"How to Deal with Weeds in Continuous No-till Organic Gardening/Farming & Big Role for Cover Crops"

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Saskatchewan farmers avoid bankruptcy with no-till

Because of extreme water shortages more than 60% of Saskatchewan crop farmers made the change to no-till but otherwise conventional farming practices in the last 15 years. Tillage results in a loss of soil carbon and destruction of soil structure created by soil microbes. They went from one commercial crop every two years to one every year and returned to making a profit.

The Saskatchewan Soil Conservation Association (SSCA) measured changes in soil organic carbon in 137 Saskatchewan sites using no-till over a period of 15 years and established that significant amounts of CO_2 — averaging 0.94 tons of CO_2 per hectare per year — was sequestered.

Equivalent to removing 2 million cars from the roads

(more than 2.5 times the number of light motor vehicles registered in all of Saskatchewan in 2016)

"Farmers ahead of carbon curve," by Julianne Isaac in Grainviews Jan. 29, 2016
http://www.grainews.ca/2016/01/29/farmers-ahead-of-carbon-curve/

EXECUTIVE SUMMARY SOIL CARBON POSITION PAPER (Version 1) Carbon Advisory Committee –August2017
http://ssca.ca/images/pdf/Soil-Carbon-Position-Paper-Version-1---August-2017.pdf

Reminder of a few of the many reasons for no-till

Two soil lessons in a minute by Ray Archuleta, USDA

Soil stability test: **comparison of healthy soil with lots of microbes creating biotic glues and fungal strands that hold the soil together, to soil that has been turned to dirt by repeated plowing.**

https://www.youtube.com/watch?v=9_ItEhCrLoQ

Water infiltration test: **shows how healthy soil can infiltrate and capture much more of the rainfall and store it in the soil. This alleviates drought and prevents soil erosion**

https://www.youtube.com/watch?v=Rpl09XP_f-w

Summary of Nature's Barter System

1. Plants use photosynthesis to convert carbon dioxide and water into sugars.
2. Plants release up to 40% of the sugars they make through their roots to attract and feed the specific soil microbes they require.
3. For the microbes these root exudates as they are known are like cakes & cookies
4. Bacteria and Fungi recycle dead plant and animal matter, and are able to mine all the additional nutrients plants require from the rocks, sand, silt, & clay, as well as nitrogen from the atmosphere.
5. If it weren't for their microscopic predators these nutrients would remain locked up in the bacteria as these are the foods they need for life.
   Their microscopic predators need these nutrient but not in such high concentration so they poop out the excess in a plant available form.
6. These microbes also build soil structure which prevents erosion and allow air and water to infiltrate into the soil.
7. Plowing, digging, and the use of synthetic fertilizers and chemicals shuts down nature's barter system and turns living soil into dirt.
8. To transform dirt to soil, inoculate the dirt with a healthy population of indigenous microbes using first class compost and follow Gabe Brown's five principles of Regenerative Agriculture.

Gabe Brown's 5 Principles of Soil Health

Least amount of soil disturbance possible, preferably no-till

Tilling causes a lot of soil carbon to be converted (oxidized) to CO_2 & destroys soil structure built by the microbes, leading to soil erosion and reduced water infiltration.

No bare soil

We want to maximize photosynthesis. The role of plants is to cover soil whether dead or alive. It's litter (or as Brown refers "armour") insulates soil surfaces against weather, preventing drying out and erosion of sediment. Litter also stimulates soil fungi which pull litter into soil providing a bed and breakfast for other organisms including earthworms.

Diversity; nature never has monocultures

Dr Ademir Caligari a Brazilian scientist and a leading expert on cover crops inspired Brown into sowing 15-25 simultaneously. Synergies compound once 7 or 8 species are grown together in a "cocktail."

Keep a living root in the ground for as long as possible

Brown extends his 100-day growing season in North Dakota by sowing species from all four groups – cool season grasses and broadleaves, warm season grasses and broadleaves. Living plants produce exudates to feed soil life which renew soil aggregates that normally break down after four weeks.

Livestock integration

Livestock grazing significantly increases the availability of major nutrients versus crop land where livestock are absent. The animal bite stimulates production of more root exudates (carbon secretions) to attract more microbes to provide the nutrients to heal the bite wound. Brown uses very high stock densities up to 700,000 kg/hectare rotated quickly through many paddocks of multispecies cover crops as a tool to get a big improvement in soil health.

