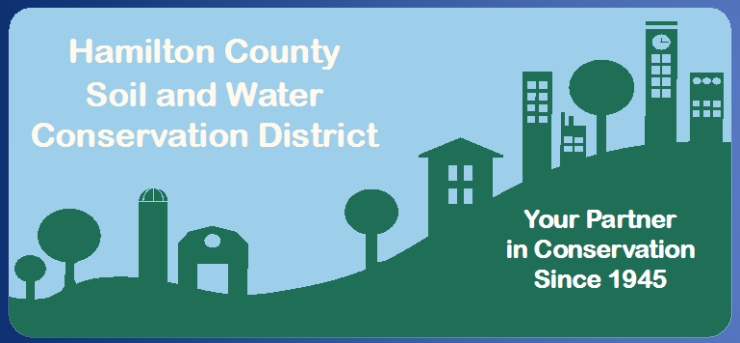
Understanding and Building Your Soil Health



Presented By:

- Holly Utrata-Halcomb, Administrator, Hamilton County Soil & Water Conservation District, Cincinnati, Ohio
- Ann Brandt, Business Mngr. Walnut Creek Seed LLC, Carroll, Ohio

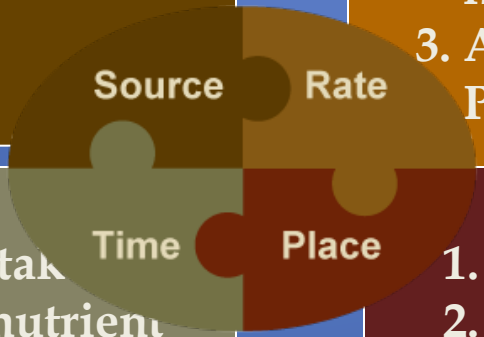
Responding to the Challenges

4R Nutrient Stewardship
- Right source
- Right rate
- Right time
- Right place

4R Management Systems & Education Based on Basic Universal Scientific Principles

1. Supply in plant available forms
2. Suit soil properties
3. Recognize synergisms among elements
4. Blend compatibility

1. Appropriately assess soil nutrient supply
2. Assess all available indigenous nutrient sources
3. Assess plant demand
   Predict fertilizer use efficiency



1. Assess timing of crop uptak
2. Assess dynamics of soil nutrient supply
3. Recognize timing of weather factors
4. Evaluate logistics of operations

1. Recognize root-soil dynamics
2. Manage spatial variability
3. Fit needs of tillage system
4. Limit potential off-field transport

Don’t Guess – Soil Test

Why Test Your Soil Fertility

- To understanding the chemical and physical qualities of the soil.
- To learn the soil's pH.
- Discloses information about the nutrient content of the soil.
- Reveals the Cation Exchange Capacity (CEC)
- Discover the "mineral components" of the soil – Soil Texture
- Can also provide information on the organic content of the soil.

Separate Test for Each Crop

	Soil Test Results: General Ideal Values								
	pH	Phosphorous (P) lbs./A*	Potassium (K) lbs./A*	Calcium (Ca) lbs./A*	Magnesium (Mg) lbs./A*	Cationic Exchange Capacits C.E.C. meq./100gms	Base Saturation		
							% Ca	%Mg	%K
General Ideal Levels	6.2 to 7.5	10 ppm to 90 ppm	60 ppm to 200 ppm	800 ppm Plus	150 ppm to 250 ppm	7 to 10 or higher	40% to 80%	10% to 40%	3% to 5%
	* To convert lb/A (pounds per Acre) to ppm (parts per million), divide by 2 Ex: 100lb/A = 50 ppm								

Specific crops*: Optimum levels for Turf -
- pH should be between 6.6 – 7.5
- Phosphorus should be between 10ppm – 20ppm
- Potassium should be between 60ppm – 125ppm

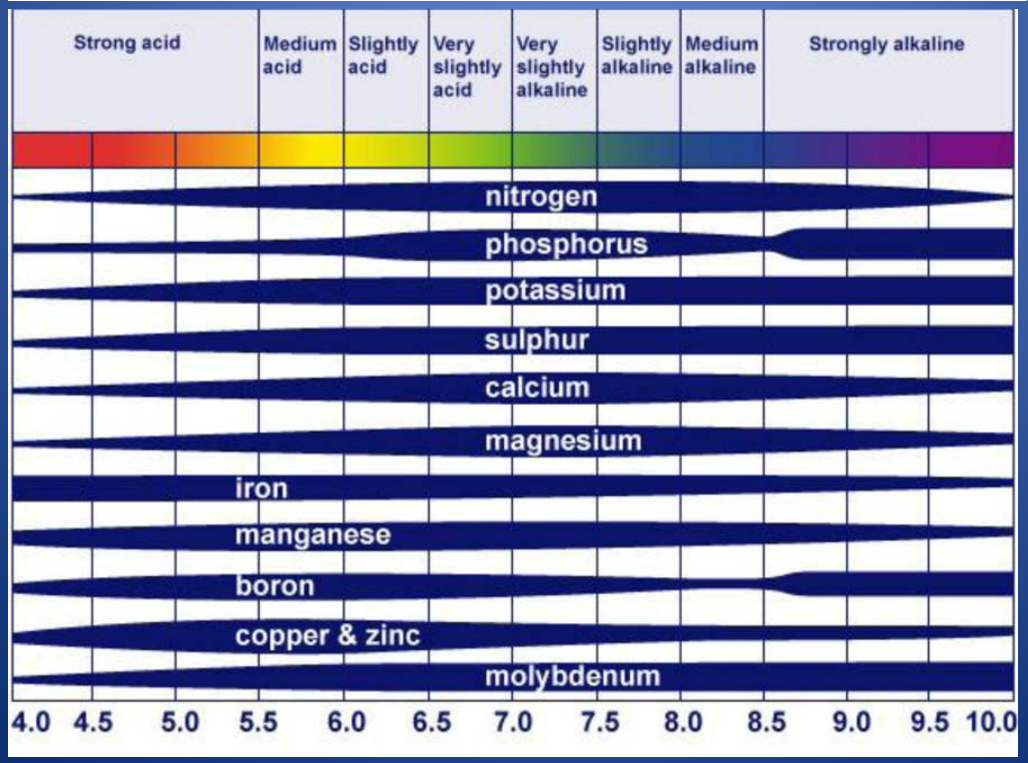
Optimum levels for Most Vegetables
- pH should be between 6.2 – 7.2
- Phosphorus should be between – 40 ppm – 70 ppm
- Potassium should be between – 90 ppm – 125 ppm

