Reduced Tillage Success

No-Till Cover Crop Symposium

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What is No-Till?

- No-till crops are planted into unprepared seed beds
- Specialized planters cut through crop residue and cover crops
- Works best on productive soil (i.e. good organic matter, good fertility, no compaction)

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What is Strip-Till?

- Creates a strip, or "zone" that is planted into
- Manure or fertilizer can be injected into strips
- May be used to transition to no-till
- May be the best option on heavier soils

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Why reduced tillage?

What wrong with this?

- Tillage releases carbon to the atmosphere by oxidizing the organic matter (carbon)
- Nitrogen is released (good in the short term)
- Excess nitrate leaches after the crop is harvested without actively growing plants
- Tillage increases soil erosion and phosphorus losses

➢ **Carbon stocks = Nitrogen use efficiency**

➢ **Soil Erosion = Phosphorus use efficiency**

Long Term tillage = Lower yields = Lost $$$

But the nutrients aren't totally gone……..

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Lake Champlain, waters near the Missisquoi Bay Bridge, August 2008.

– Source: Lake Champlain Basin Program; Credit: Larry Dupont

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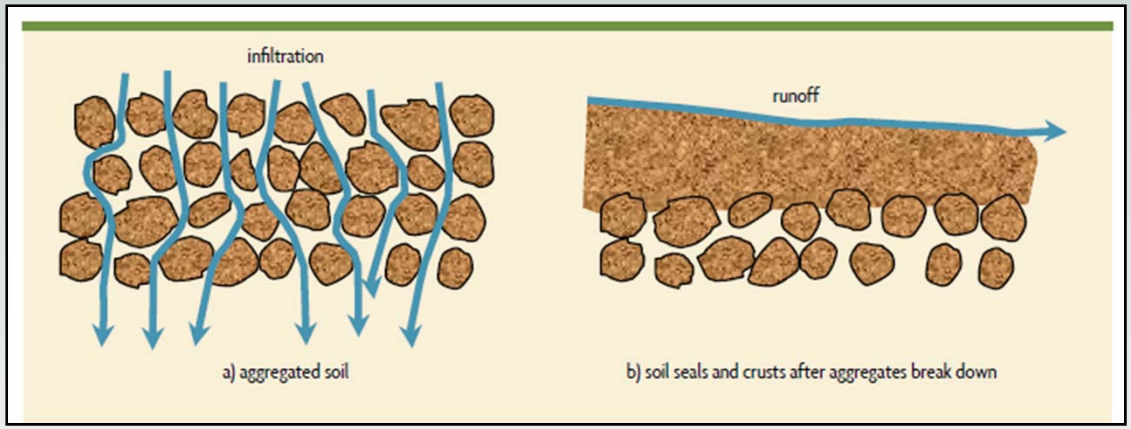
More Organic Matter means Healthier Soils

Cover Crops, crop residues, and reduced tillage increase organic matter



As organic matter increases, soils tend to be less compact and enhance rapid infiltration

One study (Weil, Magdoff. 2004) estimated the value of just N contributions and added water infiltration at: **$20 for every 1% O.M.**

- Reduces risk of compaction and builds strong aggregates
- Increases water infiltration and and Cation Exchange Capacity (CEC)
- More surface cover, stronger aggregates = ***Less soil erosion***

