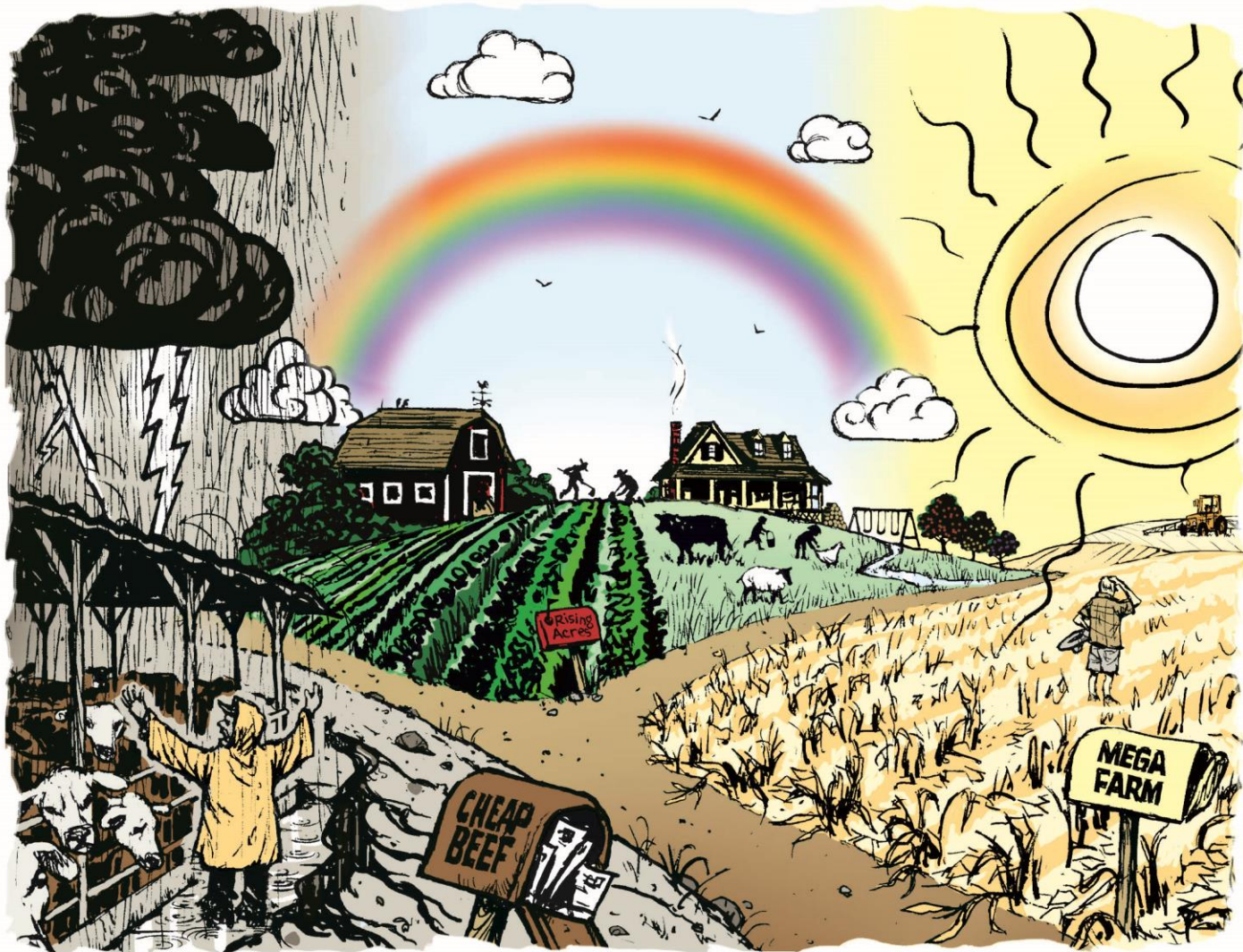


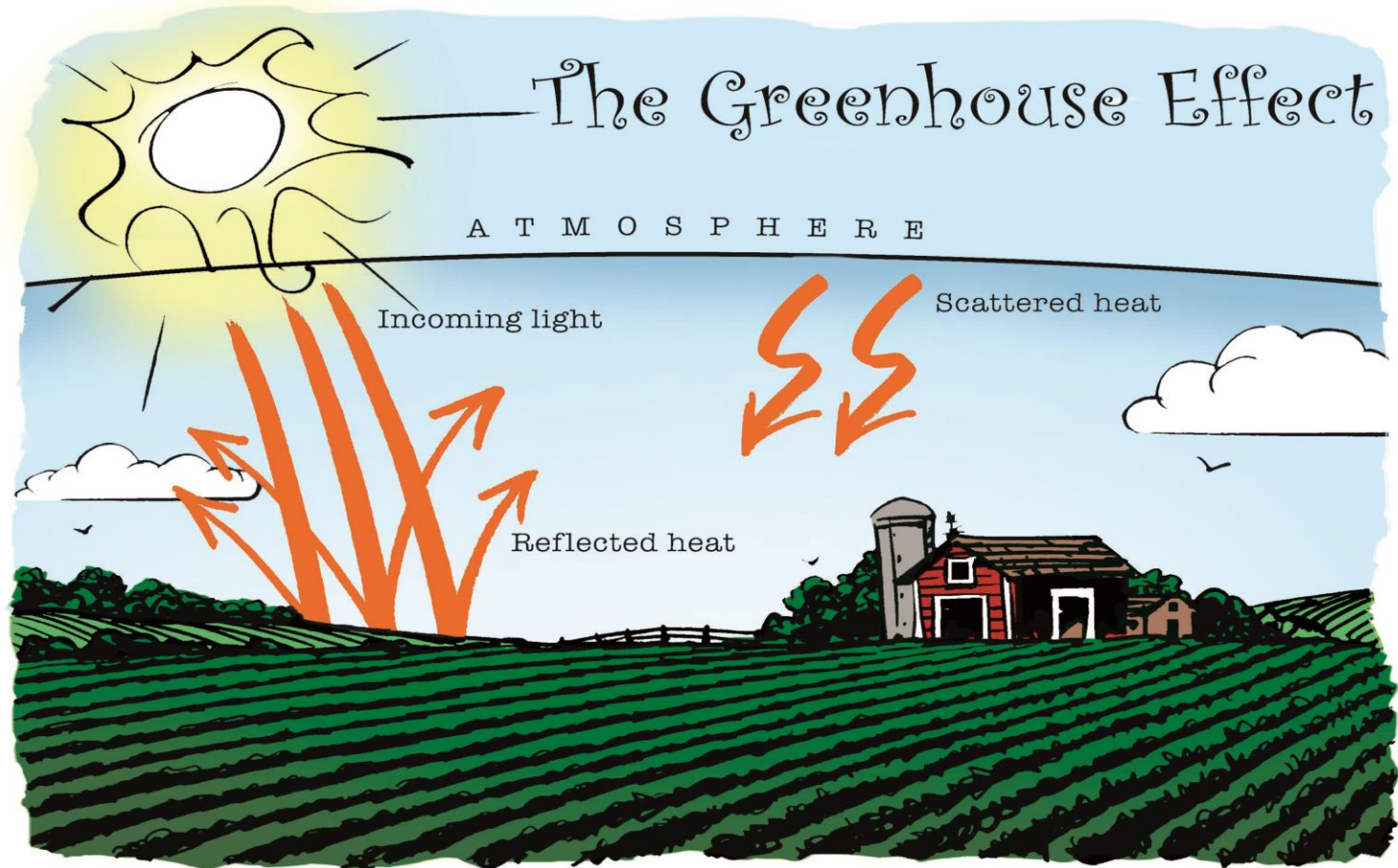
Farming for Long Term Land Preservation

Jack Kittredge
NOFA/Mass

We are noticing weather anomalies



Most scientists believe
these are the result of:



The Greenhouse Effect is solar energy being trapped by greenhouse gases (GHG) and overheating the atmosphere.

**Without some “greenhouse gases” trapping some heat,
(as we have had for centuries)
earth would freeze.**

But we have far too many of them now.

What caused this increase in greenhouse gases?

- 2/3 has been caused by combustion of fossil fuels like coal, oil, gas
- 1/3 has been caused by clearing land for agriculture

Even if we stop burning all fossil fuels now:

- Earth will continue to heat up for 100+ years
- Greenhouse Gases, already in the air, have long lifetimes
- Carbon dioxide will decay in 30 – 95 years
- Methane will decay in 12 years
- Nitrous oxide will decay in 112 years

Unless we get excess carbon out of the atmosphere:

- Arctic ice will melt, coastal areas will flood
- Permafrost will melt, releasing more methane and carbon dioxide, absorbing more heat and continuing the cycle

Where can we put excess carbon?

Only 2 places are big enough:

