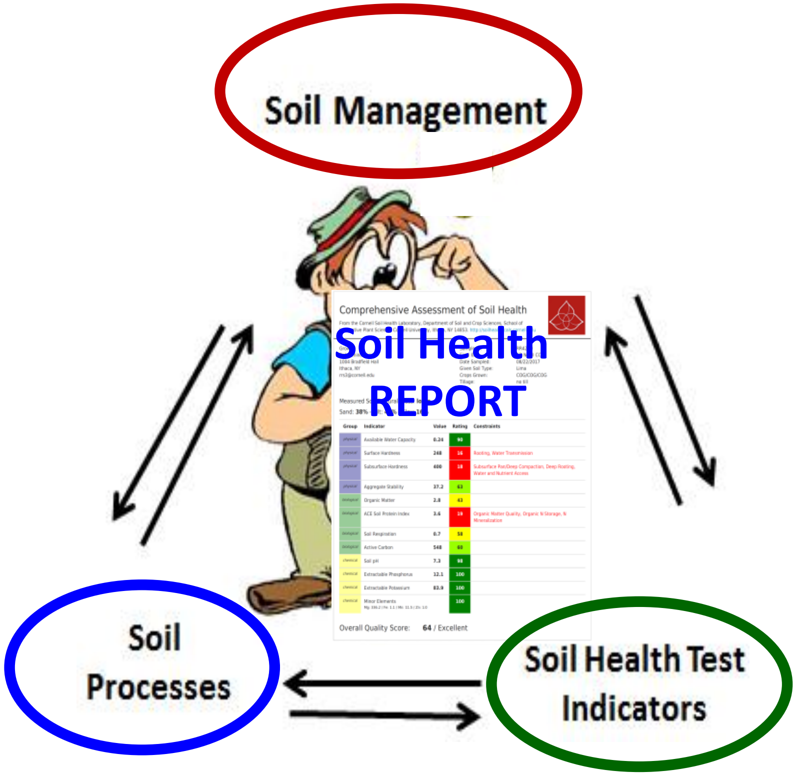
Creating a Soil Health Management Plan



How do I use the information?

- Understand soil processes & management impacts
- Identify constraints through soil health assessment
- Select & implement appropriate management strategies
- Monitor change and adjust management

Bob Schindelbeck, rrs3@cornell.edu
Aaron Ristow, ajr229@cornell.edu
http://soilhealth.cals.cornell.edu

School of Integrative Plant Science
Soil and Crop Sciences Section

Principles of Soil Health Management

Comprehensive Assessment of Soil Health

From the Cornell Soil Health Laboratory, Department of Soil and Crop Sciences, School of Integrative Plant Science, Cornell University, Ithaca, NY 14853. http://soilhealth.cals.cornell.edu

30 acre field just bought
Lima silt loam
Long term moldboard tillage
Long term corn for grain

Robust conventional grower
Interested in cover cropping
Lots of smaller equipment
Does NOT have a no-till drill

Group	Indicator	Value	Rating	Constraints
physical	Available Water Capacity	0.24	90	
physical	Surface Hardness	248	16	Rooting, Water Transmission
physical	Subsurface Hardness	400	18	Subsurface Pan/Deep Compaction, Deep Rooting, Water and Nutrient Access
physical	Aggregate Stability	37.2	63	
biological	Organic Matter	2.8	43	
biological	ACE Soil Protein Index	3.6	19	Organic Matter Quality, Organic N Storage, N Mineralization
biological	Soil Respiration	0.7	58	
biological	Active Carbon	548	60	
chemical	Soil pH	7.3	98	
chemical	Extractable Phosphorus	12.1	100	
chemical	Extractable Potassium	83.9	100	
chemical	Minor Elements Mg: 336.2 / Fe: 1.1 / Mn: 11.5 / Zn: 1.0		100	

Overall Quality Score: **64** / Excellent

Page 1

1. Report is a Management Guide, not a prescription
2. Different mgmt approaches can mitigate same problem
3. One management practice can affect multiple indicators
4. Information from varied sources: workshops, field days, local experience
5. **Adapt Report Information to a mgmt strategy to fit your field/farm**
6. **Soil health changes slowly over time**

Management Suggestions for Physical and Biological Constraints

Constraint	Short Term Management Suggestions	Long Term Management Suggestions
Available Water Capacity Low	• Add stable organic materials, mulch • Add compost or biochar • Incorporate high biomass cover crop	• Reduce tillage • Rotate with sod crops • Incorporate high biomass cover crop
Surface Hardness High	• Perform some mechanical soil loosening (strip till, aerators, broadfork, spader) • Use shallow-rooted cover crops • Use a living mulch or interseed cover crop	• Shallow-rooted cover/rotation crops • Avoid traffic on wet soils, monitor • Avoid excessive traffic/tillage/loads • Use controlled traffic patterns/lanes
Subsurface Hardness High	• Use targeted deep tillage (subsoiler, yeomans plow, chisel plow, spader.) • Plant deep rooted cover crops/radish	• Avoid plows/disks that create pans • Avoid heavy loads • Reduce traffic when subsoil is wet
Aggregate Stability Low	• Incorporate fresh organic materials • Use shallow-rooted cover/rotation crops • Add manure, green manure, mulch	• Reduce tillage • Use a surface mulch • Rotate with sod crops and mycorrhizal hosts
Organic Matter Low	• Add stable organic materials, mulch • Add compost and biochar • Incorporate high biomass cover crop	• Reduce tillage/mechanical cultivation • Rotate with sod crop • Incorporate high biomass cover crop
ACE Soil Protein Index Low	• Add N-rich organic matter (low C:N source like manure, high N well-finished compost) • Incorporate young, green, cover crop biomass • Plant legumes and grass-legume mixtures • Inoculate legume seed with Rhizobia & check for nodulation	• Reduce tillage • Rotate with forage legume sod crop • Cover crop and add fresh manure • Keep pH at 6.2-6.5 (helps N fixation) • Monitor C:N ratio of inputs
Soil Respiration Low	• Maintain plant cover throughout season • Add fresh organic materials • Add manure, green manure • Consider reducing biocide usage	• Reduce tillage/mechanical cultivation • Increase rotational diversity • Maintain plant cover throughout season • Cover crop with symbiotic host plants
Active Carbon Low	• Add fresh organic materials • Use shallow-rooted cover/rotation crops • Add manure, green manure, mulch	• Reduce tillage/mechanical cultivation • Rotate with sod crop • Cover crop whenever possible