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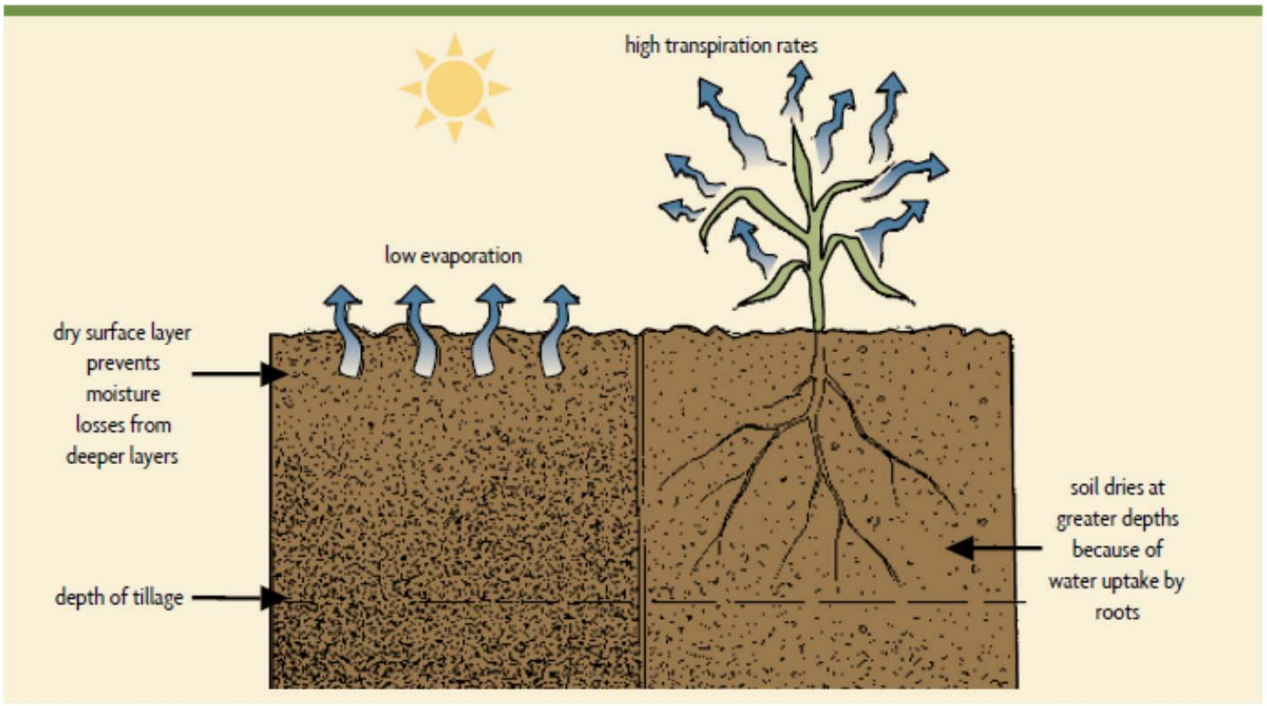
Continuous Living Cover and No-Till

Cover Crops !

- 12 month cropping concept: harvest sunlight during the winter and add carbon to the system (more carbon = more nitrogen)
- Living roots increase pore space for increased water infiltration



- Help soils warm in the Spring
- Clay soils will seal off once the top inch is dried out preventing traffic without causing excessive damage
- Cover crops draw water out from further down, making the soil workable sooner

Systems Approach to Tillage & Cropping

- Soil Health helps reduced tillage and reduced tillage helps Soil health
- Cover crops, earthworms, and soil microbes help soil health and vice versa
- Cover Crops, 12 month cropping feed soil biology, which feed cash crops
- Cover crops (especially overwintering) help alleviate compaction by rooting