- Ocean

carbon will acidify the water, killing coral, other life

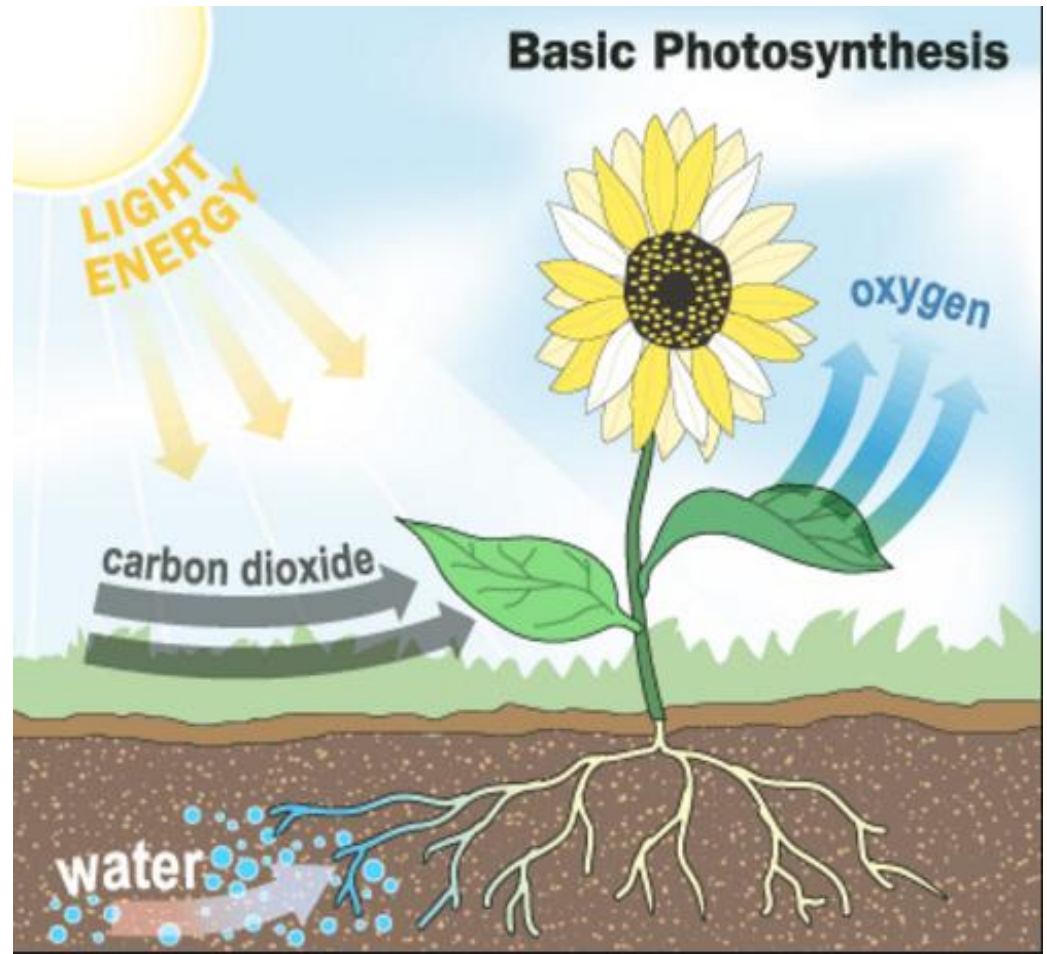
- Soil

carbon will increase tilth, water infiltration, biodiversity, plant growth

How can we get carbon into soil?

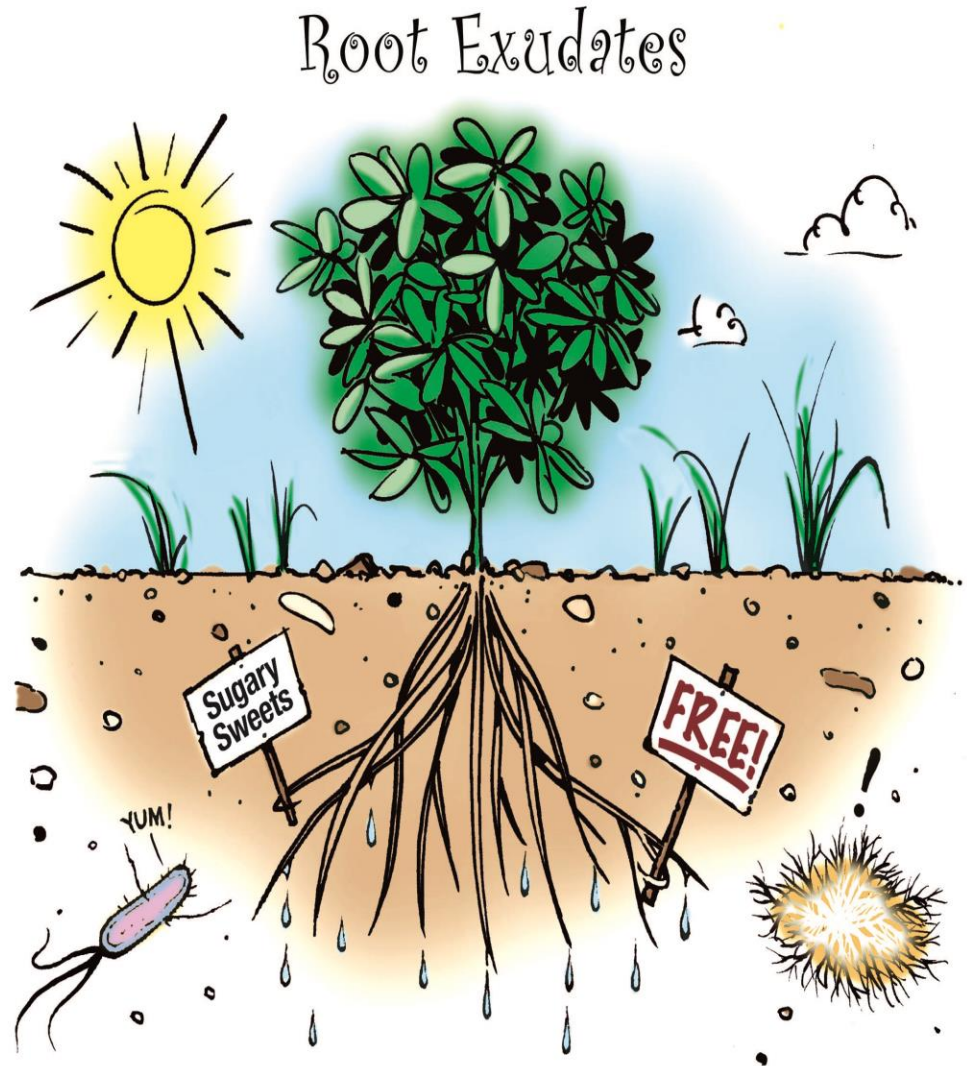
Remember
High School
Biology?

Plants use the sun to change water and carbon dioxide into carbohydrates and oxygen.



Here is what they didn't tell you!

Much of that carbon is exuded from the plant roots to feed microbes (fungi & bacteria.) They then help the plant grow stronger. It is called symbiosis



Farming, however, is our primary disruptor of soil biology



To build soil carbon we must change our farming methods

How does this affect Land Trusts?