Optimum levels for Most Flowers
- pH should be between 6.2 – 7.5
- Phosphorous should be between 70 ppm – 90 ppm
- Potassium should be between 150 ppm – 200 pmm

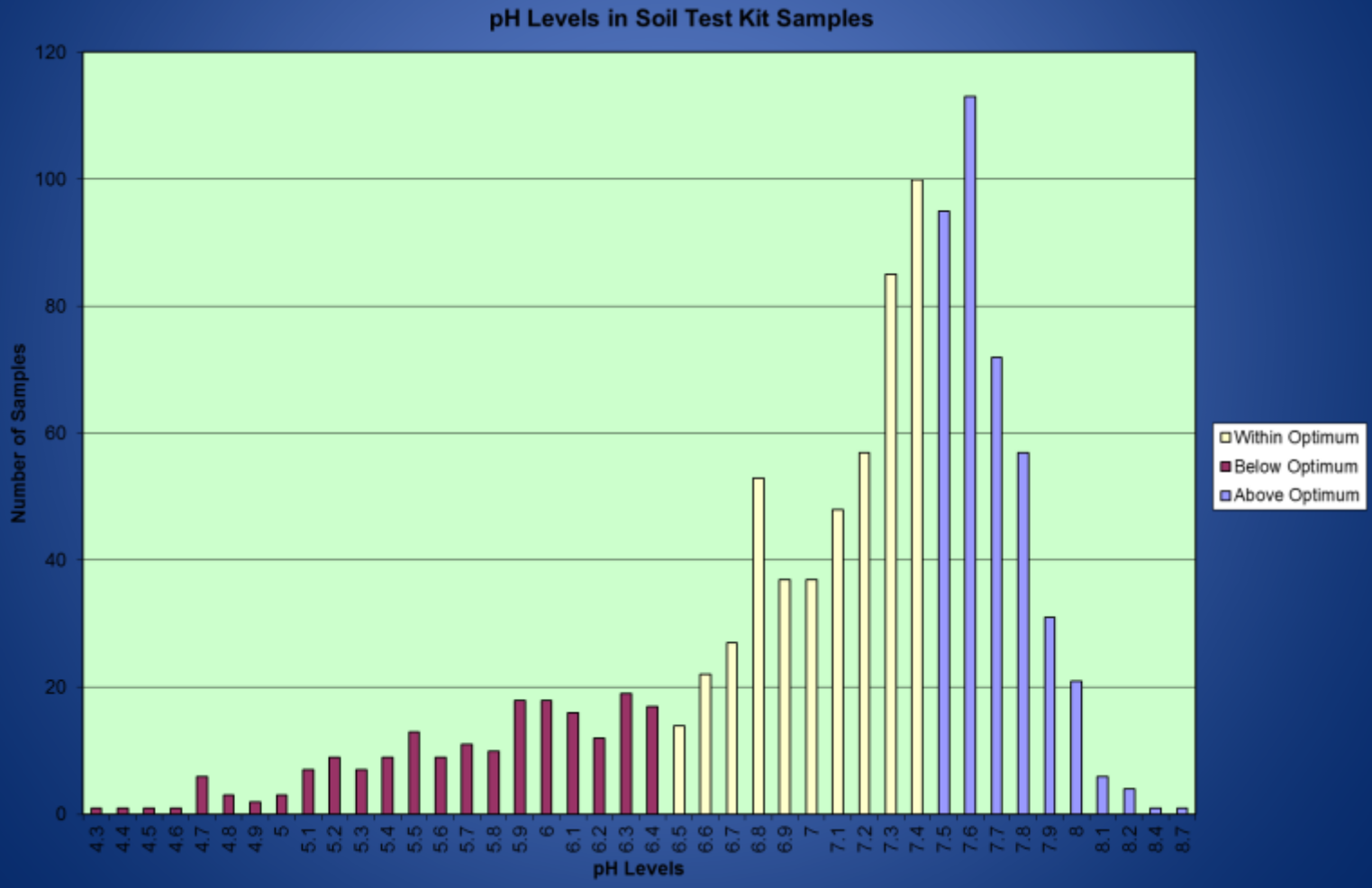
*Optimum levels determined by Michigan State University Soil Testing Lab.

The Soil's pH.