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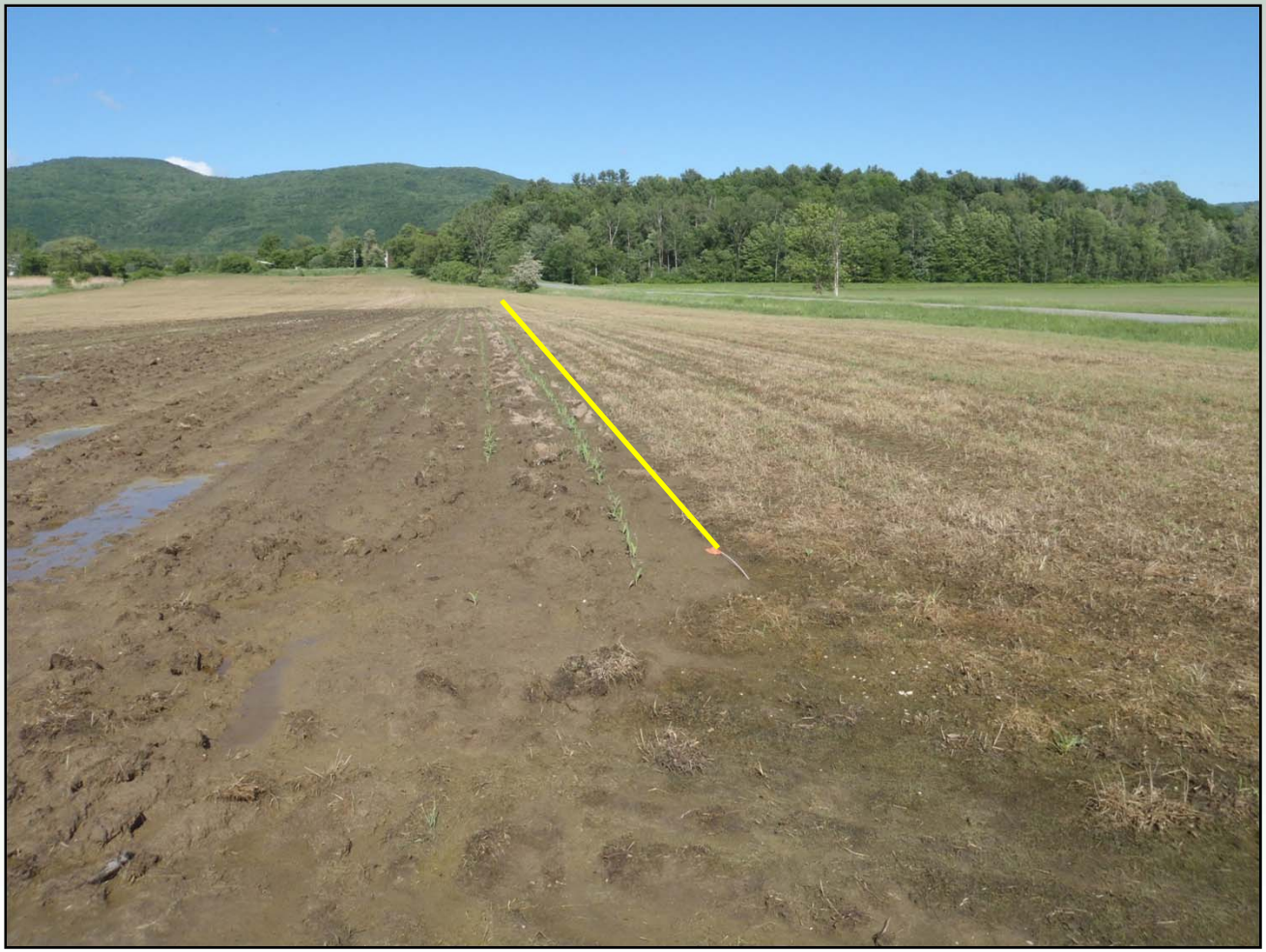
Can we No-Till in Vermont?



BMP Challenge: Side by Side comparison

- Heavy clay soil (Covington)
- Picture taken on 6-3-2013 (after a heavy rain)
- Increased water infiltration

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Why reduced Tillage?

BMP Challenge: Side by Side comparison

- Heavy clay soil (Covington)
- 9-24-2013
- No-till side was more resilient in a challenging year
- **Yields were equal**

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Who pays for Soil Erosion?

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Is it about the Money?

