



# Evaluation of the APEX Model for Organic and Conventional Management under Conservation and Conventional Tillage Systems

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## Synopsis

Research is ongoing at the Mountain Horticultural Crops Research and Extension Center in Mills River, N.C. to evaluate surface water quality from certified organic and conventionally managed farming systems. Runoff, sediment and nutrient predictions of the Agricultural Policy Environmental Extender (APEX) model are compared under organic and conventional management, and conservation and conventional tillage systems. APEX predictions showed slight differences among the four treatments: organic management in conventional tillage system, organic management in conservation tillage system, conventional management in conventional tillage system, and conventional management in conservation tillage system in terms of surface runoff, sediment yield and nutrient (Table 3). APEX simulated crop yields in 16 years, from 1995 to 2010 mimics the actual yield trends for these complex management systems (Tables 4 & 5a) except for cabbage and broccoli (Table 5b) with the conventionally managed having higher yields than the organically managed systems and plow based having higher yields than conservation tillage systems. In general, APEX yield predictions were 'satisfactory.'

## Objectives

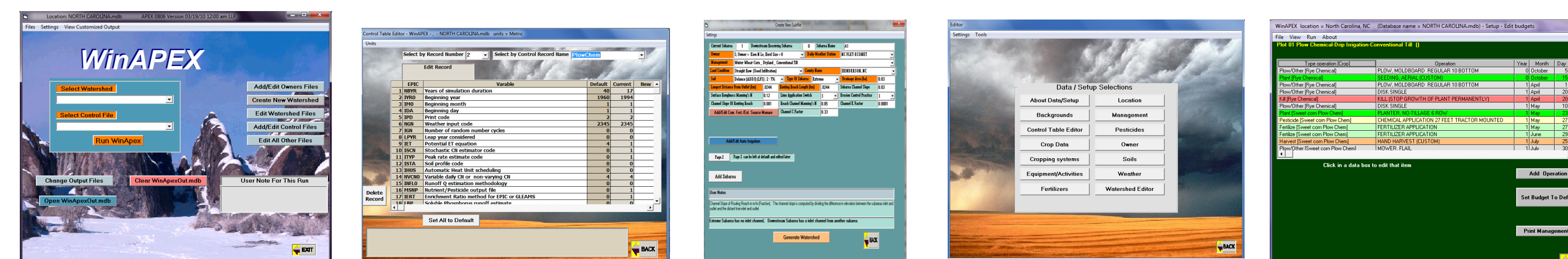
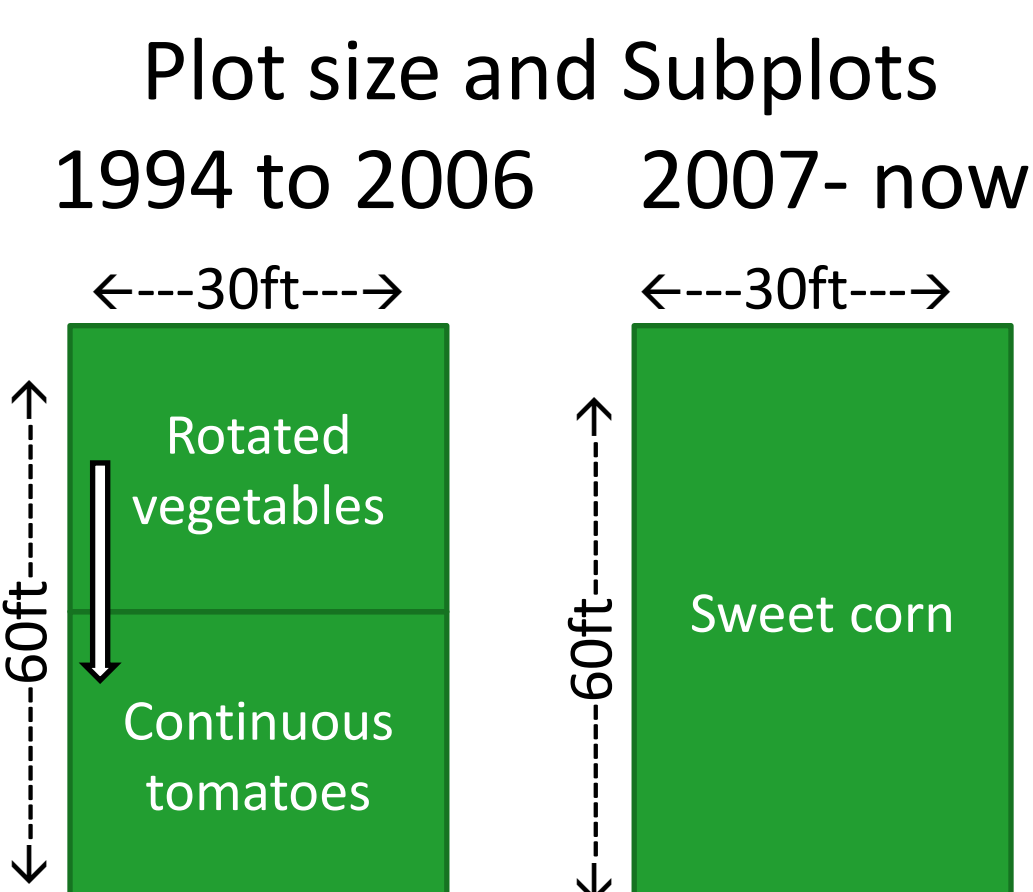
- Evaluate performance of APEX in simulating runoff, erosion, nutrient movement and yield for organic and conventional management under conservation and conventional tillage systems.
- Assess the long term impact of organic and conventional managed plots on crop yield and on surface runoff quantity and quality under conservation and conventional tillage systems