Techniques to achieve continuous no-till organic farming & gardening

1. Lasagna garden (sheet composting) avoids need for initial tilling in garden

Plant & cover with brown mulch
1”- 2” of mulch, wood shavings, straw, fine bark

Compost or Soil
1”- 2” layer of aged compost or soil

Low nitrogen layer (brown mulch)
8”- 12” of shredded leaves, wood chips, straw
Moisten as you construct

High Nitrogen Layer (green mulch)
Thin layer of lawn clippings, veggie scraps, coffee grounds, kelp, compost or manure (aged)

Sheet Mulch Layer
cardboard or newspaper ½” thick
overlap by 6”, water well

High Nitrogen Layer (green mulch)
Thin layer

Existing Vegetation
Cut down, leave in place, remove woody stems

Existing Soil
Water well night before

Photo on right
Start of a Lasagna garden showing a layer of kelp on cardboard

Lasagna garden layers ⟵

At a minimum, you just need enough cardboard to cover the earth and enough organic material to cover the cardboard. Examples of **low nitrogen** organic material are shredded leaves, straw, and wood chips or shavings. Examples of **high nitrogen** organic matter are grass clippings without seeds, coffee grounds, green leaf cuttings, compost or compost extract, aged manure or animal bedding, small quantities of spent grains left over from beer making (very high in nitrogen) . You can pile up as many alternating high and low nitrogen layers as you like.

https://modernfarmer.com/2016/05/sheet-mulching/

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3. **Use of a tarp for 2 weeks in market garden farms between plantings**

Organic
No chemicals

The New Farm RR4, Creemore, Ontario L0M 1G0
Gillian Flies TEDx talk and
Brent Preston author "The New Farm"
https://www.youtube.com/watch?v=O2bNVHbp3vM

Tarp advantages: no weeds, heated soil enhanced microbe re-cycling of dead matter, salad greens ready for harvest one week earlier

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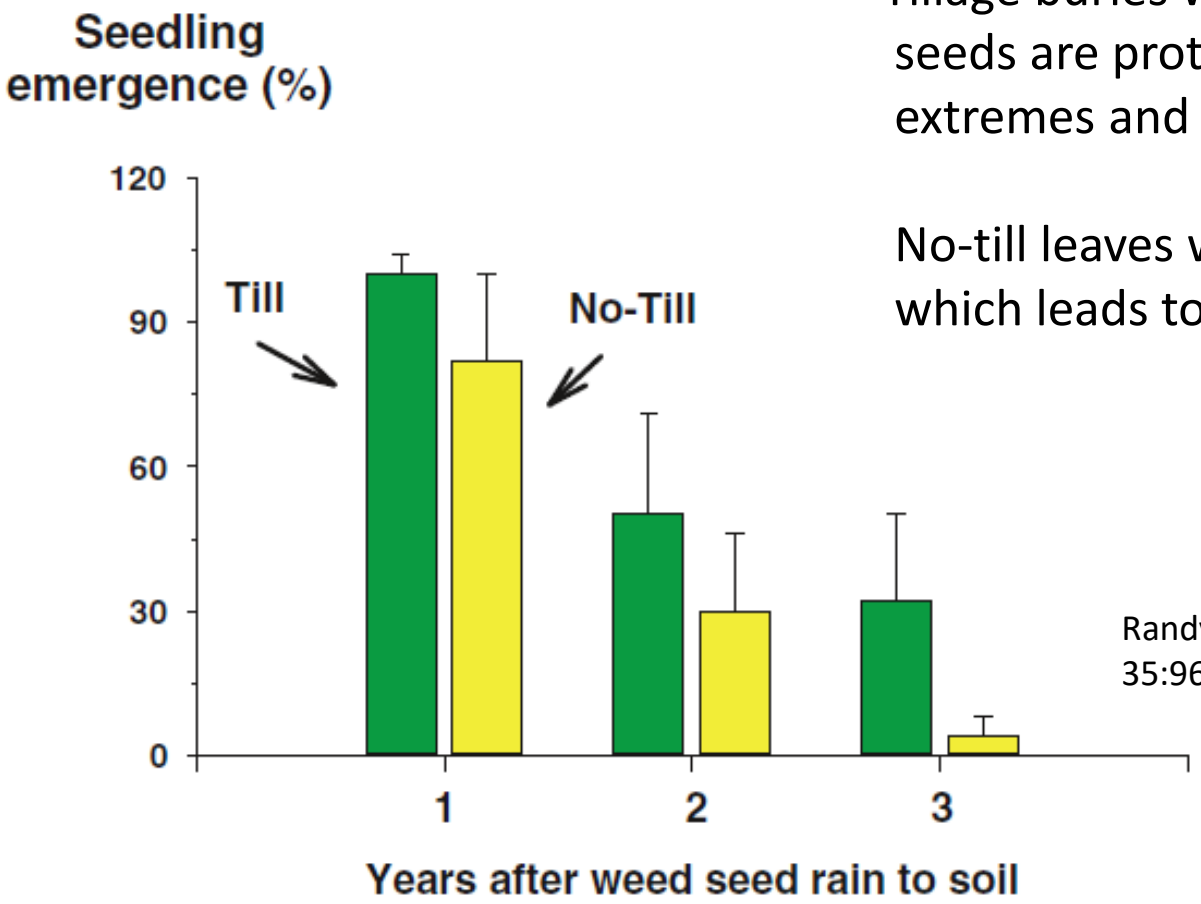
4. **No-Till naturally reduces weed seedling emergence over time (96% in 3 years)**



Tillage buries weed seeds in soil, thus seeds are protected from environmental extremes and predation.

No-till leaves weed seed on the soil surface which leads to extensive loss of seed viability.