The farmer gets a bill……

1 ton of eroded soil contains:

- 2.3 lb N @ $0.64 = $1.48
- 1 lb P @ $0.70 = $0.70

Lost Fertilizer Value: $2.18 *-Iowa State U.*

And the taxpayer gets a bill……

Lost value in water quality: $4.93 *–USDA/NRCS*

If we don't pay, the next generation will.

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Reduced Tillage by the Numbers

Conventional Till						Strip Till w/ Manure						No-Till					
Fall Tillage						**Fall Tillage**						**Fall Tillage**					
Moldboard Plow						Manure Injection w/15' toolbar (shank injector)											
Fuel	3.75	gal./ac. at=	$3.75	per gal.	$14.06	Fuel	5	gal./ac. at=	$3.75	per gal.	$18.75						
labor	0.50	hr./ac. at=	$15.00	per hour	$7.50	labor	0.5	hr./ac. at=	$15.00	per hour	$7.50						
				Fall Total	$21.56					Fall Total	$26.25					Fall Total	$0.00
Spring Tillage						**Spring Tillage**						**Spring Tillage**					
Disk						Zone Builder						Custom spray application					
Fuel	1	gal./ac. at=	$3.75	per gal.	$3.75	Fuel	1.25	gal./ac. at=	$3.75	per gal.	$4.69	Rate	1	$30.00	per ac.=	$30.00	
labor	0.1	hr./ac. at=	$15.00	per hour	$1.50	labor	0.1	hr./ac. at=	$13.00	per hour	$1.30						
Roller Harrow																	
Fuel	0.7	gal./ac. at=	$3.75	per gal.	$2.63												
labor	0.1	hr./ac. at=	$15.00	per hour	$1.50												
				Spring Total	$9.38					Spring Total	$5.99					Spring Total	$30.00
Conventional Tillage Total (Per Acre)					**$30.94**	**Strip Tillage Total (Per Acre)**					**$32.24**	**No-Till Total (Per Acre)**					**$30.00**

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Soil Loss by the Numbers

	Strip Till		No-Till		Chisel Plow	
soil loss(tons/ac.)	1		0.5		4	
Fertilizer Loss	$2.18		$1.09		$8.72	
Water Quality Loss	$4.93		$2.47		$19.72	
Lost Value due to Soil Erosion	$7.11		$3.56		$28.44	

Balance Sheet So far……

	Strip Till		No-Till		Chisel Plow	
Tillage cost=	($32.24)		($30.00)		($30.94)	
Soil Erosion Loss=	($7.11)		($3.56)		($28.44)	
Total=	**($39.35)**		**($33.56)**		**($59.38)**	

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What about the Earthworms?

Earthworm Populations in Corn/Soybean Rotation on Silt Loam Soil

Tillage Practice	Earthworms per sq. ft. (3 yr. avg.)
Strip Till	17.03
No Till	15.48
Chisel Plow	10.20

Source: Purdue University

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So What?

25 Earthworms per sq. ft. =

1 ton Earthworms per acre = 100 tons castings per acre,

or 2/3" of manure on surface per acre, or:

- 4 lbs. of NO_3 nitrogen
- 30 lbs. phosphorus
- 72 lbs. potash
- 90 lbs. magnesium
- 500 lbs. calcium

Analysis= 4-68-86 and ¾ ton of limestone

Fertilizer Value= $77.89/acre!!!

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Based on numbers from Purdue U…

	Strip Till		No-Till		Chisel Plow	
	17.03	Earthworms/ft^2	15.48	Earthworms/ft^2	10.20	Earthworms/ft^2
lbs. NO_3	2.72	$1.75	2.48	$1.59	1.63	$1.05
lbs. P	20.44	$14.22	18.58	$12.92	12.24	$8.51
lbs. K	49.05	$24.32	44.58	$22.11	29.38	$14.57
lbs. Mg	61.31		55.73		36.72	
lbs. Ca	340.60		309.60		204.00	
lbs. $CaCO_3$	1021.80	$12.77	928.80	$11.61	612.00	$7.65
	Strip till Total=	$53.06	No-Till Total=	$48.23	Chisel Total=	$31.78

Balance Sheet So far…

	Strip Till	No-Till	Chisel Plow
Tillage cost=	($32.24)	($30.00)	($30.94)
Soil Erosion Loss=	($7.11)	($3.56)	($28.44)
Earthworm Fertilizer Value=	$53.06	$48.23	$31.78
	$13.71	$14.68	($27.60)

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So….what about cover crops?

