

Realistic Regenerative Agriculture for the Prairies

Scott Gillespie M.Sc. P.Ag. CCA
Regenerative Agriculture Consultant
Plants Dig Soil Consulting Ltd.

1



My Experience

- Grew up on a corn & soybean farm in Southern Ontario
- Went to the University of Guelph for an agriculture degree (2001)
- Moved to Manitoba to do a Master's degree in Plant Science (2006)
- Came to Alberta for a job in irrigated potato agronomy (2007)
- Started growing my own garden once having a house of my own
- Attained my CCA (2008) and P.Ag status (2009)
- Started my consulting company (2018)
- Started my podcast (2019)

#RealisticRegenAg



2

Outline of the Talk

- ▶ What is possible on the Canadian Prairies
- ▶ How I differ from the celebrity farmers, ranchers, and consultants
- ▶ What growers in Southern Alberta are doing
- ▶ What to think about if you are considering regenerative agriculture
- ▶ What the course of action should be to begin

- ▶ The slides are already up at www.plantsdigsoil.com/media
 - ▶ You can download now or get them later if you like
 - ▶ Links to additional reading if you want to dig deeper are on all the slides

#RealisticRegenAg



3

Timeline of Southern Alberta Soils

- ▶ Geologically young soil estimated to be 10,000 years old
- ▶ Agriculture as we know it has only been around for about 150 years
- ▶ To help conceive of the timeline condense 10,000 years to one hour
 - ▶ You will only see agriculture develop in the last minute!

- ▶ The bar on the bottom of the slides represents our soil development visually
 - ▶ The green is for the entire length of the existence of our soils
 - ▶ The red on the right end represents the time of agriculture

#RealisticRegenAg



4


Human Management of the Soils

- Up until the 1700's the soils were managed sustainably
 - The number of people that could live on it was directly tied to what it could give
- Horses and guns allowed a greater and more efficient harvest of buffalo
- Colonists opened new trade networks for the excess
- Accelerated change lead to the collapse of the buffalo herd in late 1800's
- None of us were around when decisions were made that forced the Indigenous to sign treaties and move onto reserves
- But we can work to understand what happened & work to a better future


#RealisticRegenAg




5



BUFFALO BIRD WOMAN'S GARDEN




The classic account of Hidatsa
American Indian gardening techniques



GILBERT L. WILSON

"A gem of a book useful for today's gardener."
Organic Gardener



Buffalo Bird Woman

- Indigenous agriculture in what is now known as the Dakota's (United States)
- Adamantly kept up with weeding
- Carefully selected seed
- Broke new land and grew as long as they were productive
- Fallowed land to restore it
- Believed to have developed in the 12th century and ended with colonialization in the 19th century

Gilbert L. Wilson. 1917. Buffalo Bird Woman's Garden: Agriculture of the Hidatsa Indians.
Full text online: <https://digital.library.upenn.edu/women/buffalo/garden/garden.html>
Current publishers' site: <https://www.mnhs.org/mnhspress/books/buffalo-bird-womans-garden>

6

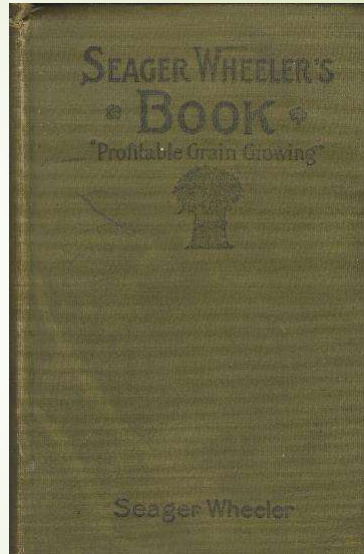
Seager Wheeler

- One of the early settlers north of Saskatoon*
- Widely known for his prize winning wheat
- Similar advice to Buffalo Bird Woman
- Differed from her in expectations
 - Believed proper tillage would unlock an inexhaustible supply of plant food
 - Appears to have subscribed to the theory that plants took up the mineral components of the soil and that you needed to pulverize the soil to powder**

*Seager Wheeler. 1919. Profitable Grain Growing. (Not in print but some booksellers have used copies.)