- ¼ of the Commonwealth's land is protected open space
- Much protected land is farmed
- Land Trust supporters care about long term sustainability
- Sustainable farming means returning carbon to soil
- Vermont is already considering a state carbon farming certification
- In future progress in soil carbon building may be added to national organic standards

National Soil Conservation Service's 14 points of Soil Health

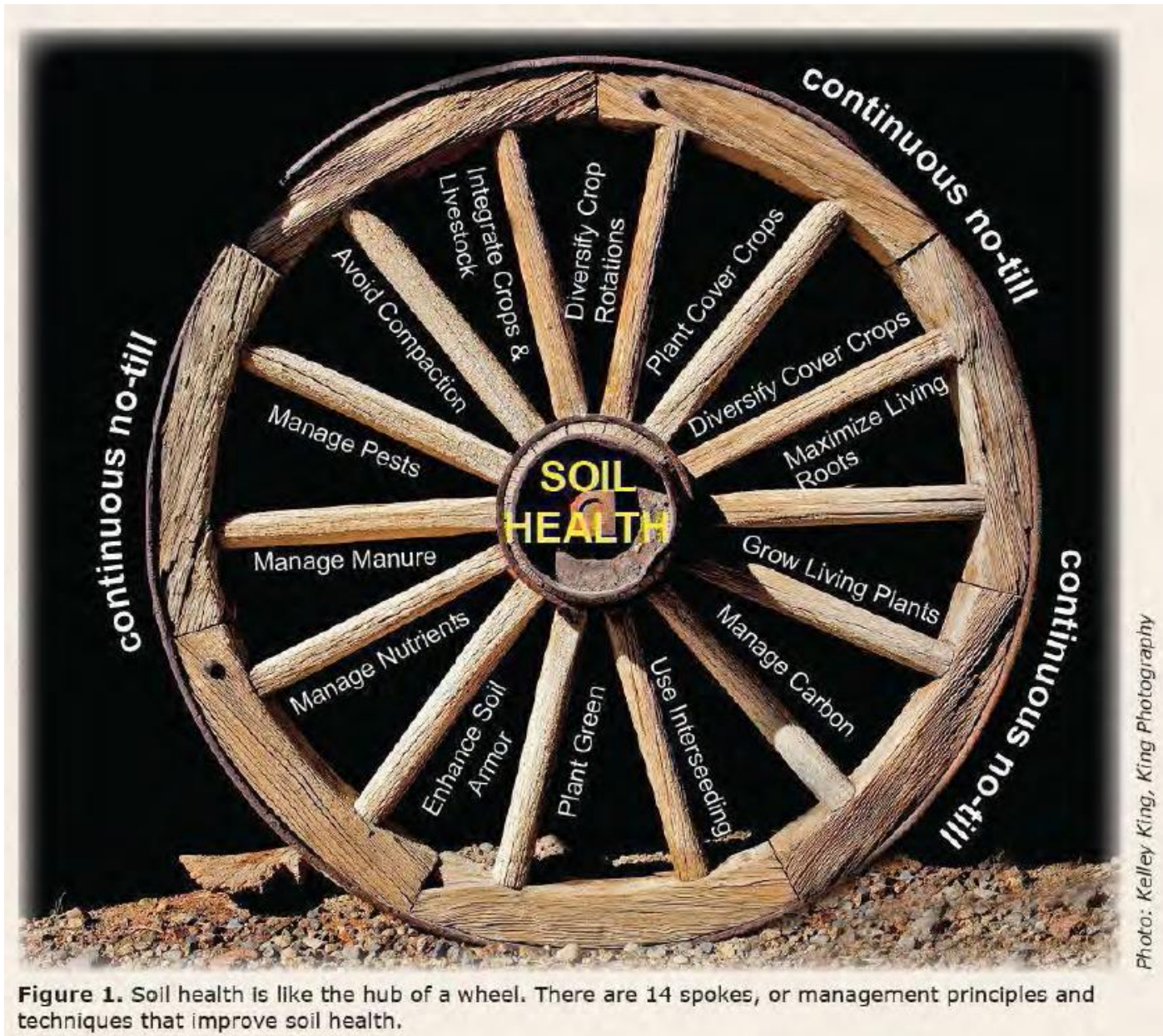
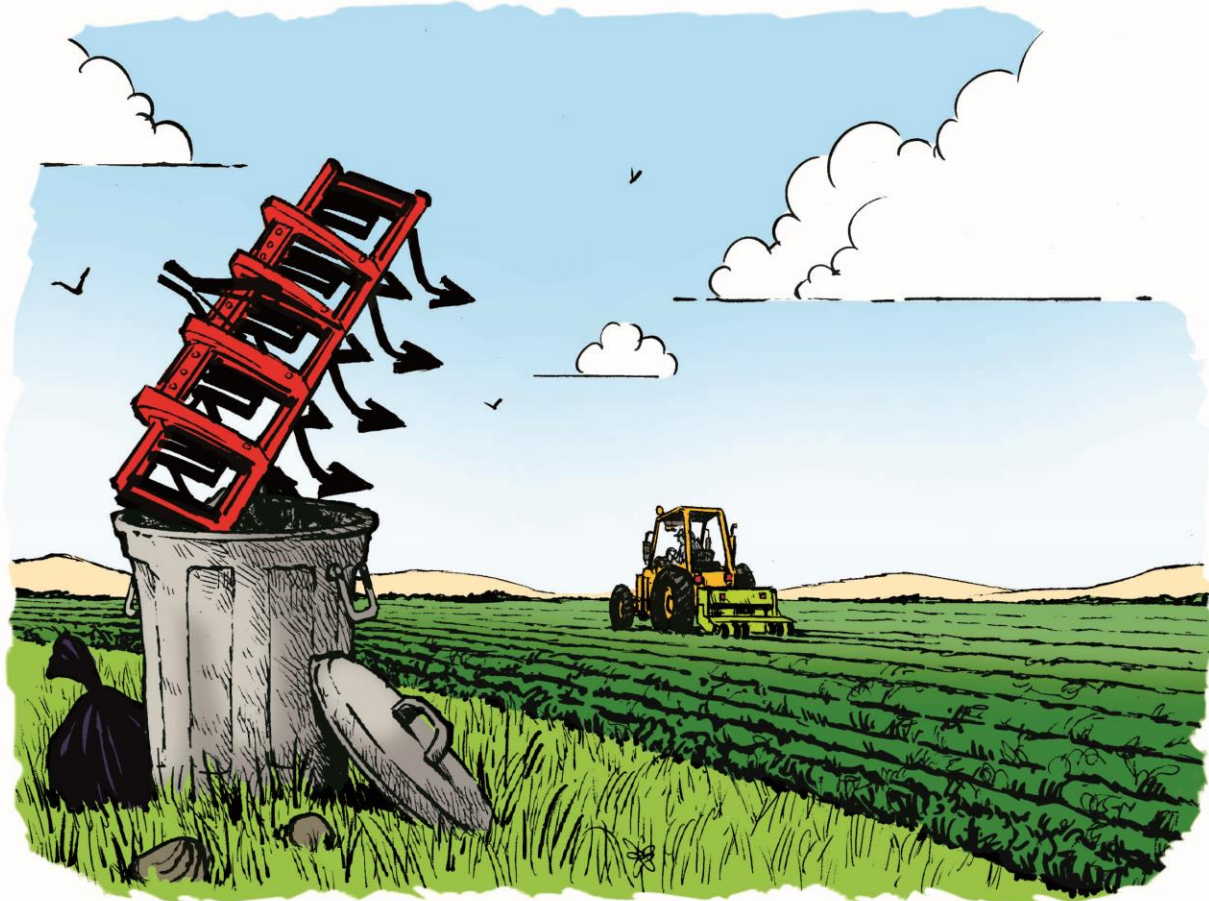