Randy L. Anderson, Agron. Sustain. Dev. (2015) 35:967–974 DOI 10.1007/s13593-015-0292-3

Weed Response to No-Till and Cover Crops, Randy Anderson https://www.youtube.com/watch?v=T4R5OaYYrNY

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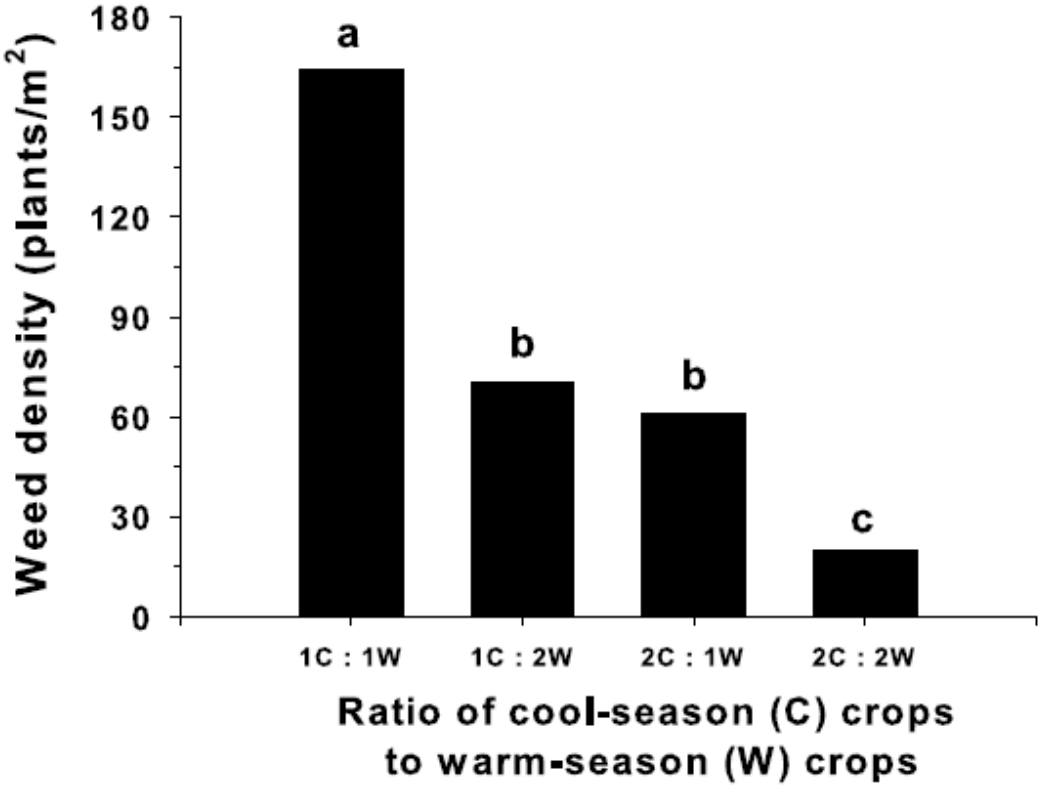
5. **Complex rotations composed of crops with different life cycles reduce weeds**

Two seasons of cool season crops
from winter wheat, oates, dry pea,
spring wheat ;
followed by
two seasons of warm-season crops
like corn, soybean, sunflower,
proso millet or chickpea



Randy L. Anderson, Renewable Agriculture and Food Systems: 25(3); 189, 2010 doi:10.1017/S1742170510000256

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6. **Underseeding/interseeding an annual cover can reduce weeds and enhance soil restoration**

Underseeding/interseeding an annual clover into winter wheat suppresses weeds after the wheat harvest, eliminating the need for tillage to control weeds.

Crimson clover (Trifolium incarnatum L.), is not winter hardy and completely winterkills .

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7. **Cocktail cover crop seeded in the fall can restore soil nutrients & block weeds**

   Cut down after flowering but before they produce seeds

   On farms this is typically mechanically terminated with a crimper-roller

SARE Outreach 2014 **Jeff Moyer** https://www.youtube.com/watch?v=FBt1OH6yIP4 **(IMPRESSIVE VIDEO)**

R

In a garden where you plant by hand it is best to transplant seedlings grown ahead of time to provide an additional head start.