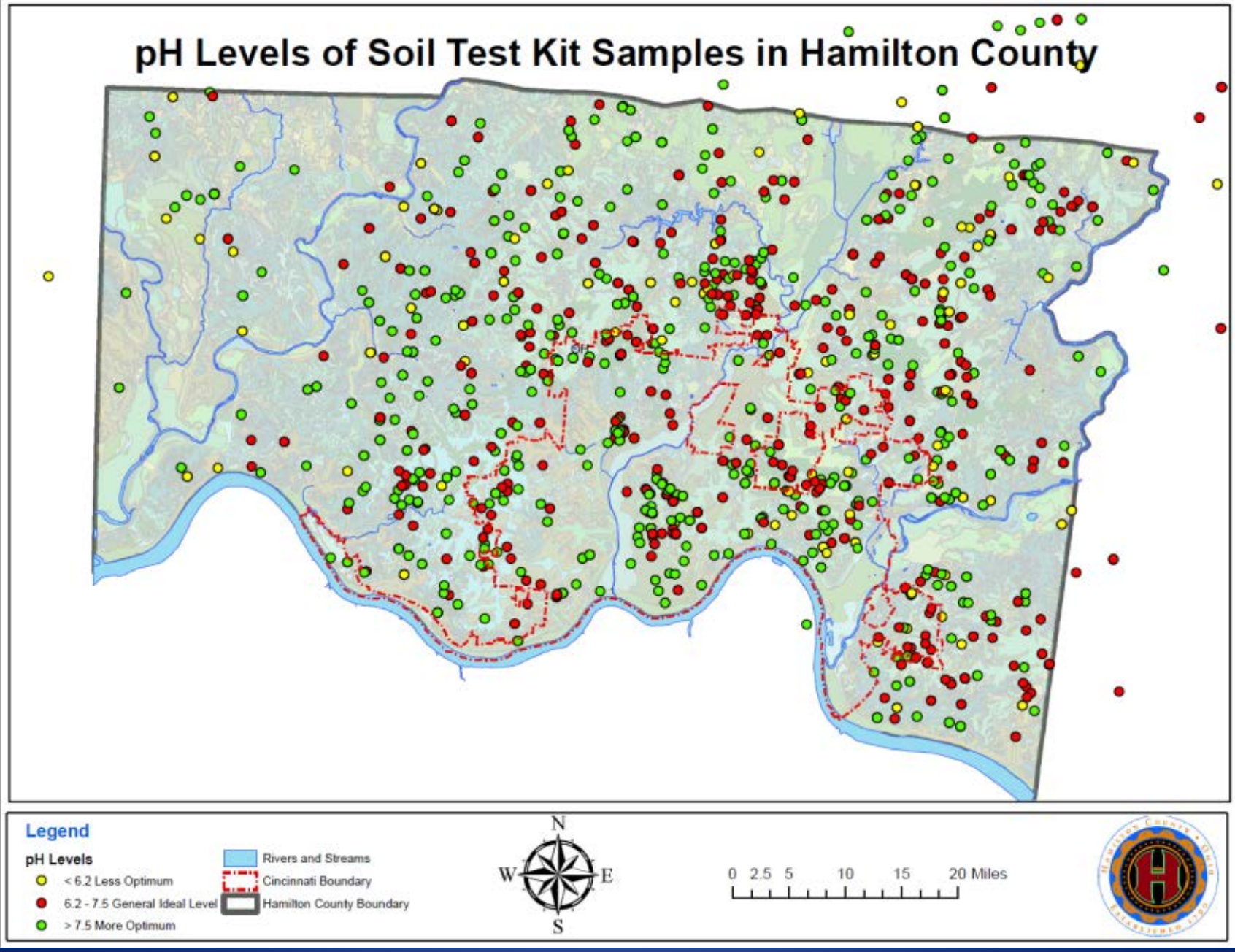
- Problems with soil pH are addressed by lime recommendations to raise the pH, or sulfur (or other soil acidifiers) recommendations to lower soil pH.



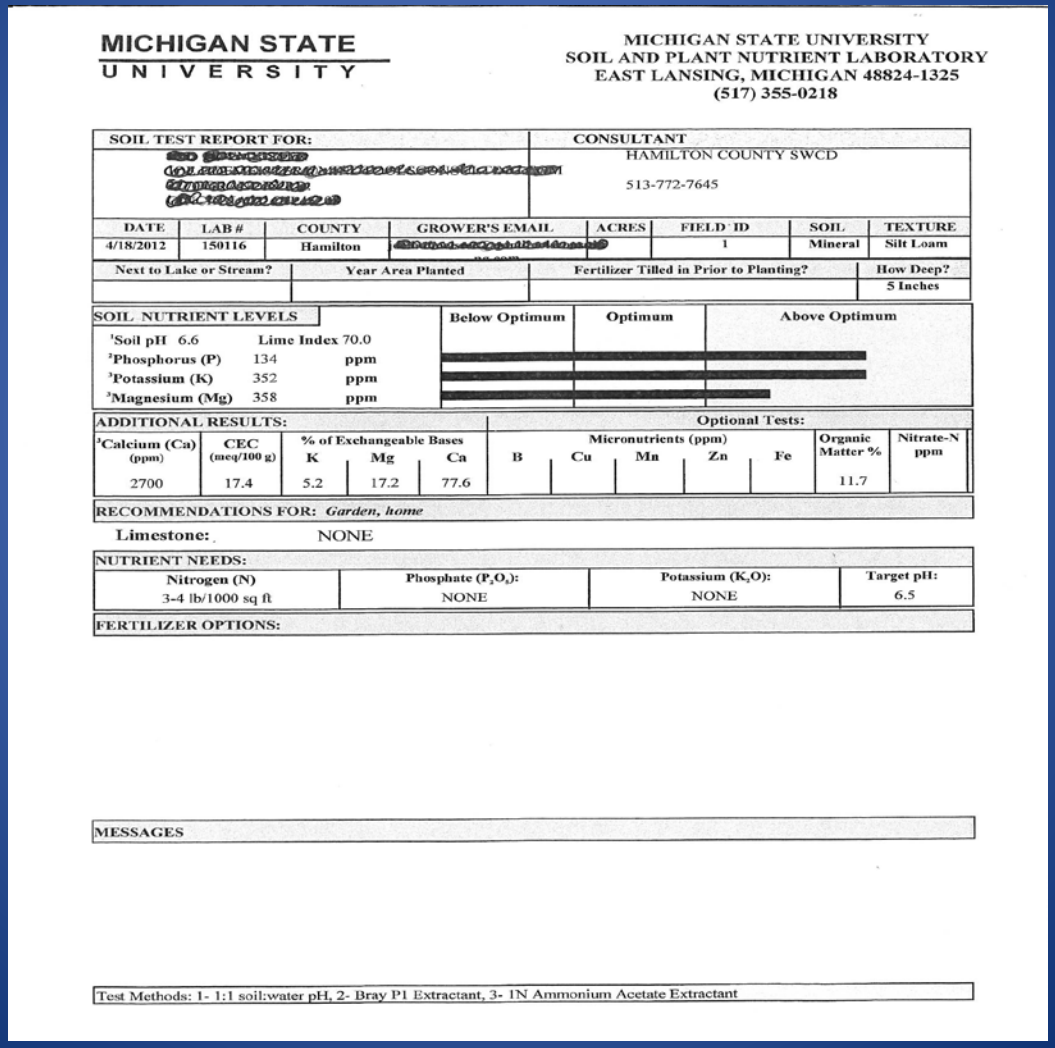
10 - Years of pH Data



pH Levels of Soil Test Kit Samples in Hamilton County



Information About the Nutrient Content of the Soil



MICHIGAN STATE UNIVERSITY

MICHIGAN STATE UNIVERSITY
SOIL AND PLANT NUTRIENT LABORATORY
EAST LANSING, MICHIGAN 48824-1325
(517) 355-0218

SOIL TEST REPORT FOR:	CONSULTANT
[redacted]	HAMILTON COUNTY SWCD 513-772-7645

DATE	LAB #	COUNTY	GROWER'S EMAIL	ACRES	FIELD ID	SOIL	TEXTURE
4/18/2012	150116	Hamilton	[redacted]		1	Mineral	Silt Loam