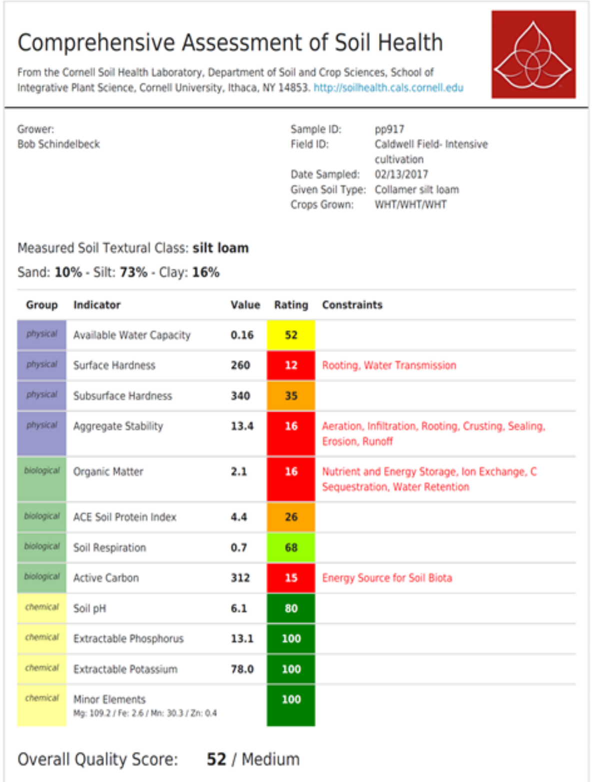
Pages 9-10

Constrained and Suboptimal indicators are flagged in Report management table

SH Management Planning Process Overview

1. Determine farm background and management history Compile background info: history by management unit, farm operation type, equipment, access to resources, situational opportunities or limitations.	**Grower strengths**
2. Set goals and sample for soil health Determine number and distribution of soil health samples needed according to operation background and goals.	**Grower goals Soil sampling**
3. For each management unit: identify and explain constraints, prioritize Soil Health Report identifies constraints, guides prioritization. Explain results based on background, and adjust priorities.	**Evaluate results**
4. Identify feasible management options Management suggestions table available as part of Soil Health Report, or online with NRCS practice linkages	**Define options**
5. Create short and long term Soil Health Management Plan Integrate agronomic science of 2-4 with grower realities of 1 to create a specific short-term schedule of management practices for each management unit and an overall long-term strategy	**Refine options**
6. Implement, monitor, and adapt Implement and document management practices. Monitor progress, repeat testing, and evaluate outcomes. Adapt plan based on experience and data over time.	**Implement Evaluate**

Focus the information



Comprehensive Assessment of Soil Health

From the Cornell Soil Health Laboratory, Department of Soil and Crop Sciences, School of Integrative Plant Science, Cornell University, Ithaca, NY 14853. http://soilhealth.cals.cornell.edu

Grower:
Bob Schindelbeck

Sample ID: pp917
Field ID: Caldwell Field- Intensive cultivation
Date Sampled: 02/13/2017
Given Soil Type: Collamer silt loam
Crops Grown: WHT/WHT/WHT

Measured Soil Textural Class: **silt loam**

Sand: **10%** - Silt: **73%** - Clay: **16%**

Group	Indicator	Value	Rating	Constraints
physical	Available Water Capacity	0.16	52	
physical	Surface Hardness	260	12	Rooting, Water Transmission
physical	Subsurface Hardness	340	35	
physical	Aggregate Stability	13.4	16	Aeration, Infiltration, Rooting, Crusting, Sealing, Erosion, Runoff
biological	Organic Matter	2.1	16	Nutrient and Energy Storage, Ion Exchange, C Sequestration, Water Retention
biological	ACE Soil Protein Index	4.4	26	
biological	Soil Respiration	0.7	68	
biological	Active Carbon	312	15	Energy Source for Soil Biota
chemical	Soil pH	6.1	80	
chemical	Extractable Phosphorus	13.1	100	
chemical	Extractable Potassium	78.0	100	
chemical	Minor Elements Mg: 109.2 / Fe: 2.6 / Mn: 30.3 / Zn: 0.4		100	

Overall Quality Score: **52** / Medium

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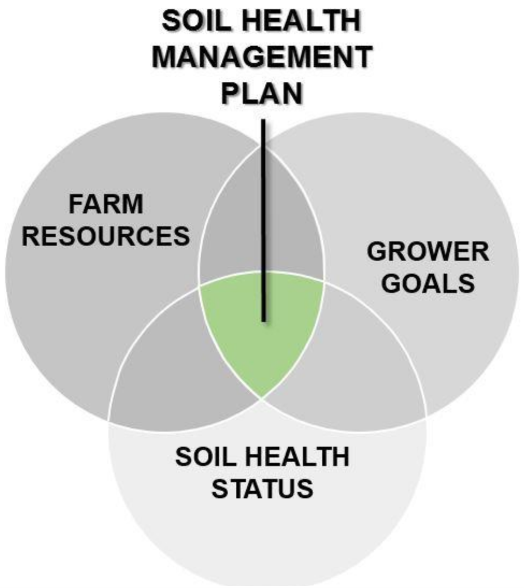
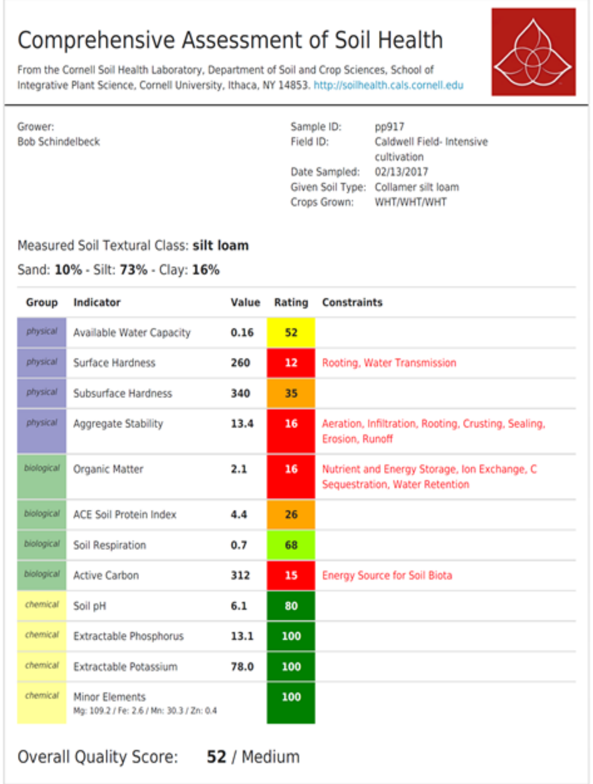
Phase I (steps 1–3)