Figure 1. Soil health is like the hub of a wheel. There are 14 spokes, or management principles and techniques that improve soil health.

These boil down to 5 ways we can farm to build soil carbon

- Minimize tillage
- Keep bare ground covered
- Plant multiple cover crops
- Stop use of synthetic pesticides, herbicides, fertilizers
- Rotate crops and animals when possible

Minimize Tillage



Solarize



Minimize Tillage

Occultize



Minimize Tillage

Broadcast Seed - by hand



Minimize Tillage

or by tractor



Minimize Tillage

Keep Bare Ground Covered



Figure 21. Soil armor includes passive armor, which is the crop residue from the previous crop, and active armor, which is the living cover crop. Both provide food sources for soil biological organisms and 'weatherize' your cropping system.
(Courtesy of Sjoerd Duiker)

Extend season



Keep Bare Ground Covered

Use mulch when you can't
use green plants



Keep Bare Ground Covered

Plant into mulch

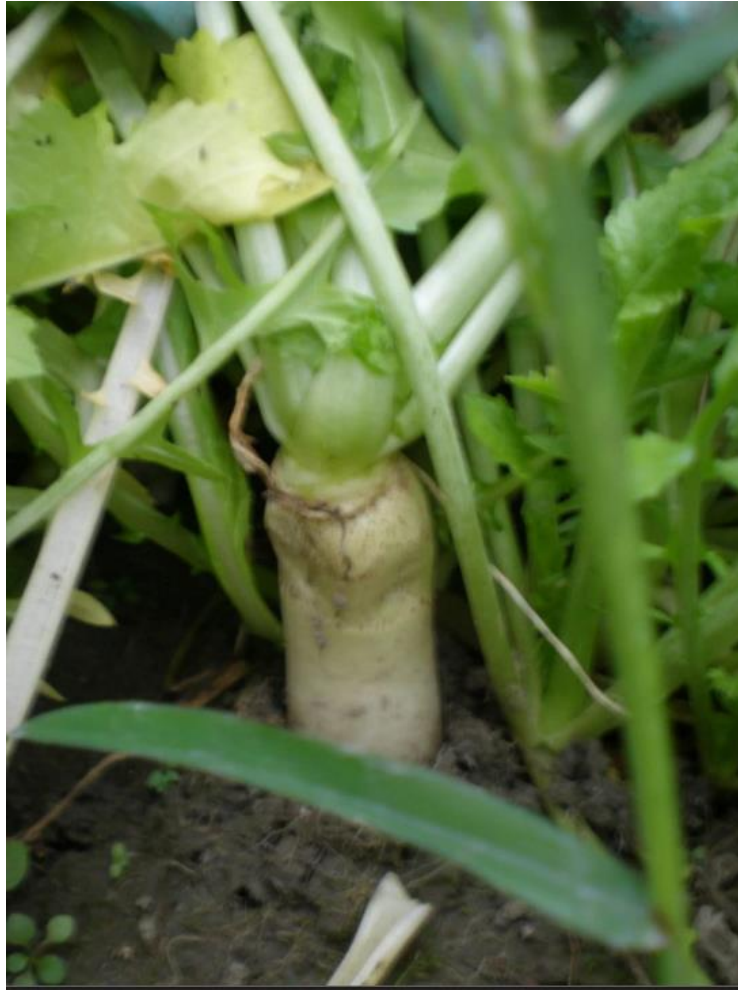


Keep Bare Ground Covered

Plant Multiple Cover Crops (cocktail)