Roller/Crimper for Raised Beds

SARE Outreach 2014 **Jeff Moyer**

https://www.youtube.com/watch?v=FBt1OH6ylP4

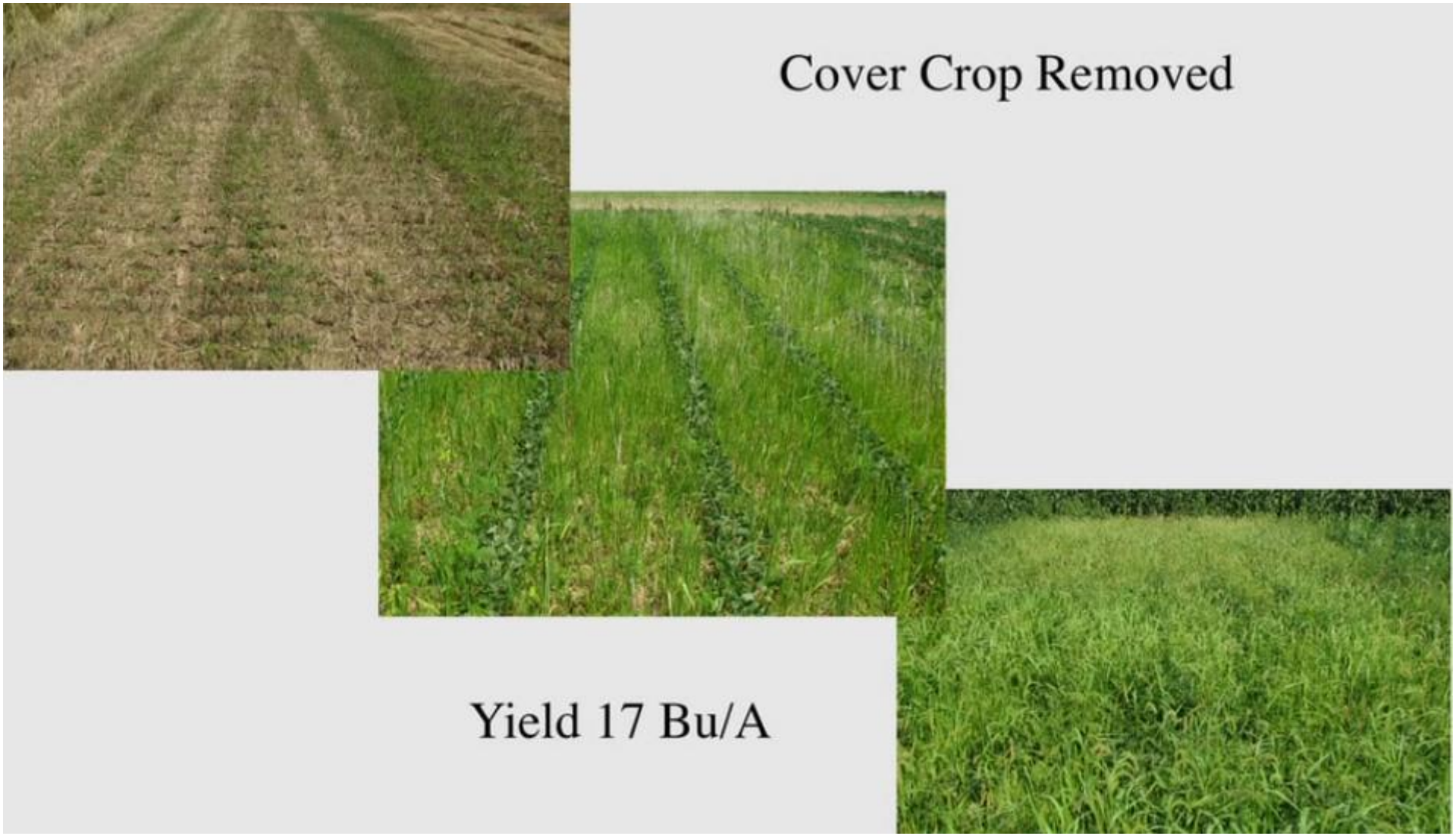
Manual powered crimper

Dana Jokela 2014, Crimping rye in an organic no-till garden
https://www.youtube.com/watch?v=-yo4eZ6xVtQ

In a greenhouse

SARE Outreach 2014 **Terminating Cover Crops for Maximum Benefits - Jeff Moyer https://www.youtube.com/watch?v=FBt1OH6ylP4**

Compare this slide with the next
a) Cover Crop Removed, Soy Bean Planted May 23, Weeds Came Up



SARE Outreach 2014 **Terminating Cover Crops for Maximum Benefits - Jeff Moyer https://www.youtube.com/watch?v=FBt1OH6ylP4**

b) Roller Crimper, Soy Bean Planted May 23, Fewer Weeds

Organic corn production, two different approaches

SARE Outreach 2014 **Terminating Cover Crops for Maximum Benefits - Jeff Moyer** https://www.youtube.com/watch?v=FBt1QH6ylP4

What does pioneering regenerative agriculture farmer Gabe Brown have to say about no-till and herbicides

"Dirt to Soil: One Family's Journey into Regenerative Agriculture" 2018

Gabe still occasionally resorts to using a herbicide to control weeds. He has gone up to five years without it, but he says it is critical to keep an eye on perennial invasive species. He doesn't use any on crops that go for human food or livestock feed.