Phase II (steps 4–5)

Phase III (step 6)

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Overall Quality Score: **64** / Excellent

1. Determine farm background and management history

Given on your Group Report

2. Set goals and sample for soil health

Grower needed baseline soil health info, wants to increase soil resiliency, likes green manures as feed for his new beef operation, access to equipment

3. For each management unit: identify and explain constraints, prioritize

Continuous corn ground is addicted to tillage. Soil is hard, biologically sluggish, low in organic nitrogen stores. Grower has learned of some new cover crops available and wants to know if he can "grow" needed nitrogen and not have to pay for it. And at the same time produce some needed feed for beef.

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Your goal this hour..
Brainstorm

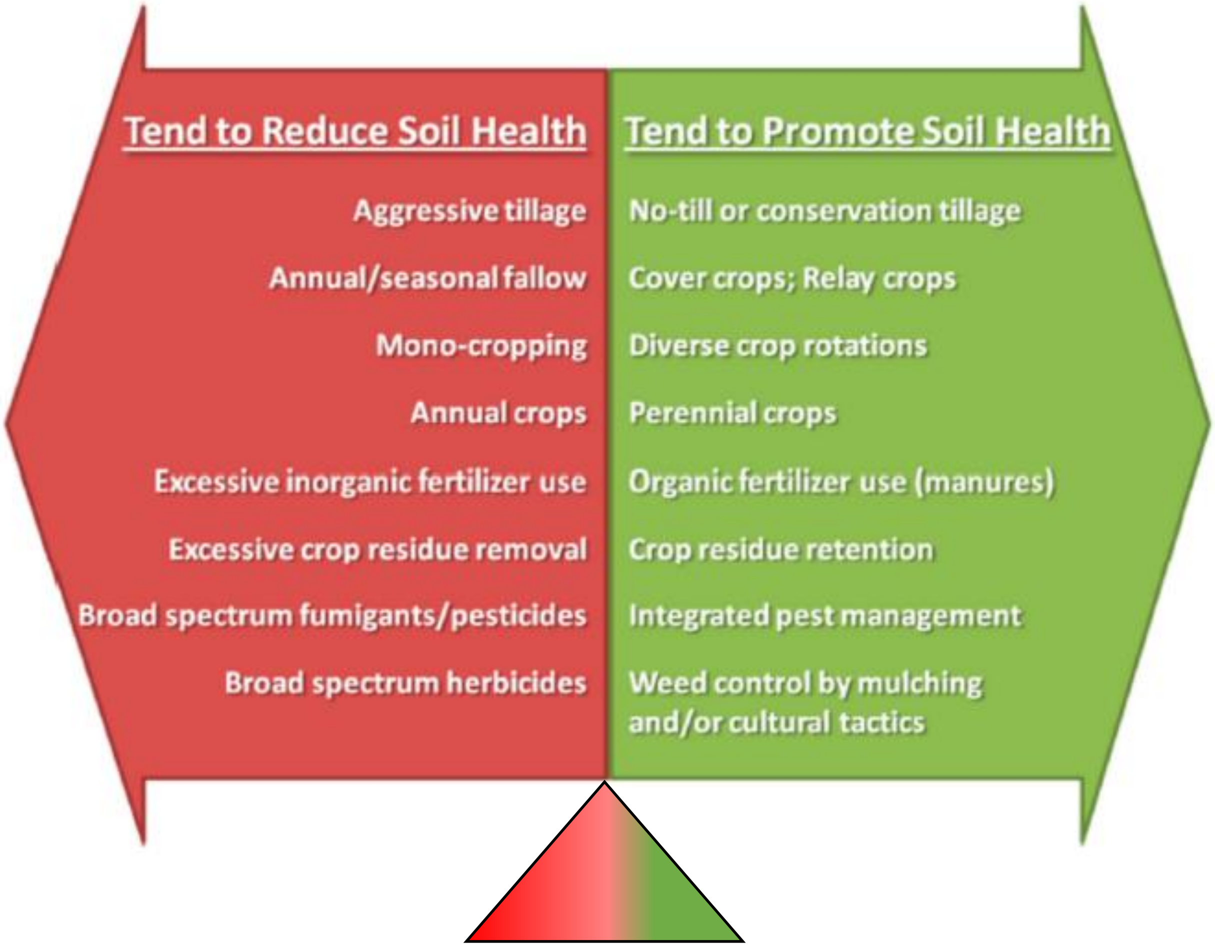
4. Identify feasible management options

Hard soil could be decompacted with tillage. Crops need to be used that prevent reconsolidation of the surface. Loosen deeper zones and ensure that root penetration will keep subsoil "open". Legume cover crop could provide for soil N and for forage material. Research cover crop to learn of availability, rates, etc.