Next to Lake or Stream?	Year Area Planted	Fertilizer Tilled in Prior to Planting?	How Deep?
			5 Inches

SOIL NUTRIENT LEVELS			Below Optimum	Optimum	Above Optimum
[1]Soil pH	6.6	Lime Index 70.0			
[2]Phosphorus (P)	134	ppm			
[3]Potassium (K)	352	ppm			
[3]Magnesium (Mg)	358	ppm			

ADDITIONAL RESULTS:

[3]Calcium (Ca) (ppm)	CEC (meq/100 g)	% of Exchangeable Bases K	Mg	Ca
2700	17.4	5.2	17.2	77.6

Optional Tests:

Micronutrients (ppm) B	Cu	Mn	Zn	Fe	Organic Matter %	Nitrate-N ppm
					11.7	

RECOMMENDATIONS FOR: *Garden, home*

Limestone: NONE

NUTRIENT NEEDS:

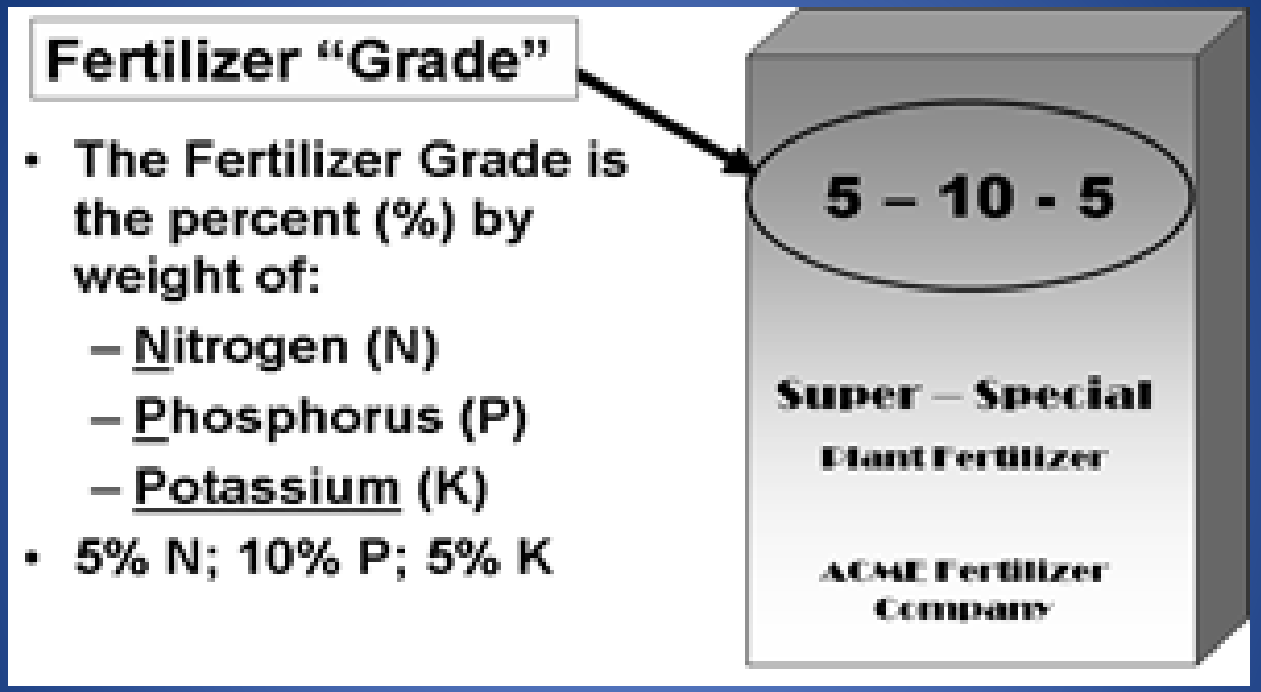
Nitrogen (N)	Phosphate (P_2O_5):	Potassium (K_2O):	Target pH:
3-4 lb/1000 sq ft	NONE	NONE	6.5

FERTILIZER OPTIONS:

MESSAGES

Test Methods: 1- 1:1 soil:water pH, 2- Bray P1 Extractant, 3- 1N Ammonium Acetate Extractant