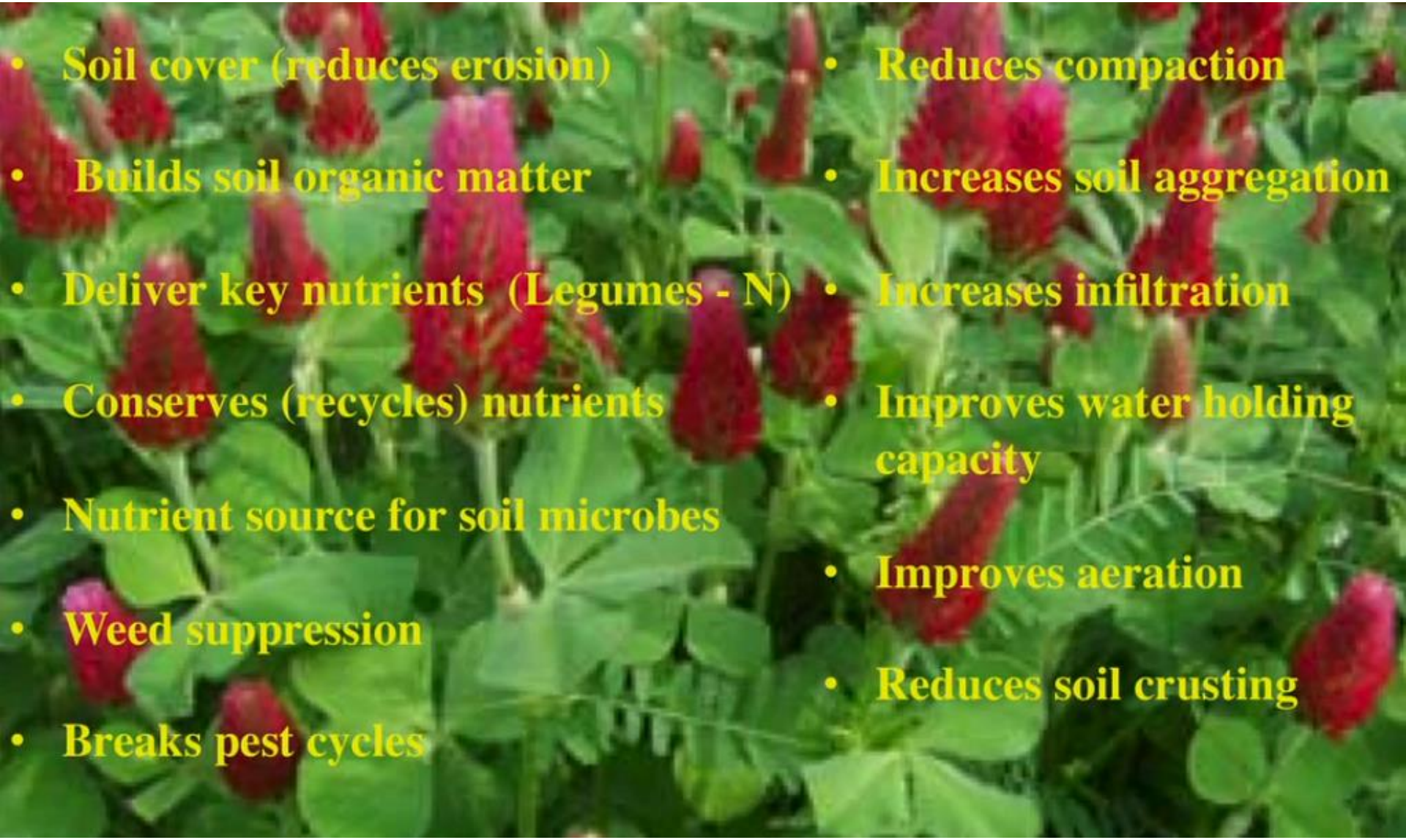
According to Gabe, tillage is much more destructive to a soil ecosystem than occasional herbicide pass. He is working diligently to end the use of herbicides but will not use tillage in its place.

"Of the hundreds of farms and ranches over North America that I visit, Including dozens of organic farms and ranches, not one of those farms has soil quality that compares favorably to the soil on my ranch. On the organic farms, they use no herbicides, but they do till, and that simply destroys soil structure and function.

I have noticed, both on my farm and visiting others, that as soil health advances, weed pressure declines. This seems to be particularly true when the fungal to bacterial ratio in the soil approaches 1:1." (Dirt to Soil, p. 135)

Dr. David Johnson (NMSU) contends that the most effective fungi:bacteria ratio for regenerative agriculture is between 1:1 and 5:1, depending on the crop.