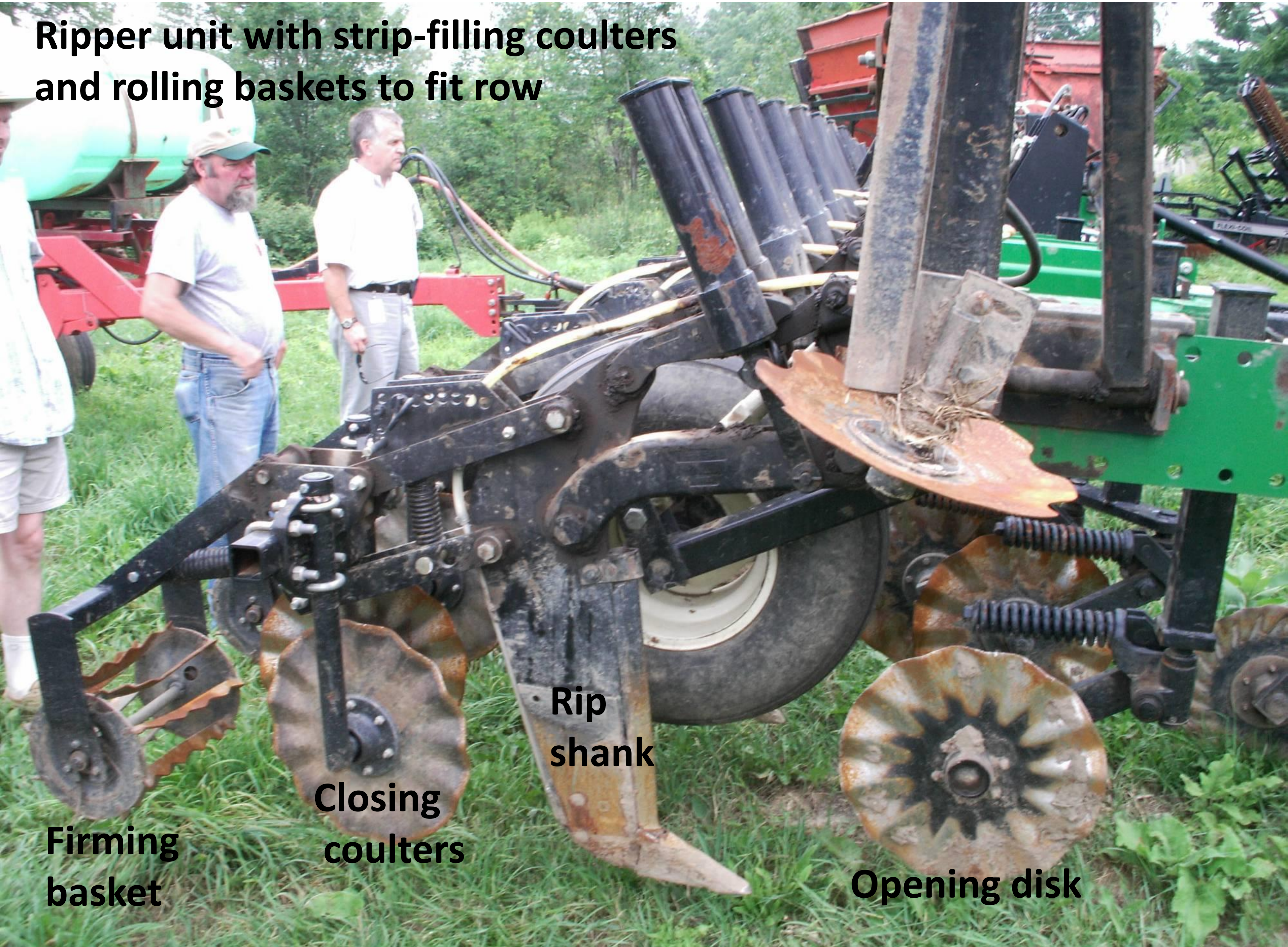
Step 4– Feasible Management Options

We know what works……

From: Lehman et al., 2015



NRCS Planning Process – Analyze Resource Data, Formulate and Evaluate Alternatives


Ripper unit with strip-filling coulters
and rolling baskets to fit row
Rip
shank
Closing
coulters
Firming
basket
Opening disk

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

COVER CROP

(Ac.)

CODE 340

DEFINITION

Grasses, legumes, and forbs planted for seasonal vegetative cover.

PURPOSE

This practice is applied to support one or more of the following purposes:

- Reduce erosion from wind and water.
- Maintain or increase soil health and organic matter content.
- Reduce water quality degradation by utilizing excessive soil nutrients.
- Suppress excessive weed pressures and break pest cycles.
- Improve soil moisture use efficiency.
- Minimize soil compaction.

CONDITIONS WHERE PRACTICE APPLIES

All lands requiring seasonal vegetative cover for natural resource protection or improvement.

CRITERIA

General Criteria Applicable to All Purposes

Plant species, seedbed preparation, seeding rates, seeding dates, seeding depths, fertility requirements, and planting methods will be consistent with applicable local criteria and soil/site conditions.

Select species that are compatible with other components of the cropping system.

Ensure herbicides used with crops are compatible with cover crop selections and successive production crops, or companion-planted or relay-planted into production crops. Select species and planting dates that will not compete with the production crop yield or harvest.

Do not burn cover crop residue.

Determine the method and timing of termination to meet the grower's objective and the current NRCS Cover Crop Termination Guidelines.

When a cover crop will be grazed or hayed ensure that crop selection(s) comply with pesticide label rotational crop restrictions and that the planned management will not compromise the selected conservation purpose(s).

Do not harvest cover crops for seed.

If the specific rhizobium bacteria for the selected legume are not present in the soil, treat the seed with the appropriate inoculum at the time of planting.

Additional Criteria to Reduce Erosion from Wind and Water

Time the cover crop establishment in conjunction with other practices to adequately protect the soil during the critical erosion period(s).

Select cover crops that will have the physical characteristics necessary to provide adequate erosion protection.

Use the current erosion prediction technology to determine the amount of surface and/or canopy cover needed from the cover crop to achieve the erosion objective.

Illinois | Indiana | Iowa | Kansas | Michigan | Minnesota | Missouri
Nebraska | North Dakota | Ohio | Ontario | South Dakota | Wisconsin

Home

Cover Crop Resources
- Cover crop species
- Cover crop selector tools
- Innovator profiles
- Extension material
- Publications
- Multimedia
- Links
- Slurry seeding
- Survey...coming soon

Calendar of Events
- Upcoming events
- Past events

About Us
- Mission & Vision
- Organization
- History
- Supporters
- Meetings

Contact
- Executive committee
- Subscribe to listserv
- Leave a comment
- Press materials

WHAT ARE COVER CROPS?

Cover crops are plants seeded into agricultural fields, either within or outside of the regular growing season, with the primary purpose of improving or maintaining ecosystem quality.

The goal of the *Midwest Cover Crops Council* (MCCC) is to facilitate widespread adoption of cover crops throughout the Midwest, to improve ecological, economic, and social sustainability.

WHAT DO COVER CROPS DO FOR THE ENVIRONMENT?

- Enhance biodiversity
- Increase soil infiltration, leading to less flooding, leaching, and runoff
- Create wildlife habitat
- Attract honey bees and beneficial insects

WHAT DO COVER CROPS DO FOR FARMERS?

- Reduce erosion
- Improve soil quality, through increases in
  - Porosity (reduced compaction)
  - Soil organic matter
  - Water holding capacity
  - Beneficial microbes
  - Micro- and macro-invertebrates
- Retain nutrients that would otherwise be lost
- Add nitrogen through fixation (leguminous cover crops)
- Combat weeds
- Break disease cycles

NEWS

The MCCC is hiring a Program Manager, please visit the link for details!