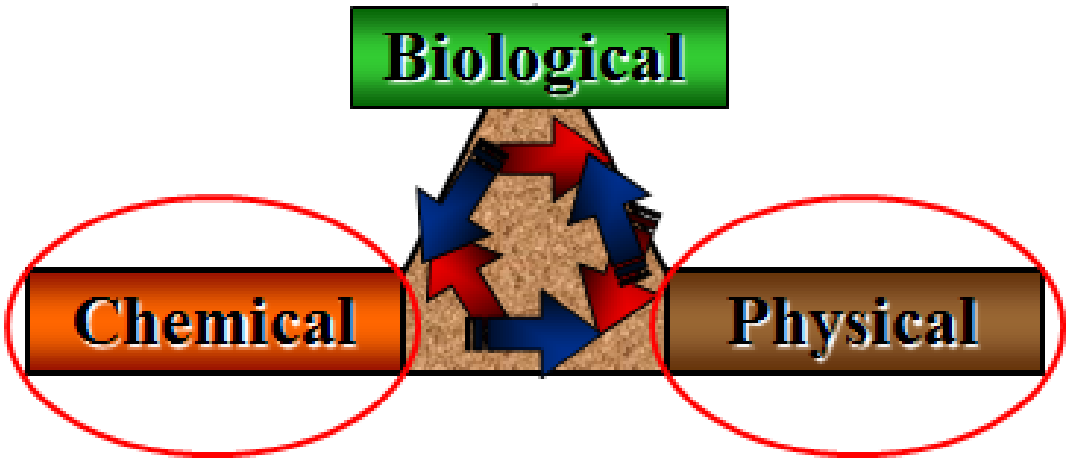
Education Opportunity on Application



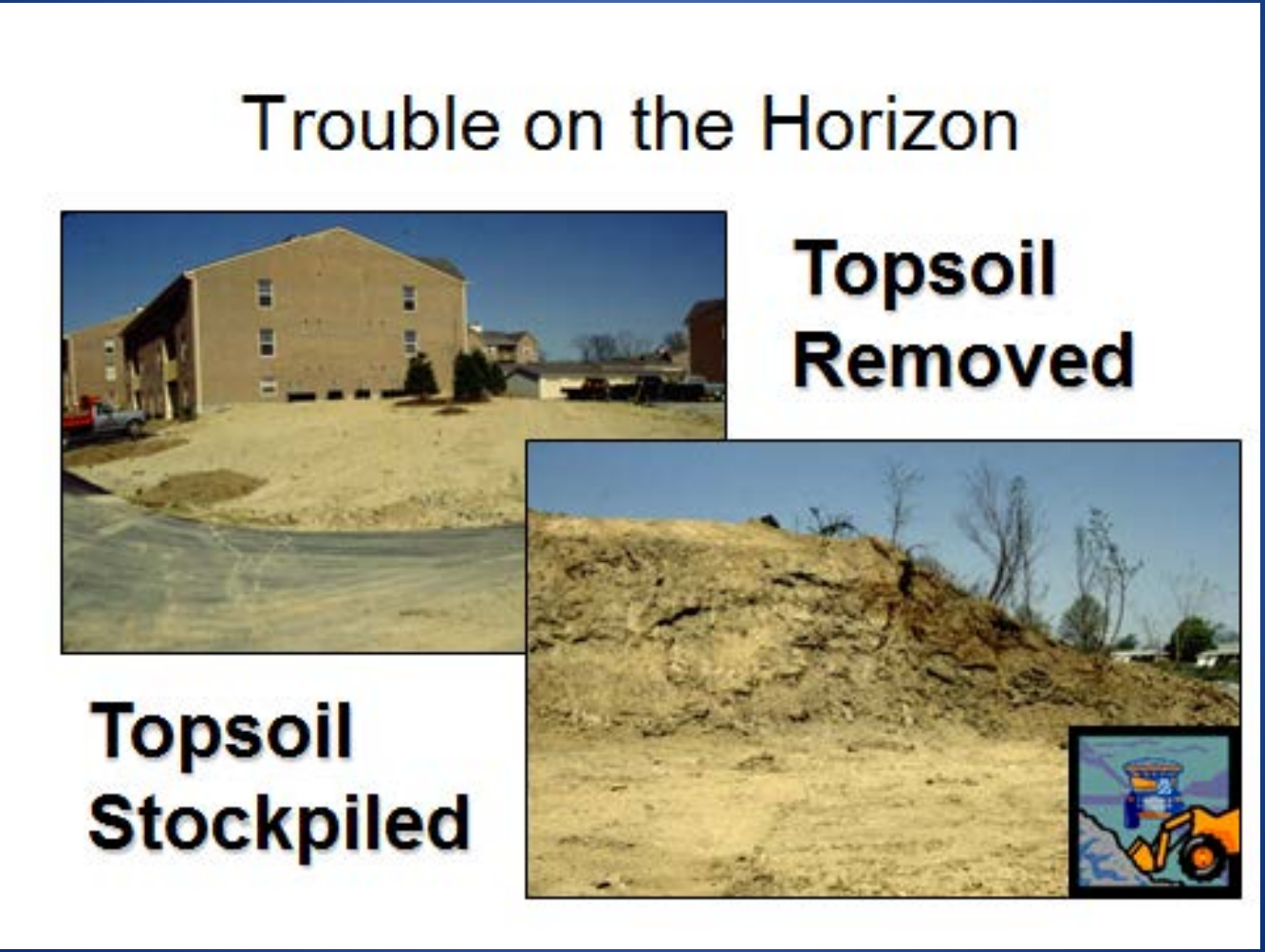
NOTE: The maximum single nitrogen application for lawn and garden should not exceed 1 lb/1000 sq. ft.

Dig Deeper

Soil Properties:
They Are Not Independent!



Compaction and "Upside Down" Soil Profiles



Not All Compost is the Same

HCSWCD - 2010 COMPOST DATA

LOCATIONS

CHEMICALS

	John Duke Yard	B Alan	IMAGO	Corooran	Findlay Market	Walnut Center	SWCD
Calcium ppm	788	409	825	300	1125	713	1255
Chloride ppm	42	155	285	41	1400	580	800
Conductivity	5.4	1.87	4.21	1	4.46	4	6.09
Magnesium ppm	195	100	145	46	23	46	23
MMHO	0	0	0	0	0	0	0
Nitrate ppm	327	54	191	24	5	1	171
PH	8.6	7.6	7.1	8.1	7.7	8.4	8
Phosphorus ppm	108.7	2.3	11.6	8.7	127.8	131.9	71.1
Potassium ppm	884	56	614	99	2184	1360	1938
Sodium ppm	32	56	108	15	441	84	287
	Waste, Veggie Scraps	Leaves	Yard Waste	Oak leaves, Veggie Scraps, Wood Ash	Food Scraps	Horse Manure	Worm Castings

ORGANIC MATTER

Where are Cover Crops used?

- Commodity Farming
- Vegetable Production
- Gardening
- Orchards
- Riparian and Land Use Stabilization
- Pastures/Forage cover
- Brown Infrastructure Rehabilitation-Phytoremediation

Cover Crop Benefits

- ☑ Reduce Weed Pressure
- ☑ Reduce erosion and nutrient leaching
- ☑ Reduce soil compaction
- ☑ Add soil organic matter (SOM)
- ☑ Increase water infiltration/water holding capacity
- ☑ Moderate soil temperature
- ☑ Add nitrogen either by fixation or scavenging
- ☑ Feed soil organisms (builders of soil structure)

What makes a good Cover Crop?