A Big Role For Cover Crops



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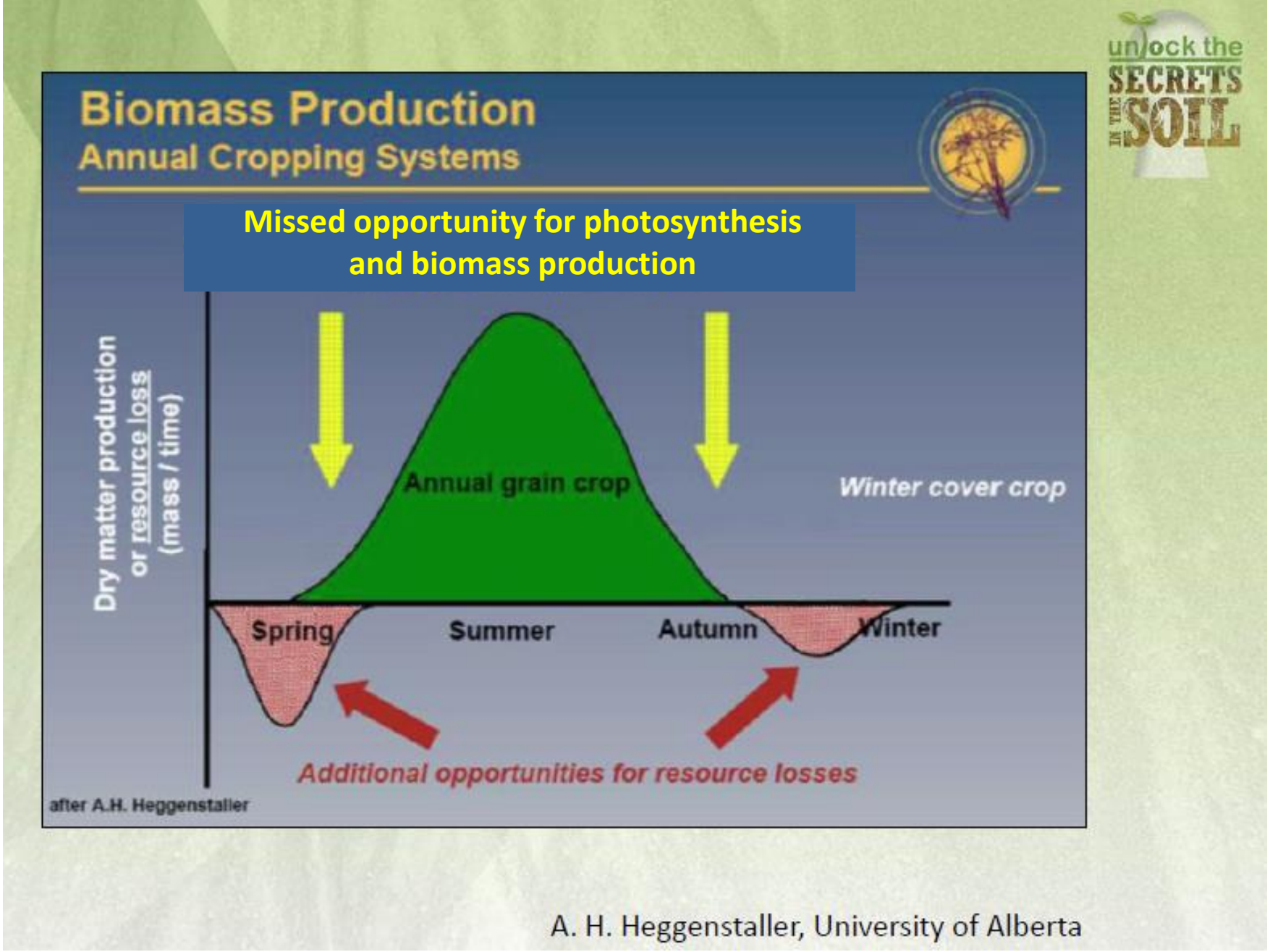
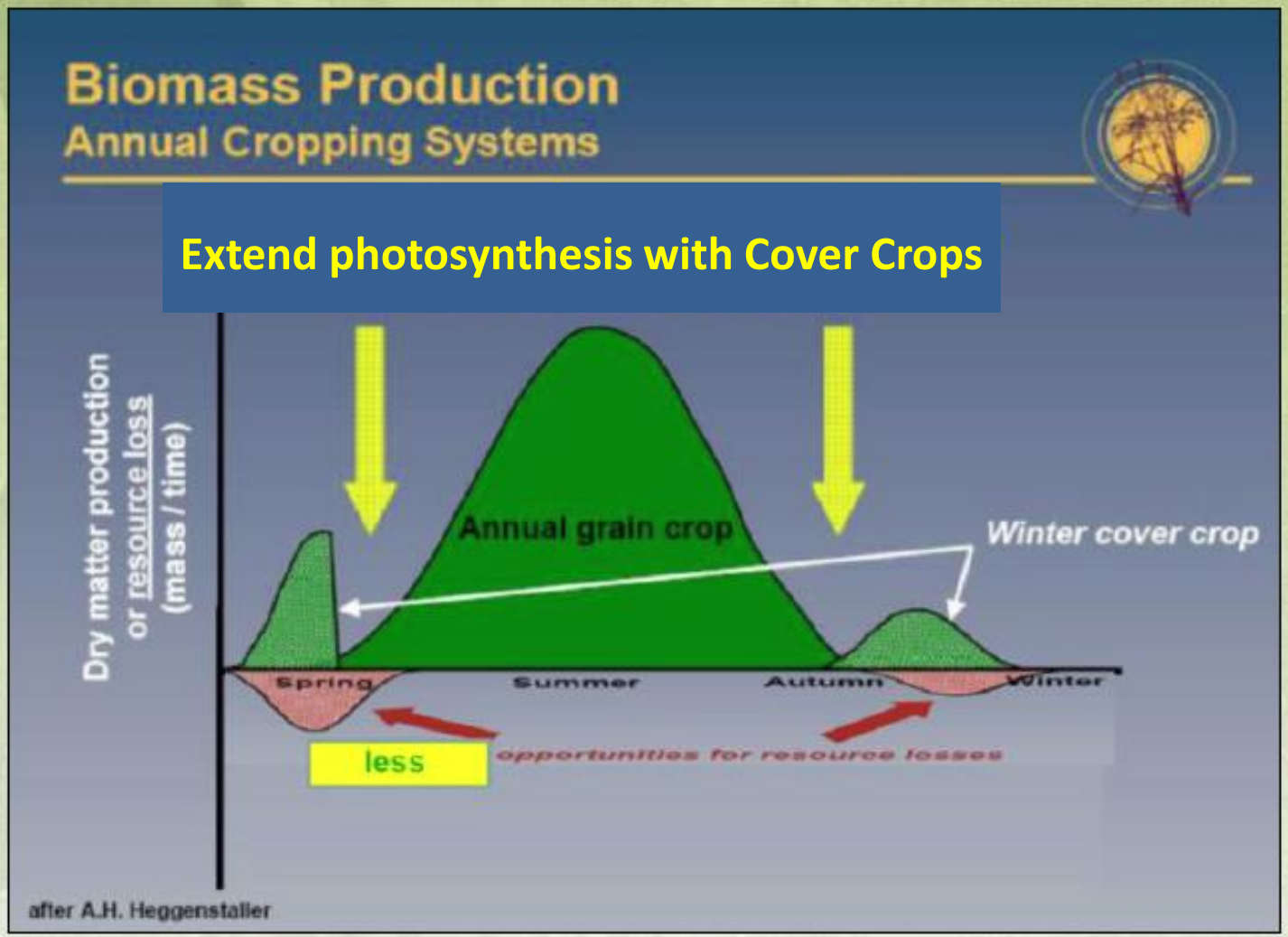