NDSU is hiring a postdoctoral research fellow to work on cover crops.

The Ohio State University has just posted several slide presentations relating to cover crops and the environment and sustainable farming, check them out on the Ohio page

New MCCC publication: Integrating Cover Crops in Soybean Rotations

New/improved cover crop extension publications from Purdue University on

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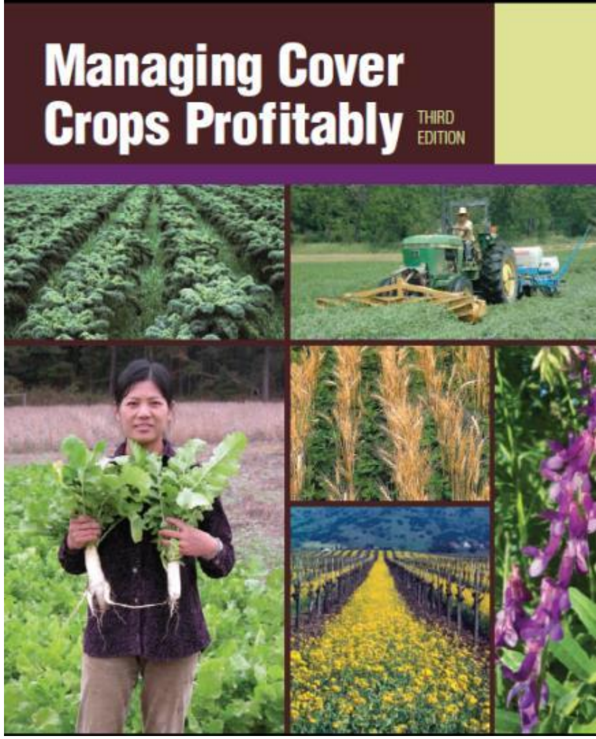

Cornell University
College of Agriculture and Life Sciences
New York State Agricultural Experiment Station

SEARCH: go
Cover Crop Guide | Cornell | more options

Cover Crops for Vegetable Growers

- Why Cover Crops?
- Soil Health
- Cover Crops Decision Tool

Newsletter Articles
- Early Summer
- Mid and Late Summer
- Late Summer Legumes
- Late Summer Crucifers
- Early Fall
- Fall
- Early Spring

Cover Crop Information
- Annual Ryegrass
- Arugula
- Buckwheat
- Field Peas
- Forage Radish

Why use cover crops in vegetable rotations

Vegetable production involves many practices that compromise soil health, and therefore limit productivity. New York soils are less forgiving of such practices than many other regions. Therefore, leading vegetable growers want to overcome this barrier to success with practices that maintain soil health. Some of the management goals for which farmers use cover crops include:

- Suppressing weeds
- Protecting soil from rain or runoff
- Improving soil aggregate stability
- Reducing surface crusting
- Adding active organic matter to soil
- Breaking hardpan
- Fixing nitrogen
- Scavenging soil nitrogen
- Suppressing soil diseases and pests

This website is part of a project that enables growers to use a broader range of cover crops to improve soil health by biological means. It will complement the chemical (fungicide) and physical (tillage) methods that are being developed by our colleagues. It will also take advantage of the Cornell Soil Health Team's new diagnostic tool for determining which aspects of soil health need improvement. Our goal is to provide a key component of an integrated management recommendation for growers.

USDA United States Department of Agriculture

Cover Crop Chart

GROWTH CYCLE	PLANT ARCHITECTURE	RELATIVE WATER USE
A = Annual	= Upright	= Low
B = Biennial	= Upright-Spreading	= Medium
P = Perennial	= Prostrate	= High

COOL: GRASS, BROADLEAF (incl. LEGUME) — WARM: BROADLEAF, GRASS

COOL – GRASS	COOL – BROADLEAF	COOL – BROADLEAF	LEGUME	LEGUME	LEGUME	LEGUME	LEGUME	WARM – BROADLEAF	WARM – GRASS
A BARLEY								A AMARANTH	A FOXTAIL MILLET
A OAT	A/B CANOLA	A/B CAMELINA						A BUCKWHEAT	A PEARL MILLET
A WHEAT	A/P MUSTARD	A PHACELIA	A FIELD PEA	A BERSEEM CLOVER	A/B VETCH	A COWPEA	A CLUSTER BEAN	A QUINOA	A PROSO MILLET
A CEREAL RYE	A RADISH	A FLAX	A LENTIL	A CRIMSON CLOVER	P BIRDSFOOT TREFOIL	A/P FENUGREEK	A SUNNHEMP	P CHICORY	A GRAIN SORGHUM
A TRITICALE	B TURNIP	A KALE	A LUPIN	B/P RED CLOVER	A/B SWEET CLOVER	A PIGEONPEA	A MUNG BEAN	A CUCURBITA	A SUDAN GRASS
A ANNUAL FESCUE	B BEET	A SPINACH	A/P MEDIC	P WHITE CLOVER	P SAINFOIN	A CHICKPEA	A SOYBEAN	A SAFFLOWER	A TEFF
P SALINE TOLERANT	A/B CARROT	A/B CHARD	P ROUNDHEAD LESPEDEZA	P KURA CLOVER	P ALFALFA	A FAVA BEAN	A/P PEANUT	A SUNFLOWER	A CORN

V 2.1. January 2016

Additional Information

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Overall Quality Score: **64** / Excellent

5. Create short and long term Soil Health Management Plan

Present these to the group

Rent deep ripper in May 2018. Spring drill barley, clover, vetch cocktail. Harvest as forage when barley is in flower. Fall drill wheat with rented no-till drill. June 2019 roll down wheat and plant no-till soybeans for forage or grain.

Conventional Cash Grain 1

Location/Site History:

Five years ago Bob bought a piece of the Aurora research farm ~32 ac of mostly Lima silt loam. Field has been in **continuous corn** for 25 years. Tried NT and some interseeded cover cropping now for 5 years. Wet springs mean late planting and low areas had generally **poor stands of** corn. Soil is crusted but a few earthworms are present. Grower feels that this could be good land but it is "tired".

Opportunities, Challenges, Grower Info:

There are a number of **dairy farms** and an **equipment dealer** in close vicinity. Grower wants to try to incorporate some of the features of the "new" cover crops into the rotation to 1) loosen the profile, 2) add N to the soil, 3) produce forage for his brothers beef operation that has been brought in.