- Quick to establish, out-compete weeds
- Rapid, significant root development
- Long or rapid vegetative growth (biomass)
- Ability to accumulate or produce nutrients (N)
- Ease of termination(except for permanent covers)
- Low maintenance, tolerant
- Inexpensive and available

General Types of Cover Crops

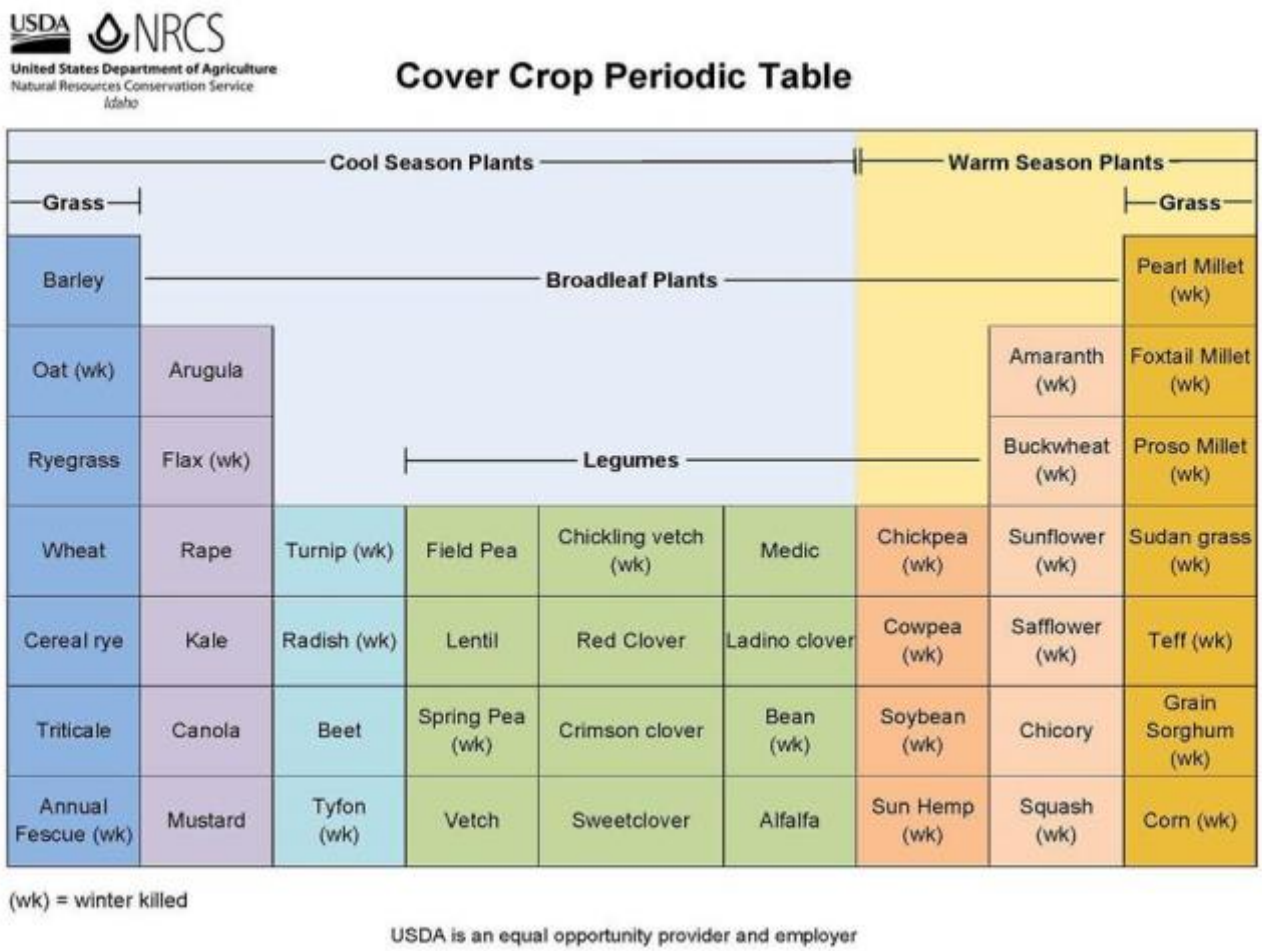
Grasses/Grains

Legumes

Brassicas

Broadleaf

Cool Chart


USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service
Idaho
Cover Crop Periodic Table
Cool Season Plants
Warm Season Plants
Grass
Grass
Broadleaf Plants
Legumes
Barley
Pearl Millet (wk)
Oat (wk)
Arugula
Amaranth (wk)
Foxtail Millet (wk)
Ryegrass
Flax (wk)
Buckwheat (wk)
Proso Millet (wk)
Wheat
Rape
Turnip (wk)
Field Pea
Chickling vetch (wk)
Medic
Chickpea (wk)
Sunflower (wk)
Sudan grass (wk)
Cereal rye
Kale
Radish (wk)
Lentil
Red Clover
Ladino clover
Cowpea (wk)
Safflower (wk)
Teff (wk)
Triticale
Canola
Beet
Spring Pea (wk)
Crimson clover
Bean (wk)
Soybean (wk)
Chicory
Grain Sorghum (wk)
Annual Fescue (wk)
Mustard
Tyfon (wk)
Vetch
Sweetclover
Alfalfa
Sun Hemp (wk)
Squash (wk)
Corn (wk)
(wk) = winter killed
USDA is an equal opportunity provider and employer

Grasses & Grains
Barley, Oats, Ryegrass, Cereal Rye

- Generally Used to:
  - Scavenge nutrients, especially N, from previous crop, long term release for crop
  - Reduce or prevent erosion
  - High residue producers (C:N)
  - Add organic matter to the soil (SOM)
  - Suppress weeds (allelopathy in cereal rye)


09.05.2012


07.11.2012

Brassicas

Oilseed Radish, Turnips, Ethiopian Cabbage

- Generally Used to:
  - Scavenging nutrients, especially N (140-170lb/acre from deep soil profile), release early with decomp
  - Reduce or prevent erosion
  - Alleviate soil compaction (tap root)
  - Nematode suppression
  - Suppress weeds <allelopathy in dispute>


RAPTOR

Legumes
Peas, Vetch, Clovers, Alfalfa, Sunnhemp

- Generally Used to:
  - Fix Atmospheric Nitrogen
  - Reduce or prevent erosion
  - Add active organic matter to the soil (SOM)
  - Suppress weeds

Nitrogen Fixation

Inoculation:
Rhizobia soil bacteria form a symbiotic relationship with plant .

The bacteria invade the plant root and form nodules to convert atmospheric nitrogen into plant-accessible forms of nitrogen.

Treated legumes can provide 45-160 lbN/A/yr to subsequent crops.

Each plant requires a specific bacterium
-Peas, vetch, lentils need *Rhizobium leguminosarum biovar viceae*
-Clovers need *Rhizobium leguminosarum biovar trifolii*

Broadleaf
Sunflowers, Flax, Phacelia, Buckwheat

- Mixed bag of uses, plant specific:
  - Some scavenge nutrients
  - All reduce or prevent erosion
  - Some high residue producers (C:N)
  - All add organic matter to the soil (SOM)
  - Most suppress weeds
  - Sunflowers have deep tap root for compaction

How to Choose Covers

- Soil condition? soil test?
- Land use?
- What crop is it following?
- What crop will be coming?
- What are you trying to add, correct or do?
- When will you be planting?
- How long does it have to grow?
- How will you terminate?