Mike Kucera, Agronomist, USDA NRCS National Soil Survey Center, Soil Quality and Ecosystems Branch, Lincoln, NE

https://www.ok.gov/conservation/documents/Soil%20Health%20%20101%20Planning%20Principles.pdf



A. H. Heggenstaller, University of Alberta

Mike Kucera, Agronomist, USDA NRCS National Soil Survey Center, Soil Quality and Ecosystems Branch, Lincoln, NE
https://www.ok.gov/conservation/documents/Soil%20Health%20%20101%20Planning%20Principles.pdf

Monocultures versus 6 Species Cover Crop Trials

2006 Burleigh County ND

The monocultures of

- Oilseed Radish
- Purple top turnip
- Pasja turnip
- Soybean
- Cowpea
- Lupin

were nowhere near as successful as the mix of all 6

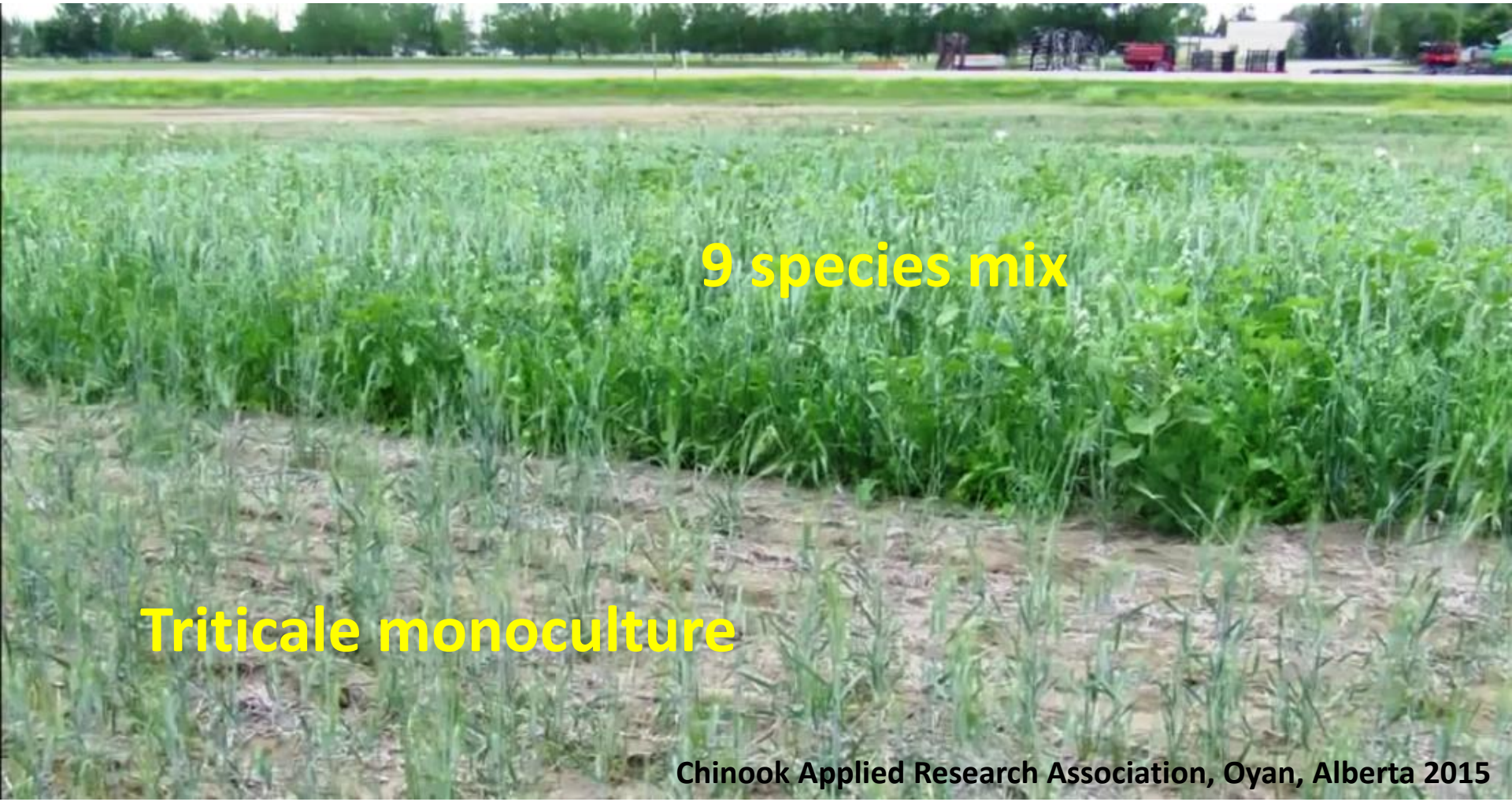
A Major Soil-Building Breakthrough – Cocktail Cover Crops