Bob has a moldboard plow, disc set, and an old grain drill. He has a modern Deere corn planter which can handle high residue. Brother brought TWO 65HP Deere tractors, a haybine and round baler with him. The brothers want to split the land and grow grain corn for the animals and graze the stover. The rotated land would be used for pasture and haylage.

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Grower:
Sandy Rockland
Vernon Center, NY

Sample ID:	RR4424
Field ID:	Conventional field
Date Sampled:	08/22/2017
Given Soil Type:	Lima
Crops Grown:	COG/COG/COG
Tillage:	no till

Measured Soil Textural Class: **loam**

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Conventional Cash Grain 2

Location/Site History:

Productive soil near the Aurora research farm – 50 ac of mostly Lima silt loam. Long history of **moldboard plowing at 7-9"** depth. Field has been in **continuous corn/ soybean** for well over 20 years, and soil was eroded when taken on by this grower back then. Sidedressing usually done at V6 at 200lb/ac since 200 bu/ac is the usual yield. Extreme rainfall caused late planting and **poor stands** resulted. Corn was yellow. Much of field was **soggy, some ponded areas. Crusts formed** in higher areas.

Opportunities, Challenges, Grower Info:

There are a number of **dairy farms** and an **equipment dealer** in close vicinity. Farmer is concerned with weather variability, especially with all the talk of climate change. He is fairly social, willing to talk to growers in the area about options, but is also cautious/ risk-averse. Participated in a research trial for which he was given this soil health test and was told **his soil looks 'tillage addicted**' –all news to him. He isn't up for spending a ton of money on equipment. He does have a smartphone, and is somewhat computer-inclined. He's ideally looking for **one tried-and-true, simple solution** that can apply to the rest of his farm, since he manages 2000 acres and does not have a lot of extra time for special management of one field.

Comprehensive Assessment of Soil Health

From the Cornell Soil Health Laboratory, Department of Soil and Crop Sciences, School of Integrative Plant Science, Cornell University, Ithaca, NY 14853. http://soilhealth.cals.cornell.edu

Grower:
Charlie Cashgrain
3333 Longacre
Poplar Ridge, NY 13026

Sample ID:	RR4249
Field ID:	Field E
Date Sampled:	10/22/2017
Given Soil Type:	Lima
Crops Grown:	COG/COG/COG
Tillage:	7-9 inches

Agricultural Service Provider:
Mr. Bob Consulting
rrs3@cornell.edu

Measured Soil Textural Class: **loam**

Sand: **39%** - Silt: **43%** - Clay: **17%**

Group	Indicator	Value	Rating	Constraints
physical	Available Water Capacity	0.21	76	
physical	Surface Hardness	240	18	Rooting, Water Transmission
physical	Subsurface Hardness	290	53	
physical	Aggregate Stability	8.0	10	Aeration, Infiltration, Rooting, Crusting, Sealing, Erosion, Runoff
biological	Organic Matter	2.5	28	
biological	ACE Soil Protein Index	3.5	18	Organic Matter Quality, Organic N Storage, N Mineralization
biological	Soil Respiration	0.6	55	
biological	Active Carbon	326	17	Energy Source for Soil Biota
chemical	Soil pH	8.0	24	
chemical	Extractable Phosphorus	5.2	100	
chemical	Extractable Potassium	66.4	91	
chemical	Minor Elements Mg: 301.1 / Fe: 1.4 / Mn: 10.7 / Zn: 0.7		100	

Overall Quality Score: **49** / Medium

Conventional Dairy

Location/Site History:

This 40 ac field is part of a 60 cow dairy near Niagara Falls, NY. This field has been in **corn silage for 5 years**, receiving bedded pack manure frequently since there is not much storage. The dairy buys wood shavings from a local carpenter and wood chips from the city of Niagara Falls. Before this the field was hay field for a long time. Corn grew well early on but then just seemed to shut down in August and the soil surface got VERY dry.

Opportunities, Challenges, Grower Info:

Growers are older, but **their nephew is taking an interest in their operation.** They have never used a tillage system other than moldboard plowing and don't really want to branch out. **They incorporate manure with their Aerway** on occasion. The dairy has received requests to compost food waste from the college cafeteria since the nephew started to windrow some of their bedded pack to sell compost to a local nursery. He is **considering other options for diversification** and value addition now that he's done with college. He wants to move to more rotational grazing. He has also found some neighbors with an **Unverferth Zone Builder** that he could rent.

Comprehensive Assessment of Soil Health

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Grower:		Sample ID:	RR4248
John Nice		Field ID:	Back 40
234 Longview Rd.		Date Sampled:	10/15/2017
Akron, NY 14072		Given Soil Type:	Raynham
		Crops Grown:	AGT/COS/COS
rrs3@cornell.edu		Tillage:	7-9 inches

Measured Soil Textural Class: **silty clay loam**

Sand: **18%** - Silt: **54%** - Clay: **28%**

Group	Indicator	Value	Rating	Constraints
physical	Available Water Capacity	0.18	62	
physical	Surface Hardness	280	8	Rooting, Water Transmission
physical	Subsurface Hardness	400	18	Subsurface Pan/Deep Compaction, Deep Rooting, Water and Nutrient Access
physical	Aggregate Stability	81.7	99	
biological	Organic Matter	4.8	97	
biological	ACE Soil Protein Index	7.3	68	
biological	Soil Respiration	1.8	100	
biological	Active Carbon	790	85	
chemical	Soil pH	6.4	100	
chemical	Extractable Phosphorus	66.9	6	High Phosphorus, Environmental Impact Risk
chemical	Extractable Potassium	324.2	100	
chemical	Minor Elements Mg: 164.0 / Fe: 4.3 / Mn: 16.4 / Zn: 1.7		100	

Overall Quality Score: **70** / Excellent

Organic Vegetables

Location/Site History:

Western PA, within 10 miles of population centers. 50 acres total of very intensive production on this farm. **Good vegetable land** is getting to be hard to come by –this 5 ac field is partly covered by **two high tunnels** (they happen to be movable, but haven't been moved). Long history of moldboard tillage and **intensive secondary tillage. Regular cultivation using Allis-Chalmers G tractors**. Multiple crops grown per year. Recently crops in high tunnel are looking a little odd (curled and brown leaf edges). **White crust was noticed on the surface a few times** –grower didn't know what it was. **Growing a lot of greens, tomatoes and brassicas for wholesale**. Sweet corn looked awful after all that rain last year. Some veggies sold at one larger farmer's market.