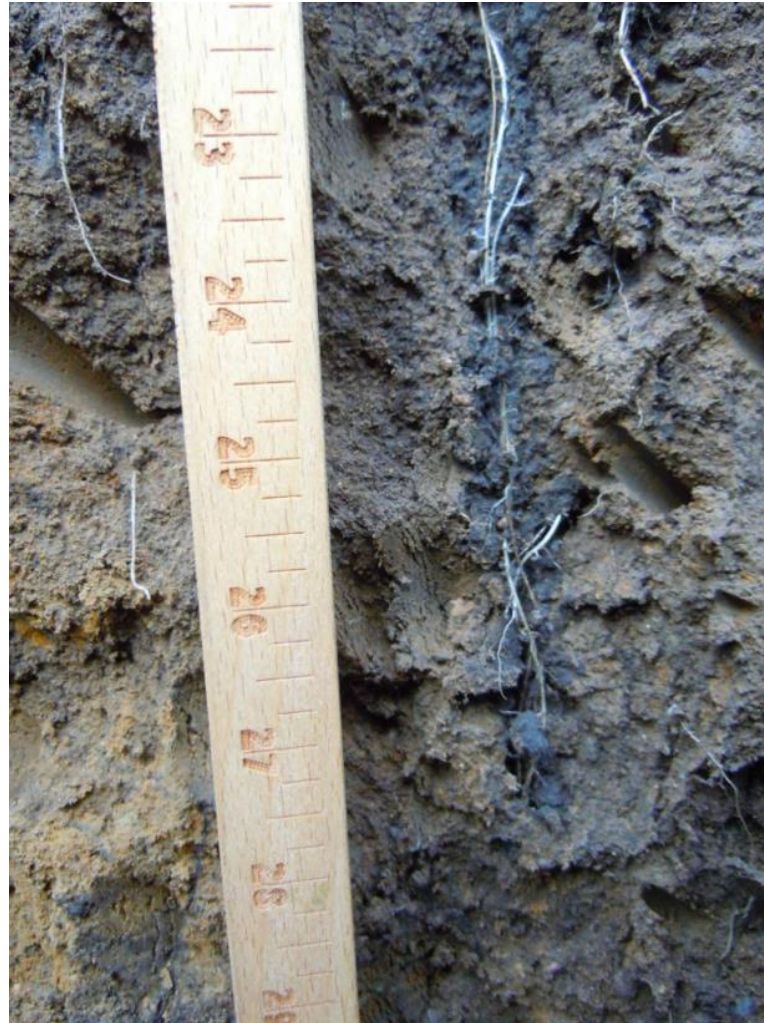


Cover crops open up soil



Plant Multiple Cover Crops

Cover crops access nutrients as legumes, or with deep roots



Plant Multiple Cover Crops

Use a mix of grasses, legumes, forbs, and brassicas

 **Cover Crop Chart** 

GROWTH CYCLE

A = Annual
B = Biennial
P = Perennial

RELATIVE WATER USE

• = Low
• = Medium
• = High

PLANT ARCHITECTURE

Y = Upright
* = Upright-Spreading
~ = Prostrate

-----Cool Season----- Warm Season-----

Cool Season				Warm Season			
Grass				Grass			
A Barley							A Pearl millet
A Oat	A Phacelia				A Amaranth		A Foxtail millet
A/P Ryegrass	A Flax				A Buckwheat		A Proso millet
A Wheat	A Spinach	B Turnip	A Field pea	A Berseem clover	A/P Medic	A Chickpea	A Sunflower
A Cereal rye	A Kale	A Radish	A Lentil	B/P Red clover	P Birdsfoot trefoil	A Cowpea	A Safflower
A Triticale	A/B Canola	B Beet	A Lupin	P White clover	P Sainfoin	A Soybean	A Squash
A Annual fescue	A/P Mustard	A/B Carrot	A/B Vetch	A/B Sweetclover	P Alfalfa	A Mung bean	A Chicory
							A Corn

Plant Multiple Cover Crops

Different varieties adapted to different characteristics

Adaptability:		Not Adapted	Winterkills	Overwinters	Benefit:													
										-None	* Poor	** Fair	*** Good	**** Excellent				
	Cover Crop	Plant Hardiness Zone								Benefits								
		2	3	4	5	6	7	8	9	10	Scavenge Nitrogen	Prevent Erosion	Build OM	Break Compaction	Nitrogen Source	Quick Growth	Suppress Weeds	Provide Forage
Grasses	Annual ryegrass										****	***	****	****	-	**	**	**
	Winter barley										***	***	***	**	-	***	***	***
	Oats										***	**	**	*	-	****	***	***
	Winter rye										****	****	****	***	-	***	****	****
	Winter triticale										***	****	***	**	-	***	***	****
	Winter wheat										***	****	***	**	-	***	***	****