Grass cover crop@ 8" high and 100% ground cover= 2,000 lbs dry matter/ac.

- @ 2% N = 40 lbs. of N/ac.
- @ $0.64/lb. of N = $25.40

Legume cover crop@ 6" high and 100% ground cover=2,000 lbs dry matter/ac.

- @ 3.5% N = 70 lbs. of N/ac.
- @ $0.64/lb. of N = **$44.80**

A grass/legume mix can be expected to contribute **$35.10** of nitrogen per acre

- This nitrogen will be available over a 2 year period if plowed down
- …and over a 4 year period if killed and left on surface (no-till)

	Strip Till		No-Till		Chisel Plow	
Cover crop seed	($25.00)		($25.00)		$0.00	
No-till Drill	($14.38)		($14.38)		$0.00	
N-Fertilizer value	$35.10		$35.10		$0.00	
P&K Fertilizer Value	$3.66		$3.66		$0.00	
	($0.62)		($0.62)		$0.00	

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Harvest the cover crops!

1 ton of dry matter @50% moisture= 4000 lbs. of balage

or about 4 bales @ $60 bale = $240 per acre value

Cost/ac.	Strip Till	No-Till	Chisel Plow
Cover crop seed	($25.00)	($25.00)	$0.00
No-till Drill	($14.38)	($14.38)	$0.00
mower/conditioner	($9.18)	($9.18)	$0.00
rake	($6.04)	($6.04)	$0.00
round baler/wrapper	($9.09)	($9.09)	$0.00
Double Crop Value	$240.00	$240.00	$0.00
	$176.31	$176.31	$0.00

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Harvest the cover crops!

Better yet, apply 50 lbs. N.....and get 1.5 ton of dry matter @50% moisture = 6000 lbs. of balage

or about 6 bales @ $60 bale = <u>$360 per acre value</u>

Cost/ac.	Strip Till		No-Till		Chisel Plow	
Cover crop seed	($25.00)		($25.00)		$0.00	
No-till Drill	($14.38)		($14.38)		$0.00	
N-fertilizer	($32.00)		($32.00)		$0.00	
mower/conditioner	($9.18)		($9.18)		$0.00	
rake	($6.04)		($6.04)		$0.00	
round baler/wrapper	($9.09)		($9.09)		$0.00	
Double Crop Value	$360.00		$360.00		$0.00	
	$264.31		$264.31		$0.00	

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Transitioning to No-Till

Watch out for compaction!!!

- Transition to no-till can be challenging if soil was previously degraded and compacted. Build up O.M. first and consider strip till, zone till, etc.
- Cover Crops have the ability to "jump start" no-till by recycling nutrients, building O.M., and improving soil structure
- Crop residues and cover crops help distribute equipment load

Be Aware of N immobilization!!!

- Lower availability of N during the first years of transitioning to no-till due soil microbes converting and storing N as organic matter
- Compensate by adding more N: legumes, manure, fertilizers (lower C:N ratio)

Don't Panic!!!

Research shows it takes 7-9 years of continuous no-till to produce higher yields than conventionally tilled fields because it takes 7-9 years to improve soil health by getting microbes and earthworms back into balance.- *Ohio State U. Extension*

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Other considerations

- With no-till systems, seed placement becomes more critical
  - No-Till planters and drills are advanced pieces of engineering that need to be rugged and precise
- Manure: surface applied or injected?
- Controlled traffic: GPS makes it easier
- Tile drainage