Opportunities, Challenges, Grower Info:

Grower uses **seasonal laborers**. Farm has access to an **organic matter source** – a nursery for wood chips, sawdust. **Daughter just finished college** and wants to **increase vegetable quality**. She is interested in taking over the business. Grower has no experience with cover crops. Varied equipment for veg production is available.

Comprehensive Assessment of Soil Health

From the Cornell Soil Health Laboratory, Department of Soil and Crop Sciences, School of Integrative Plant Science, Cornell University, Ithaca, NY 14853. http://soilhealth.cals.cornell.edu

Grower:
Charissa Carrot
556 Loamy Haven
Birdy, PA 12231

rrs3@cornell.edu

Sample ID:	RR4247
Field ID:	Deep six
Date Sampled:	11/01/2017
Given Soil Type:	Adams sandy loam
Crops Grown:	SWC/MIX
Tillage:	7-9 inches

Measured Soil Textural Class: **sandy loam**

Sand: **59%** - Silt: **36%** - Clay: **5%**

Group	Indicator	Value	Rating	Constraints
physical	Available Water Capacity	0.09	28	
physical	Surface Hardness	255	14	Rooting, Water Transmission
physical	Subsurface Hardness	400	18	Subsurface Pan/Deep Compaction, Deep Rooting, Water and Nutrient Access
physical	Aggregate Stability	26.2	27	
biological	Organic Matter	2.1	55	
biological	ACE Soil Protein Index	6.9	44	
biological	Soil Respiration	0.6	55	
biological	Active Carbon	359	32	
chemical	Soil pH	5.9	67	
chemical	Extractable Phosphorus	2.3	66	
chemical	Extractable Potassium	175.3	100	
chemical	Minor Elements Mg: 134.0 / Fe: 3.4 / Mn: 2.7 / Zn: 1.3		100	

Overall Quality Score: **51** / Medium

Pasture/ hay field

Location/Site History:

250 total acres of diversified organic hay and dairy production **(increasing)** on this farm. This 25 ac field has been in long term hay production with the alfalfa component decreasing. The naturally well-draining field is easily eroded and there is a pond located at the bottom of the 6% slope. There is a CNMP-required buffer strip around the pond but the family can no longer swim due to excessive algae blooms.

Opportunities, Challenges, Grower Info:

The farm uses most of the land to grow organic hay for sale off-farm. Limited inputs include wood ash and horse manure. The farm now offers eggs, meat, and **more milk** (sold to a local cheesemaker) all with organic certification. Farm goals are to improve soil health and farm productivity, long-term sustainability and the regained use of the pond for recreational uses. The CNMP showed that net nutrient exports off the farm were causing nutrient deficiencies on some of the fields. Diverse equipment is available to the younger generation of farmers who want to use cover crops to improve pastures and enhance the function of the land resource.

Comprehensive Assessment of Soil Health

From the Cornell Soil Health Laboratory, Department of Soil and Crop Sciences, School of Integrative Plant Science, Cornell University, Ithaca, NY 14853. http://soilhealth.cals.cornell.edu

Grower:
Ben Fayson
344 Eastview
Groton, NY 12294

Sample ID:	RR5249
Field ID:	Rolling Acres
Date Sampled:	10/22/2017
Given Soil Type:	Palmyra
Crops Grown:	pasture/pasture/pasture
Tillage:	no till

Agricultural Service Provider:
Mr. Bob Consulting
rrs3@cornell.edu

Measured Soil Textural Class: **fine sandy loam**

Sand: **56%** - Silt: **32%** - Clay: **11%**

Group	Indicator	Value	Rating	Constraints
physical	Available Water Capacity	0.17	56	
physical	Surface Hardness	283	8	Rooting, Water Transmission
physical	Subsurface Hardness	404	17	Subsurface Pan/Deep Compaction, Deep Rooting, Water and Nutrient Access
physical	Aggregate Stability	84.0	99	
biological	Organic Matter	5.3	99	
biological	ACE Soil Protein Index	12.9	94	
biological	Soil Respiration	0.8	75	
biological	Active Carbon	566	63	
chemical	Soil pH	6.1	91	
chemical	Extractable Phosphorus	46.4	9	High Phosphorus, Environmental Impact Risk
chemical	Extractable Potassium	37.8	54	
chemical	Minor Elements Mg: 256.9 / Fe: 0.9 / Mn: 6.7 / Zn: 2.1		100	

Overall Quality Score: **64** / Excellent

SH Management Planning Process

1. Determine farm background and management history Compile background info: history by management unit, farm operation type, equipment, access to resources, situational opportunities or limitations.
2. Set goals and sample for soil health Determine number and distribution of soil health samples needed according to operation background and goals.
3. For each management unit: identify and explain constraints, prioritize Soil Health Report identifies constraints, guides prioritization. Explain results based on background, and adjust priorities.
4. Identify feasible management options Management suggestions table available as part of Soil Health Report, or online with NRCS practice linkages
5. Create short and long term Soil Health Management Plan Integrate agronomic science of 2-4 with grower realities of 1 to create a specific short-term schedule of management practices for each management unit and an overall long-term strategy
6. Implement, monitor, and adapt Implement and document management practices. Monitor progress, repeat testing, and evaluate outcomes. Adapt plan based on experience and data over time.

SH Management Planning Process

1. Determine farm background and management history
2. Set goals and sample for soil health
3. For each management unit: identify and explain constraints, prioritize
4. Identify feasible management options
5. Create short and long term Soil Health Management Plan
6. Implement, monitor, and adapt