- Brazilian agronomist **Aldemir Caligari** discovered a revolutionary new way to cover crop. When five specific plant families are included in a cover crop blend, it fast-tracks improvements in soil structure and humus generation, yielding as much soil improvement in 1 year as was formerly achieved in 4 years.
- **5 families = grasses, cereals (grains), legumes, brassicas (5%), chenopods (1%)** The plant roots begin messaging each other and then initiate an outpouring of **phenolic compounds** into the soil. Phenolic compounds are the reason that we drink green tea. These powerful antioxidants affect us at a cellular level, and it turns out they have a similar impact upon the trillions of tiny creatures beneath our feet.
- A good home garden cover crop blend might include ryegrass, barley, wheat, lucerne (alfalfa), three clovers, daikon radish, kale and silverbeet. All these species are edible and you can provide a chlorophyll-packed addition to your green smoothie. You could even juice the young wheatgrass and barley grass at the height of their antioxidant powers.
- **Chenopods** include beets (sugar beet), amaranth, quinoa, Spinach, Chard. They are only required at **1%** of the total blend but if they are missing, then so is the big kick. **Brassicas** should also be seen as something of a seasoning spice in the recipe (should not comprise more than **6%** of the total mix).

Graeme Sait Nutrition Matters https://blog.nutri-tech.com.au/ten-tips-home-garden-4/

Triticale Monoculture Versus Multi-species

of triticale, oats, tillage radish, sunflower, field peas, fava beans, chickpeas, proso millet and foxtail millet



Dr. Christine Jones, Ohio USA, Mar. 2019 https://www.youtube.com/watch?v=K8_i1EzR5U8

USDA United States Department of Agriculture
Agricultural Research Service

Cover Crop Chart

Plus additions from Phil Gregory

AREA 4 SCD Cooperative Research Farm

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

Jackie's assessment

E – easy to work with
WV – constant work for a gardener but valuable
T – grows really tall
D – stalks difficult to cut after seeds form

C= Chenopods

COOL								WARM		
GRASS	BROADLEAF									GRASS
ANNUAL FESCUE								AMARANTH C T		BROWNTOP MILLET
BARLEY										FOXTAIL MILLET
OAT E	CAMELINA	MUSTARD T	BALANSA CLOVER	CHICKPEA	MEDIC	COWPEA	CLUSTER BEAN	BUCKWHEAT E		PEARL MILLET
SPELT	PHACELIA	CANOLA	BERSEEM CLOVER	PEA	LUPIN	LABLAB	JACK BEAN	QUINOA C T		PROSO MILLET
WHEAT T	FLAX	RADISH	CRIMSON CLOVER E	LENTIL	FABA BEAN	FENUGREEK	VELVET BEAN	CHICORY		GRAIN SORGHUM
CEREAL RYE D	KALE	TURNIP	RED CLOVER	LESPEDEZA	SWEET CLOVER	PIGEONPEA	MUNG BEAN	CUCURBITA		SUDAN GRASS
TRITICALE	SPINACH C	BEET C	WHITE CLOVER	BIRDSFOOT TREFOIL	ALFALFA	PARTRIDGE PEA	SOYBEAN	SAFFLOWER		TEFF
SALINE TOLERANT	CHARD C	CARROT	KURA CLOVER	VETCH WV	SAINFOIN	SUNNHEMP	PEANUT	SUNFLOWER T		CORN

V 3.0 February 2018

Additional Information

https://www.ars.usda.gov/plains-area/mandan-nd/ngprl/docs/cover-crop-chart/