Plant Multiple Cover Crops

Stop Use of Synthetic Chemicals

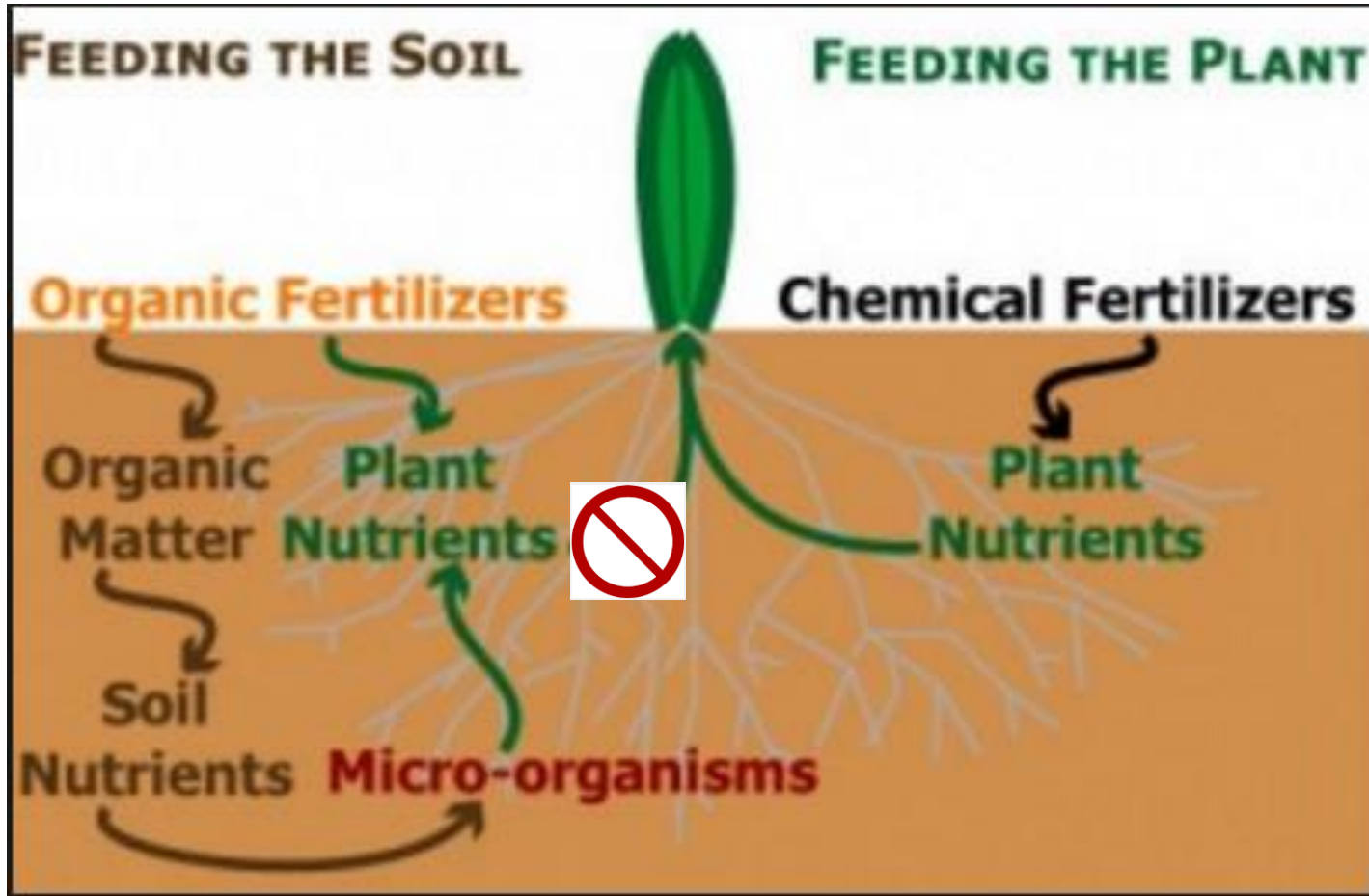


Toxins kill microbes



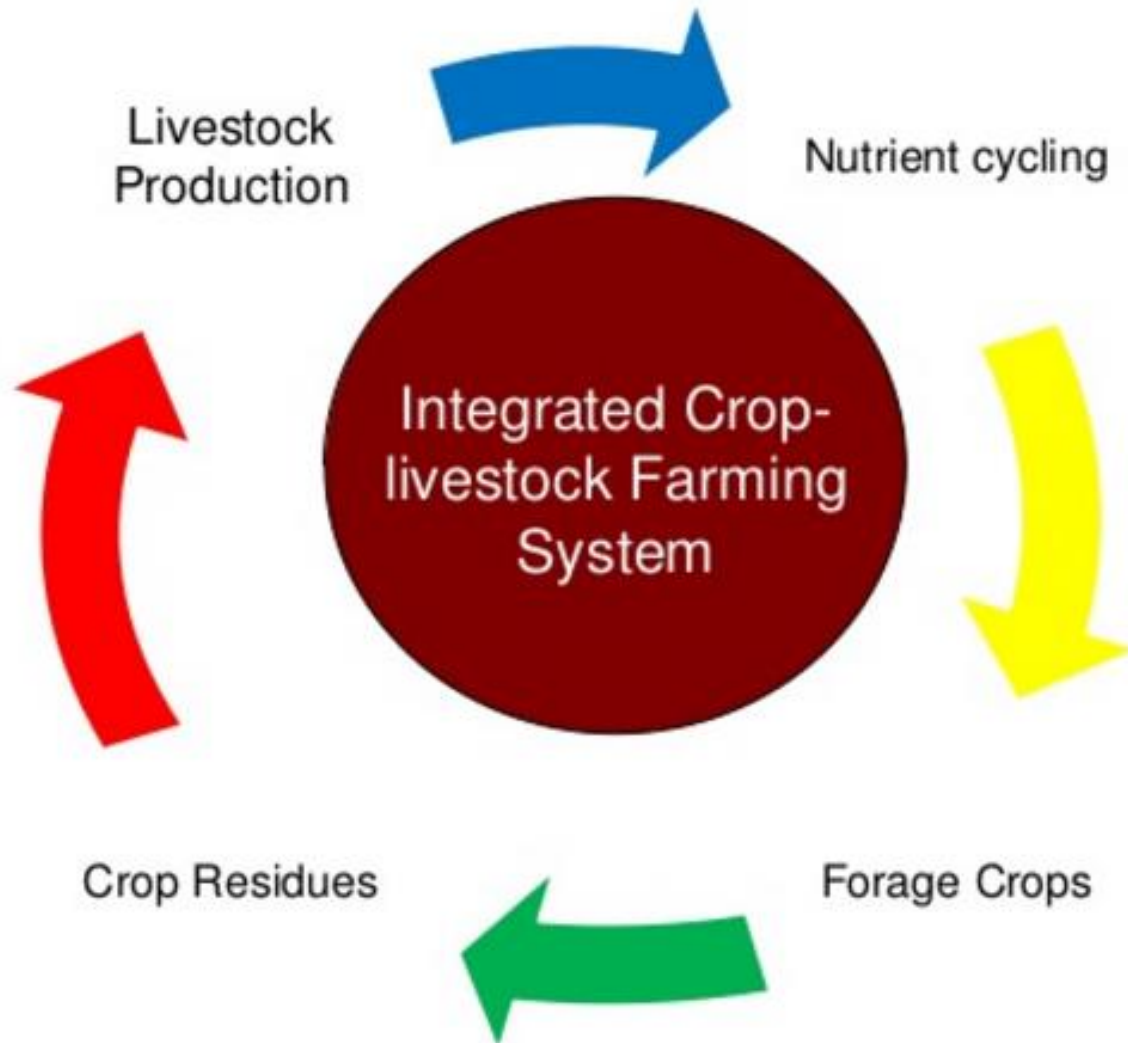
Stop Use of Synthetic Chemicals

Synthetic nutrients shut down microbial nutrient pathways



Stop Use of Synthetic Chemicals

Rotate/diversify crops and livestock

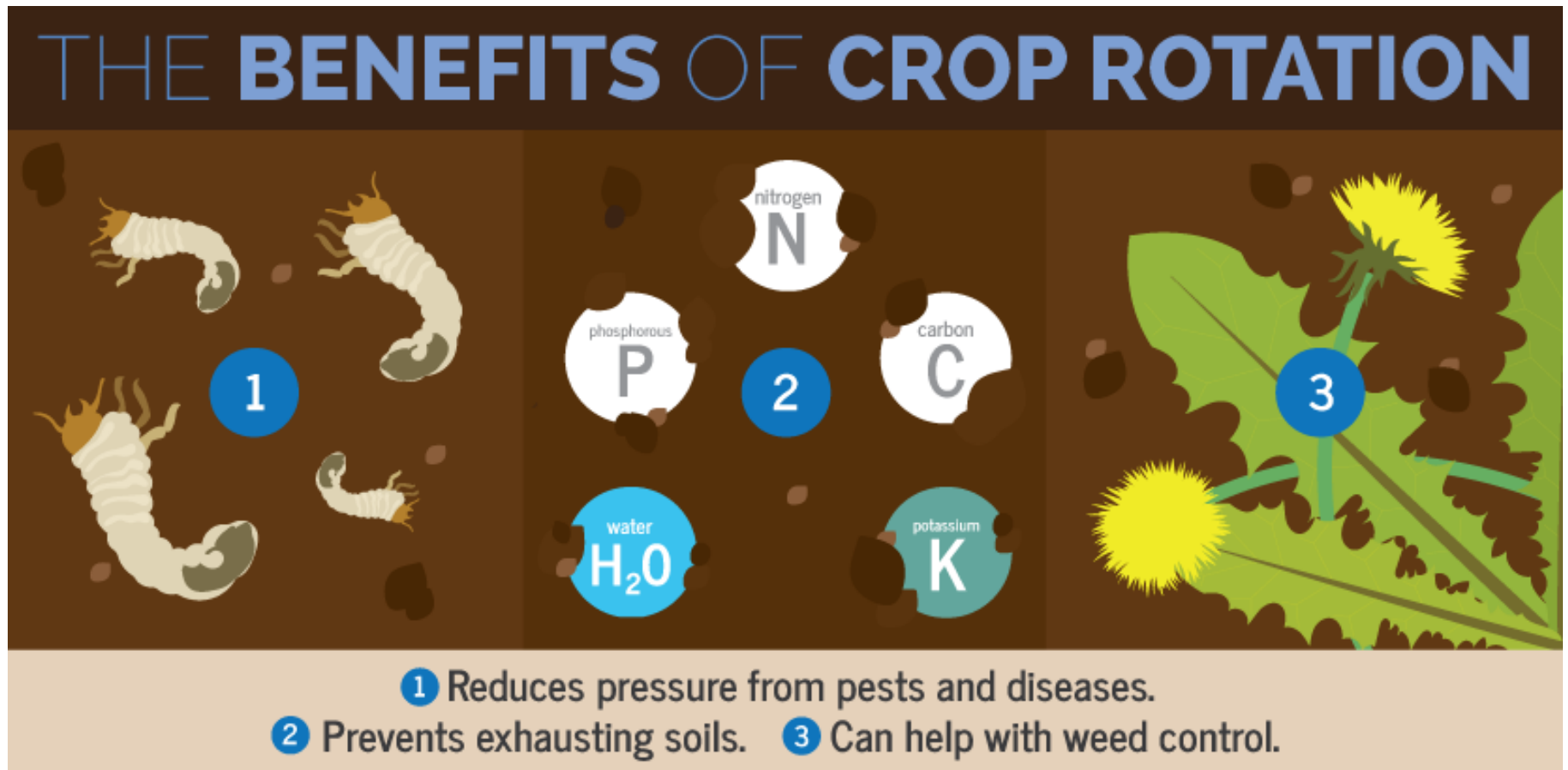


Cycle nutrients – crop wastes to animals, manure to plants



Rotate/diversify crops and livestock

Break disease and pest cycles



Rotate/diversify crops and livestock

How Can We Help?

- NOFA is building a network of farmers who are already carbon farmers
- We manage a list-serve and forum on carbon building for network members
- NOFA is compiling protocols and low cost devices to measure soil carbon progress
- We are organizing research into simultaneously building soil carbon and farm viability
 - NOFA actively promotes the value of restoring soil carbon as public policy
- We are committed to education about soil carbon.
Ask us how we can help you!

www.NOFA/Mass.org