High Achievers

- Nitrogen Fixation – Vetch
- Nitrogen Scavenging – Cereal Rye, Radish
- Loosen Topsoil – Cereal Rye, Ryegrass
- Subsoilers – Sorghum-sudan, Radish
- Scavenge/Free P & K, Ca - Buckwheat
- Light Heavy Metal Contamination*
  - Mercury: Brassica napus (rapeseed)
  - Lead: Alfalfa, Sunflowers w/ chelation
  - Arsenic, Zinc, Uranium, Copper: Sunflowers

*Always seek professional guidance on testing, remediation

How to Choose Monoculture vs. Diverse Mix

>Either can be used for weed suppression, increased water holding capacity, erosion prevention

Hairy Vetch-legume

AWP/Radish-2 way mix

7-way Mix

How to Choose Monoculture vs. Diverse Mix

>Monocultures are usually used to achieve very specific results, poor comparative soil improvement

severe compaction – oilseed radish

add N for upcoming corn crop – peas, vetch

>Complex Mixes provide diversity, resilience, and superior soil health improvement

Fall Cover Crop Planting
(Community Garden – Cincinnati, Ohio)

Hamilton Co. SWCD donated 93 lbs of Winter Cover Crop Seed to Community Gardens in 2013. They are tracking impacts on soil fertility for the next three years.

Use of Clover in a Raised Bed

And Field

Spring Management

Cover & Color Mix

Fall Growth

Early Spring

Spring Growth

Fall Growth

Fall Cover Mix

Spring Mulch

Know Your Plants

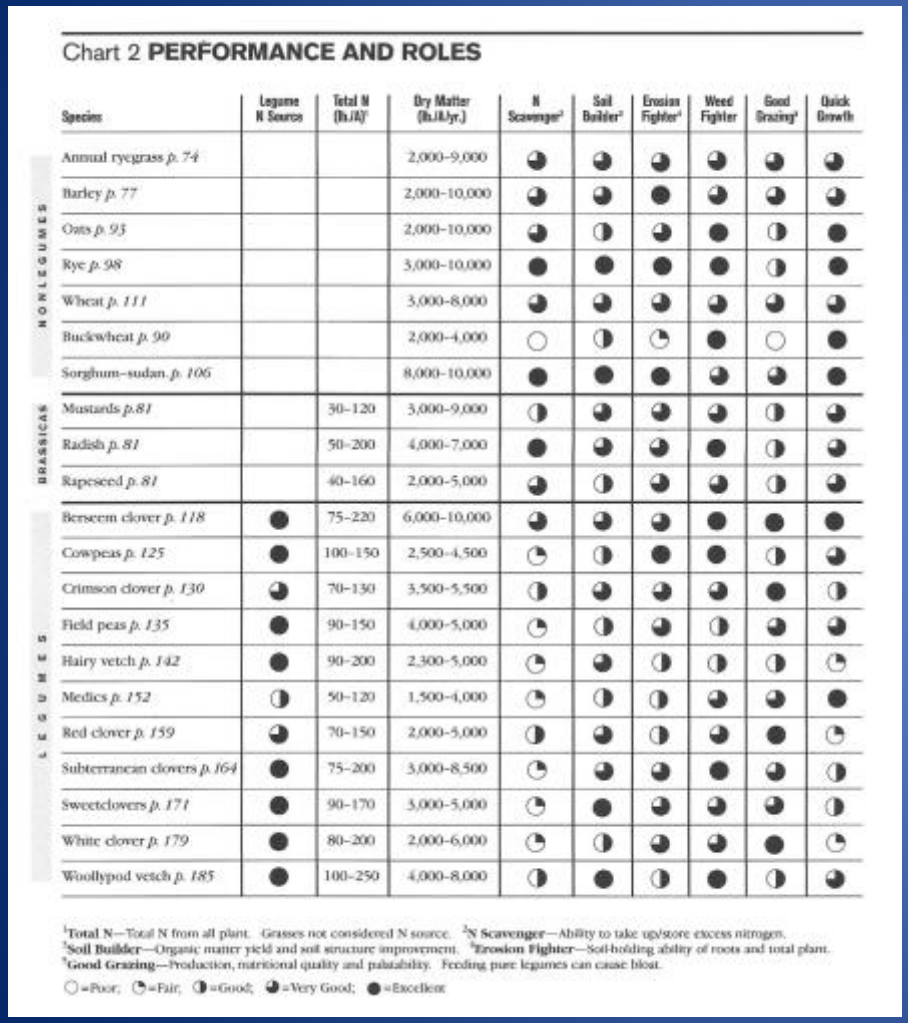


Chart 2 **PERFORMANCE AND ROLES**

	Species	Legume N Source	Total N (lb./A)[1]	Dry Matter (lb./A/yr.)	N Scavenger[2]	Soil Builder[3]	Erosion Fighter[4]	Weed Fighter	Good Grazing[5]	Quick Growth
NONLEGUMES	Annual ryegrass *p. 74*			2,000–9,000	◕	◕	◕	◕	◕	◕
	Barley *p. 77*			2,000–10,000	◕	◕	●	◕	◕	◕
	Oats *p. 93*			2,000–10,000	◕	◑	◕	●	◑	●
	Rye *p. 98*			3,000–10,000	●	●	●	●	◑	●
	Wheat *p. 111*			3,000–8,000	◕	◕	◕	◕	◕	◕
	Buckwheat *p. 90*			2,000–4,000	○	◑	◔	●	○	●
	Sorghum–sudan *p. 106*			8,000–10,000	●	●	●	◕	◕	●
BRASSICAS	Mustards *p.81*		30–120	3,000–9,000	◑	◕	◕	◕	◑	◕
	Radish *p. 81*		50–200	4,000–7,000	●	◕	◕	●	◑	◕
	Rapeseed *p. 81*		40–160	2,000–5,000	◕	◑	◕	◕	◑	◕
LEGUMES	Berseem clover *p. 118*	●	75–220	6,000–10,000	◕	◕	◕	●	●	●
	Cowpeas *p. 125*	●	100–150	2,500–4,500	◔	◑	●	●	◑	◕
	Crimson clover *p. 130*	◕	70–130	3,500–5,500	◑	◕	◕	◕	●	◑
	Field peas *p. 135*	●	90–150	4,000–5,000	◔	◑	◕	◑	◕	◕
	Hairy vetch *p. 142*	●	90–200	2,300–5,000	◔	◕	◑	◑	◑	◔
	Medics *p. 152*	◑	50–120	1,500–4,000	◔	◑	◑	◕	◕	●
	Red clover *p. 159*	◕	70–150	2,000–5,000	◑	◕	◑	◕	●	◔
	Subterranean clovers *p. 164*	●	75–200	3,000–8,500	◔	◕	◕	●	◕	◑
	Sweetclovers *p. 171*	●	90–170	5,000–5,000	◔	●	◕	◕	◕	◑
	White clover *p. 179*	●	80–200	2,000–6,000	◔	◑	◕	◕	●	◔
	Woollypod vetch *p. 185*	●	100–250	4,000–8,000	◑	●	◑	●	◑	◕

