@N IRRIGATION   IMDEP ITHRL ITHRU IROFF IMETH IRAMT IREFF
 2 IR              30    50   100 GS000 IR001    10     1
@N NITROGEN      NMDEP NMTHR NAMNT NCODE NAOFF
 2 NI              30    50    25 FE001 GS000
@N RESIDUES      RIPCN RTIME RIDEP
 2 RE             100     1    20
@N HARVEST       HFRST HLAST HPCNP HPCNR
 2 HA               0 90320   100    50
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Viewing residue carryover amounts in MgmtEvent.OUT file

The MgmtEvent.OUT file is very helpful when determining if the user's selection of harvest options are correctly simulated. This is especially important for crop rotation simulations where multiple management options might be specified for different crops. To activate this file, go to Simulation Options → Outputs and set "Operations output" to "Yes". (In FileX, set "OPOUT" to "Y"). This file provides a chronological listing of all management operations. This file also shows the crop residue that is carried over in the field to the next season. Box 2 shows a listing of a portion of the MgmtEvent.OUT file which resulted from the sample crop rotation FileX in Box 1.

Box 2. MgmtEvent.OUT file showing carry-over of residues in a crop rotation simulation

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*MANAGEMENT OPERATIONS EVENT SUMMARY

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!----------------------------------------------------------------------------
@RUN Date........  DOY    DAS    DAP  CR  Stage          Operation       Quantities
!----------------------------------------------------------------------------
   2 MAY  4, 1989  124     1      0   MZ                 Planting
   2 MAY  4, 1989  124     1      0   MZ  14 Start Sim
   2 MAY  5, 1989  125     2      1   MZ  08 Germinate
   2 MAY 20, 1989  140    17     16   MZ  09 Emergence
   2 JUN  6, 1989  157    34     33   MZ  01 End Juveni
   2 JUN 13, 1989  164    41     40   MZ  02 Floral Ini
   2 JUL 20, 1989  201    78     77   MZ  03 75% Silkin
   2 AUG  1, 1989  213    90     89   MZ  04 Beg Gr Fil
   2 SEP 16, 1989  259   136    135   MZ  05 End Gr Fil
   2 SEP 20, 1989  263   140    139   MZ  06 Maturity
   2 SEP 23, 1989  266   143    142   MZ  16 Harvest
                                               95.0 % yield harvested   2805. kg/ha
                                               75.0 % by-product harv    376. kg/ha
                                               Surface residue carryover 1400. kg/ha
                                               Root residue carryover    2204. kg/ha
. . .


!----------------------------------------------------------------------------
@RUN Date........  DOY    DAS    DAP  CR  Stage          Operation       Quantities
!----------------------------------------------------------------------------
   4 MAY 29, 1990  149     1      0   SB                 Planting
   4 MAY 29, 1990  149     1      0   SB  15 Sowing
   4 JUN  7, 1990  158    10      9   SB  03 End Juven.
   4 JUN 16, 1990  167    19     18   SB  02 Unifoliate
   4 JUN 20, 1990  171    23     22   SB  04 Flower Ind
   4 JUL 27, 1990  208    60     59   SB  05 First Flwr
   4 AUG 15, 1990  227    79     78   SB  06 First Pod
   4 AUG 26, 1990  238    90     89   SB  08 First Seed
   4 SEP  5, 1990  248   100     99   SB  09 End Pod
   4 SEP 11, 1990  254   106    105   SB  12 End Msnode
   4 SEP 25, 1990  268   120    119   SB  13 End Leaf
   4 SEP 28, 1990  271   123    122   SB  10 Phys. Mat
   4 OCT 10, 1990  283   135    134   SB  11 Harv. Mat
   4 NOV  1, 1990  305   157    156   SB  16 Harvest
                                              100.0 % yield harvested   2887. kg/ha
                                               50.0 % by-product harv    103. kg/ha
                                               Surface residue carryover 1910. kg/ha
                                               Root residue carryover     784. kg/ha
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For some crops, e.g., maize, the surface residue carryover includes not only the unharvested by-product (stover) but also unharvested grain, unharvested cob (assumed to be 100%), and any plant tissue which was senesced over the season and not previously dropped from the plant. All of these are

added to the surface organic matter on the day of harvest. Root residues are added to subsurface organic matter.