

DSSAT User Guide to managing harvest residues in crop rotations

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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.

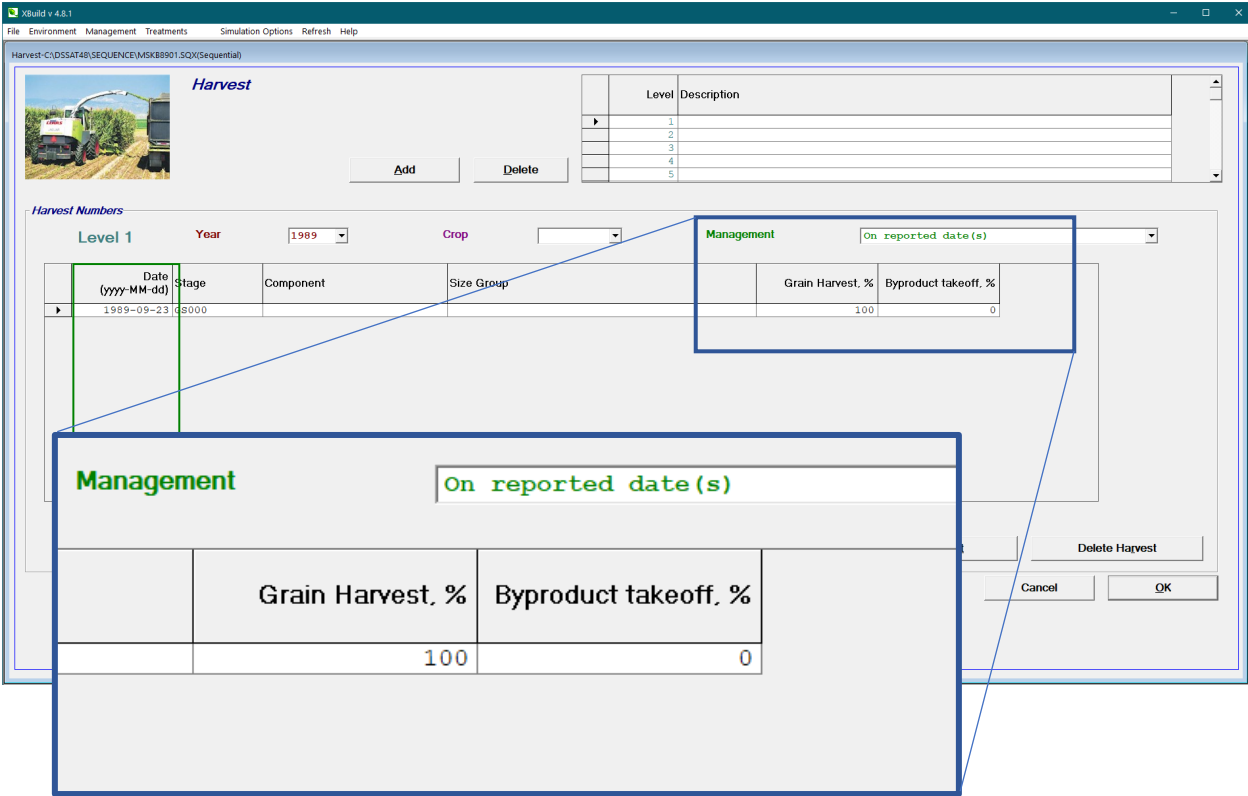


Figure 1. Specification of the harvested percentages in the Harvest Section using XBuild

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).

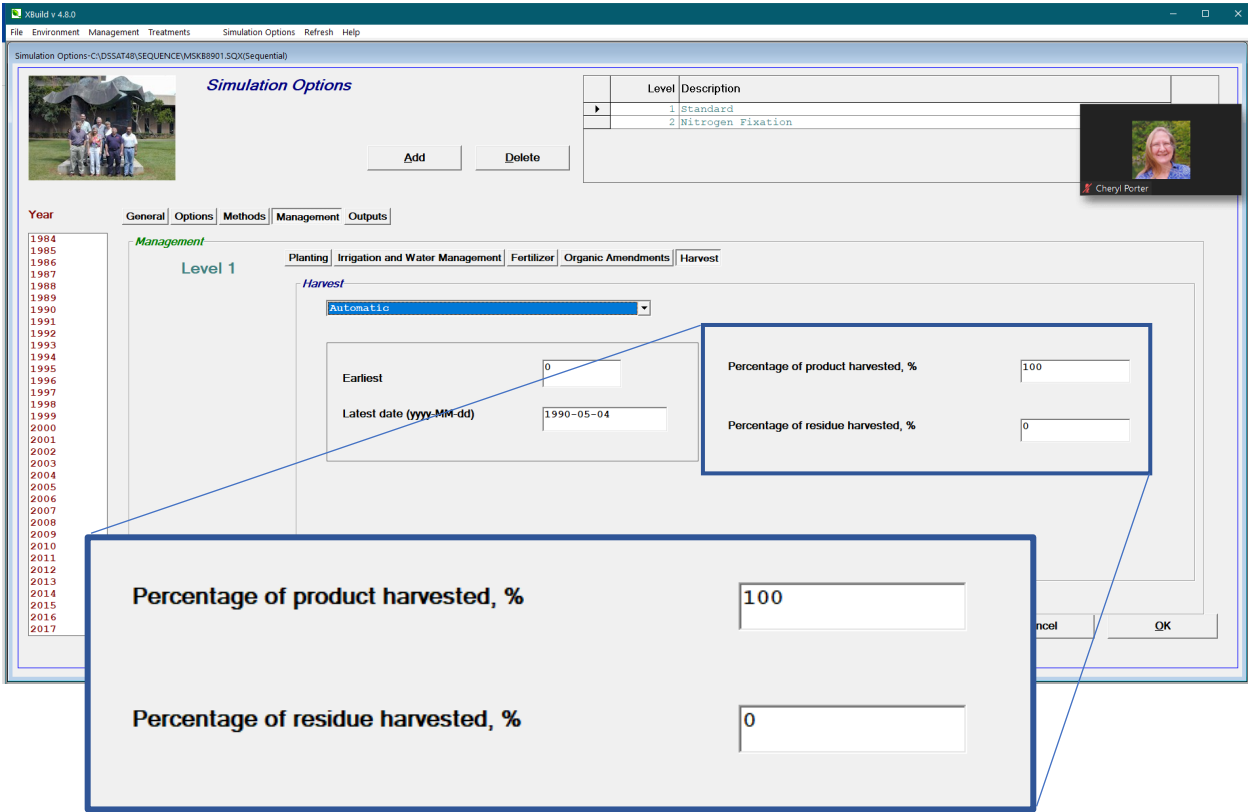


Figure 2. Specification of the harvested percentages in the Simulation Options, Automatic Harvest Section using XBuild

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

*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	

*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
1	OP	Y	Y	N	N	N	N	M
@N	METHODS	WTHR	INCON	LIGHT	EVAP	INFIL	PHOTO	HYDRO
1	ME	M	M	E	R	S	C	R
@N	MANAGEMENT	PLANT	IRRIG	FERTI	RESID	HARVS		
1	MA	R	N	R	N	A		
@N	OUTPUTS	FNAME	OVVIEW	SUMRY	FROPT	GROUT	CAOUT	WAOUT
1	OU	Y	Y	Y	1	Y	Y	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			

@ 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			

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

*MANAGEMENT OPERATIONS EVENT SUMMARY									
. . .									
!-----									
@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

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.