[1]**Total N**—Total N from all plant. Grasses not considered N source. [2]**N Scavenger**—Ability to take up/store excess nitrogen.
[3]**Soil Builder**—Organic matter yield and soil structure improvement. [4]**Erosion Fighter**—Soil-holding ability of roots and total plant.
[5]**Good Grazing**—Production, nutritional quality and palatability. Feeding pure legumes can cause bloat.

○=Poor; ◔=Fair; ◑=Good; ◕=Very Good; ●=Excellent

Whether monoculture or mix, choose plants with the attributes you desire.

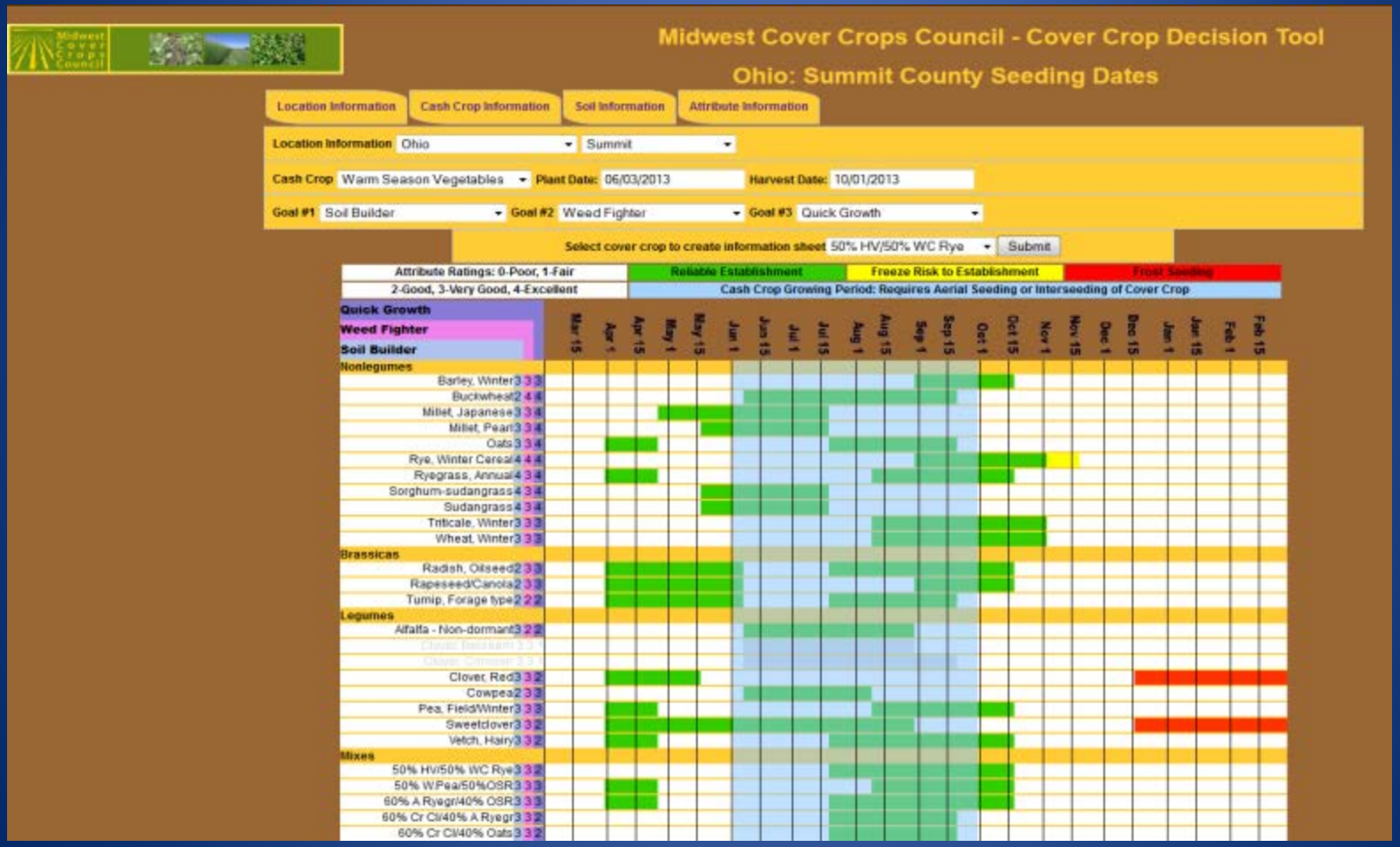
Research to know how each plant behaves in your region.

Remember, these are still plants and need quality soil in which to grow and perform. They are meant to improve and stabilize, not create.

Works best in long-term approach.

From "Managing Cover Crops Profitably" 3rd Edition, Published by SARE, 2007

Midwest Cover Crop Council Cover Crop Selector



http://www.mccc.msu.edu/selectorINTRO.html

Programs and Support

- SWCD Cover Crop Seed Program
  - 11 Offices in Ohio Participating
- Research/Testing/Experience
- Presentations/Education

To contact Ann Brandt: 330-475-6352 or ann.brandt@walnutcreekseed.com
or Holly Utrata-Halcomb: 513-772-7645 or holly.utrata-halcomb@hamilton-co.org