NRCS Natural Resources Conservation Service

Interpreting Soil Health Assessments in NH
NH-590 Quick Reference

Test Results	Suggested Management Practices		NH NRCS Practice
	Short Term	Long Term	(code)
Physical Concerns			
Low Aggregate stability	• Incorporate fresh organic materials • Use shallow-rooted cover/rotation crops • Add manure, green manure, mulch	• Reduce tillage • Use a surface mulch • Rotate with sod crops	(328) Conservation Crop Rotation; (340) COVER CROP; (329) Residue Mgmt No-Till/Strip-Till; (484) Mulching; (512) Forage & Biomass Planting; (528) Prescribed Grazing
Low Available Water Capacity	• Add stable organic materials, mulch • Add compost or biochar • Incorporate high biomass cover crop	• Reduce tillage • Rotate with sod crops • Incorporate high biomass cover crop	(328) Conservation Crop Rotation; (329) Residue Mgmt No-Till/Strip-Till; (317) Compost Facility; (340) COVER CROP; (512) Forage & Biomass Planting; (528) Presc. Grazing
High Surface Hardness	• Perform some mechanical soil loosening (strip till, aerators, broadfork, spader) • Use shallow-rooted cover crops • Use a living mulch or interseed cover crop	• Shallow-rooted cover/rotation crops • Avoid traffic on wet soils, monitor • Avoid excessive traffic/tillage/loads • Use controlled traffic patterns/lanes	(328) Conservation Crop Rotation; (345) Residue Mgmt, Mulch Till; (340) COVER CROP; (484) Mulching; (528) Prescribed Grazing (512) Forage & Biomass Planting
High Subsurface Hardness	• Use targeted deep tillage (subsoiler, yeomans plow, chisel plow, spader.) • Plant deep rooted cover crops/radish	• Avoid plows/disks that create pans • Avoid heavy loads • Reduce traffic when subsoil is wet	(324) Deep Tillage; (329) Residue Mgmt, No-Till/Strip-Till; (345) Residue Mgmt, Mulch Till (340) COVER CROP ; (606) Subsurface Drain
Biological Concerns			
Low Organic Matter	• Add stable organic materials, mulch • Add compost and biochar • Incorporate high biomass cover crop	• Reduce tillage/mechanical cultivation • Rotate with sod crop • Incorporate high biomass cover crop	(328) Conservation Crop Rotation; (340) COVER CROP; (329) Residue Mgmt No-Till/Strip-Till; (317) Compost Facility; (528) Prescribed Grazing (512) Forage & Biomass Planting;
Low Active Carbon	• Add fresh organic materials • Use shallow-rooted cover/rotation crops • Add manure, green manure, mulch	• Reduce tillage/mechanical cultivation • Rotate with sod crop • Cover crop whenever possible	(328) Conservation Crop Rotation; (329) Residue Mgmt, No-Till; (340) COVER CROP; (345) Residue Mgmt, Mulch Till; (528) Presc.Grazing (512) Forage & Biomass Planting
Low Mineralizable Nitrogen	• Add N-rich organic matter (low C:N source like manure or well-finished compost) • Incorporate legume or young, green cover crop (inoculate legume seed) • Adjust pH to 6.2-6.5 (helps molybdenum)	• Reduce tillage • Rotate with forage legume sod crop • Cover crop and add fresh manure • Keep pH at 6.2-6.5 (helps molybdenum) • Monitor C:N ratio of inputs	(328) Conservation Crop Rotation; (329) Residue Mgmt No-Till/Strip-Till; (317) Compost Facility; (340) COVER CROP; (512) Forage & Biomass Planting; (528) Prescribed Grazing ; (590) Nutrient Mgmt
High Root Rot Rating	• Use disease-suppressive cover crops • Biofumigate • Plant on ridges/raised beds • Monitor irrigation	• Use disease-suppressive cover crops • Increase diversity of crop rotation • Sterilize seed and equipment • Improve drainage/monitor irrigation	(328) Conservation Crop Rotation; (346) Residue Mgmt, Ridge Till; (340) COVER CROP; (449) Irrigation Water Mgmt; (595) Integrated Pest Mgmt; (606) Subsurface Drain

United States Department of Agriculture

Interpreting Soil Health Assessments in NH
NH-590 Quick Reference

Test Results	Suggested Management Practices: Short Term	Suggested Management Practices: Long Term	Test Results (code)
Chemical Concerns			
Low pH	• Add lime or wood ash per soil test recs • Add calcium sulfate (gypsum) in addition to lime if aluminum is high • Use less ammonium or urea	• Test soil annually & add "maintenance" lime per soil test recs to keep pH in range • Raise organic matter to improve buffering capacity	(340) Cover Crop; (512) Forage & Biomass Planting; (590) Nutrient Mgmt
High pH	• Stop adding lime or wood ash • Add elemental sulfur per soil test recs	• Test soil annually • Use higher % ammonium or urea	(590) Nutrient Mgmt
Low Phosphorus	• Add P amendments per soil test recs • Use cover crops to recycle fixed P • Adjust pH to 6.2-6.5 to free up fixed P	• Promote mycorrhizal populations • Maintain a pH of 6.2-6.5 • Use cover crops to recycle fixed P	(340) Cover Crop; (590) Nutrient Mgmt
High Phosphorus	• Stop adding manure and compost • Choose low or no-P fertilizer blend • Apply only 20 lbs/ac starter P if needed • Apply P at or below crop removal rates	• Use cover crops that accumulate P and export to low P fields or offsite • Consider low P rations for livestock • Consider phytase for non-ruminants	(340) Cover Crop; (393) Filter Strip; (484) Mulching; (590) Nutrient Mgmt; (633) Waste Recycling
Low Potassium	• Add wood ash, fertilizer, manure, or compost per soil test recs • Use cover crops to recycle K • Choose a high K fertilizer blend	• Use cover crops to recycle K • Add "maintenance" K per soil recs each year to keep K consistently available	(340) Cover Crop; (590) Nutrient Mgmt
High Potassium	• Stop adding high K fertilizer or manure • Grow high K removing crops	• Use cover crops to accumulate K and export to low K fields or offsite	(340) Cover Crop; (590) Nutrient Mgmt
Low Micronutrients	• Add chelated micros per soil test recs • Use cover crops to recycle micronutrients • Do not exceed pH 6.5 for most crops	• Promote mycorrhizal populations • Improve organic matter • Decrease soil P (binds micros)	(340) Cover Crop; (590) Nutrient Mgmt; (633) Waste Recycling
High Micronutrients	• Raise pH to 6.2-6.5 (for all high micros except Molybdenum) • Do not use fertilizers with micronutrients	• Maintain a pH of 6.2-6.5 • Monitor irrigation/improve drainage • Improve soil calcium levels	(449) Irrigation Water Mgmt; (512) Forage & Biomass Planting; (590) Nutrient Mgmt; (606) Subsurface Drain
High Salinity[1]	• Leach soils • Use fertilizers with a low salt index (avoid chlorine and ammonium/urea fertilizers) • Do not use Chilean nitrate	• Test compost for soluble salts • Use electroconductivity meter to monitor salts in the soil and irrigation water • Improve drainage	(449) Irrigation Water Mgmt; (512) Forage & Biomass Planting; (590) Nutrient Mgmt; (606) Subsurface Drain