## Methods

- Use WinAPEX to input crops and all managements and run for 20 plots from 1994 to 2010
- Compare the simulated and measured runoff, sediment and nutrient in 2010
- Compare the simulated and measured crop yield from 1995 to 2010

20 plots (4 replications, 5 treatments):

- (1) organic management in conservation tillage (Strip Organic)
- (2) organic management in conventional tillage (Plow Organic)
- (3) conventional management in conservation tillage (Strip Chemical)
- (4) conventional management in conventional tillage (Plow Chemical)
- (5) Control



## Methods

Table 1. Treatment definition in summary

No	Treatment	Preparation for First Summer crop			Preparation for Second Summer crop		Inter-crop	Fertilizer	Pesticide
		Winter cover crop	Tillage	Plastic apply	1st Summer crop	Tillage			
1	Strip Organic	Flail chop	Strip till/No-till	No	Harvest, Flail chop	Strip till	Yes	Organic	No
2	Plow Organic	Flail chop	Plow & disk	Yes	Harvest, flail chop	Plow & disk	No	Organic	No
3	Strip Chemical	Kill with chemical	Strip till/No-till	No	Harvest, Flail chop	Strip till	No	Chemical	Chemical
4	Plow Chemical	Kill with chemical	Plow & disk	Yes, with fumigant	Harvest, flail chop	Plow & disk	No	Chemical	Chemical
5	Control	No	No	No	Harvest, flail chop	Plow & disk	No	No	No

Table 2. Rotated and continuous crops from 1994 to 2010

Year	Vegetable Crop			Winter Cover Crops	
	Rotated Section		Continuous	Fall planted	
	First Summer Crop	Second Summer Crop		Chemical plot	Organic plot
1994				Rye	Hairy Vetch
1995	Sweet corn	Cabbage	Tomatoes	Rye	Hairy Vetch
1996	Cucumbers	Cabbage	Tomatoes	Rye	Hairy Vetch
1997	Tomatoes		Tomatoes	Rye	Hairy Vetch
1998	Sweet corn	Cabbage	Tomatoes	Rye	Hairy Vetch
1999	Cucumbers	Cabbage	Tomatoes	Rye	Hairy Vetch
2000	Tomatoes		Tomatoes	Rye	Hairy Vetch
2001	Peppers		Tomatoes	Wheat/ C. Clover	Wheat/ C. Clover
2002	Squash	Broccoli	Tomatoes	Wheat/ C. Clover	Wheat/ C. Clover
2003	Tomatoes		Tomatoes	Wheat/ C. Clover	Wheat/ C. Clover
2004	Peppers		Tomatoes	Wheat/ C. Clover	Wheat/ C. Clover
2005	Squash	Broccoli	Tomatoes	Wheat/ C. Clover	Wheat/ C. Clover
2006	Tomatoes		Tomatoes	Wheat/ C. Clover	Wheat/ C. Clover
2007	Sweet Corn		Sweet Corn	Wheat/ C. Clover	Wheat/ C. Clover
2008	Sweet Corn		Sweet Corn	Wheat/ C. Clover	Wheat/ C. Clover
2009	Sweet Corn		Sweet Corn	Wheat/ C. Clover	Wheat/ C. Clover
2010	Sweet Corn		Sweet Corn	Wheat/ C. Clover	Wheat/ C. Clover

## Results

Table 3. Average simulated runoff, total flow, sediment and nutrient yield for four treatments from 1994 to 2010

Variable	Variable Name	Plow Chemical	Strip Organic	Plow Organic	Strip Chemical
PRCP	Precipitation(mm)	2326	2326	2326	2326
QSW	Surface runoff from watershed (mm)	422	409	426	405
QTW	Total flow from watershed (mm)	588	577	594	572
YW	Sediment yield from watershed(t/ha)	2.1	2.0	2.5	1.7
YNW	Yield of sediment transported N(kg/ha)	12.2	14.4	13.3	12.0
YPW	Yield of sediment transported P (kg/ha)	2.2	2.3	2.5	1.9
QNW	Watershed soluble N yield (kg/ha)	38.6	19.8	25.5	27.7
QPW	Watershed soluble P yield (kg/ha)	0.7	0.5	0.4	0.7

## Results

Table 4. Observed and APEX dry yields from 1995 to 2010 for continuous cropping system (tons/ha)

Year	Crop	Plow Organic		Plow Conventional		Conserva- Organic		Conserva-Convent	
		Observed	APEX	Observed	APEX	Observed	APEX	Observed	APEX
1995	Tomatoes	3.9	5.2	5.2	5.2	2.0	4.4	5.7	5.1
1996	Tomatoes	2.9	4.7	4.3	5.5	1.9	2.9	2.9	4.3
1997	Tomatoes	4.6	3.2	4.1	4.8	1.1	2.3	3.9	3.9
1998	Tomatoes	1.9	3.8	3.1	5.0	2.3	2.0	5.2	3.5
1999	Tomatoes	3.3	3.4	4.7	4.6	2.1	1.9	4.2	3.6
2000	Tomatoes	3.8	3.7	3.1	5.2	3.0	2.1	4.2	3.8
2001	Tomatoes	2.6	3.0	5.0	4.9	3.3	1.9	3.7	3.7
2002	Tomatoes	2.0	3.1	3.5	4.7	1.8	2.0	3.1	3.6
2003	Tomatoes	1.4	3.5	3.8	5.1	0.8	3.0	3.8	4.7
2004	Tomatoes	2.6	3.8	5.1	4.7	3.2	2.9	3.9	4.0
2005	Tomatoes	no data	3.5	2.9	4.7	0.3	2.5	1.0	3.8
2006	Tomatoes	1.0	3.3	4.4	4.6	1.8	2.2	4.2	4.0
2007	Sweet corn	4.4	4.3	4.3	4.4	4.7	3.1	5.1	4.5
2008	Sweet corn	3.0	4.6	5.4	5.0	3.2	2.3	5.3	5.0
2009	Sweet corn	0.5	4.3	5.0	4.9	1.1	3.1	6.1	5.1
2010	Sweet corn	1.9	3.9	4.1	5.2	4.1	2.4	6.7	5.2
Average		2.7	3.9	4.3	4.9	2.3	2.6	4.3	4.2

Table 5. Observed and APEX dry yields from 1995 to 2010 for Rotated cropping system (tons/ha)

Year	1st Crop	Plow Organic		Plow Conventional		Conserva- Organic		Conserva-Convent	
		Observed	APEX	Observed	APEX	Observed	APEX	Observed	APEX
1995	Sweet corn	1.4	4.1	2.6	4.0	1.4	4.2	2.9	4.2
1996	Cucumber	1.8	2.6	2.8	2.5	0.2	2.6	1.4	2.5
1997	Tomatoes	5.4	3.6	6.2	5.5	2.2	2.0	4.6	4.4
1998	Sweet corn	5.2	4.2	5.6	4.3	2.8	2.3	6.1	4.4
1999	Cucumber	2.1	2.3	2.9	2.3	1.8	2.3	2.7	2.3
2000	Tomatoes	5.0	2.8	3.5	5.1	4.9	1.7	5.6	3.6
2001	Peppers	1.8	1.9	2.1	1.9	1.8	1.8	1.7	1.8
2002	Squash	1.6	1.8	1.8	2.1	1.7	1.1	2.2	1.7
2003	Tomatoes	1.4	4.3	4.0	5.4	0.3	3.4	3.5	4.7
2004	Peppers	2.3	1.9	1.8	1.7	2.1	1.7	1.7	1.9
2005	Squash	no data	1.8	no data	1.9	no data	1.4	no data	1.8
2006	Tomatoes	1.1	4.5	5.0	5.0	2.2	2.8	5.6	3.8
2007	Sweet corn	4.8	4.4	4.5	4.4	5.0	3.6	5.3	4.5
2008	Sweet corn	3.1	4.9	5.0	5.0	4.0	2.7	5.3	5.0
2009	Sweet corn	no data	4.6	4.9	4.9	1.5	3.4	6.5	5.1
2010	Sweet corn	1.9	3.9	4.1	4.7	4.1	2.4	6.7	4.8
Average		2.8	3.1	3.8	3.9	2.4	2.5	4.1	3.6

Table 5b. Second summer crop

Year	2nd Crop	Plow Organic		Plow Conventional		Conserva- Organic		Conserva-Convent	
		Observed	APEX	Observed	APEX	Observed	APEX	Observed	APEX
1995	Cabbage	1.0	2.2	0.6	2.2	0.3	2.2	1.0	2.2
1996	Cabbage	1.7	2.2	1.0	2.2	0.8	2.1	1.5	2.2
1998	Cabbage	1.8	2.1	1.3	2.2	1.2	1.3	1.7	2.2
1999	Cabbage	no data	2.3	no data	2.4	no data	1.6	no data	2.4
2002	Broccoli	0.3	0.8	0.2	0.8	0.4	0.8	0.5	0.8
2005	Broccoli	0.2	1.2	0.3	1.2	0.4	0.8	0.3	1.2
Average		1.0	1.7	0.7	1.7	0.6	1.4	1.0	1.7

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