Full text: <https://www.canadiana.ca/view/ocidm.991508/8?r=0&s=1>

**University of Minnesota Extension. 2017?. Upper Midwest Tillage Guide <https://extension.umn.edu/soil-and-water/soil-management-and-health>



#RealisticRegenAg



7

Three Pillars Propping Regenerative Agriculture

- Inflated expectations of microbial mining of soil particles
- Mining of the legacy nutrient applications
- Faulty accounting of nutrient flows

COLLEGE OF AGRICULTURAL, HUMAN, AND NATURAL RESOURCE SCIENCES

WASHINGTON STATE UNIVERSITY

CSANR
Center for Sustaining Agriculture and Natural Resources

HOME ABOUT BLOG PUBLICATIONS GRANTS PROGRAM AREAS EDUC

Home » How does regenerative agriculture reduce nutrient inputs?

How does regenerative agriculture reduce nutrient inputs?

Posted by Andrew McGuire | February 4, 2020

“When you start farming regeneratively, you rely a lot less on external inputs, such as fertilizers...” — Tom Tolpelt

One of regenerative agriculture's extraordinary claims is that it can drastically reduce or even eliminate nutrient inputs, fertilizers. How is this possible? The go-to explanation is often “soil biology” — revived soil biology makes nutrients available that plants can't normally access. As it often the case, there is a bit of truth here. Regenerative ag

Andrew McGuire. 2020. How does regenerative agriculture reduce nutrient inputs?
<http://csanr.wsu.edu/how-does-regenerative-agriculture-reduce-nutrient-inputs/>

#RealisticRegenAg



8

Microbial Mining of Soil Particles

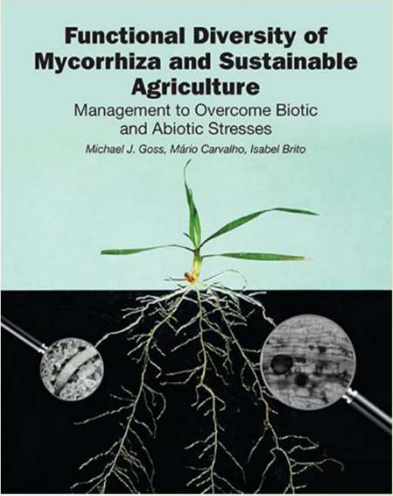
- ▶ No mention in the book of microbial rates

Other sources:

- ▶ Dr. Monika Gorzelak from AAFC Lethbridge could not find any rates in literature searches
- ▶ Dr. Andrew McGuire says it may be higher than previously thought but nowhere near export rates for annual cropping systems.

Michael J. Goss, Mário Carvalho, and Isabel Brito. 2017. Functional Diversity of Mycorrhiza and Sustainable Agriculture. <https://www.sciencedirect.com/book/9780128042441/functional-diversity-of-mycorrhiza-and-sustainable-agriculture>

#RealisticRegenAg



PLANTS
DIG SOIL
FOR THE LIFE

9

IMPACT OF MACRONUTRIENTS ON CROP
RESPONSES AND ENVIRONMENTAL
SUSTAINABILITY ON THE CANADIAN PRAIRIES

Fertilizer Inputs

- ▶ Nitrogen response research not initiated until the 1950's
- ▶ Phosphorus was the first major limiting nutrient
 - ▶ <1970 >90% chance of a response when adding fertilizer
 - ▶ >1970 response drops to 30-50%
- ▶ Dr. Cynthia Grant – 15-30% of applied phosphorus goes to current cash crop
 - ▶ Rest of crop's supply comes from soil test P and the weakly bound P coming back into the soil solution

Canadian Agronomist. 1993. The Red Book. <https://canadianagronomist.ca/resource/the-red-book/>

10

“No Fertilizer Needed”

- Many claims that diverse cover crops grow with no fertilizer.
- Instead of tillage being the tool, it appears cover crops will do it for us
- They believe they are tapping into microbial mined phosphorus
- In reality they are tapping into the legacy fertilizer applications
- Using the legacy phosphorus is a good way to use excess nutrients but it's not a sustainable way



11

Faulty Accounting of Nutrients


Crop	Yield (bu/ac)	Nitrogen (lb/ac)	Phosphorus (lb/ac)
Peas	50	0	35
Wheat	40	60	25
Canola	35	65	35
Barley	60	60	35
Total	---	185	130
Average	---	47	33
Cow-Calf Grazing	1 pair / 5ac	2	1

Government of Saskatchewan. Nitrogen Fertilization in Crop Production. <https://www.saskatchewan.ca/business/agriculture-natural-resources-and-industry/agribusiness-farmers-and-ranchers/crops-and-irrigation/soils-fertility-and-nutrients/nitrogen-fertilization-in-crop-production>
 Government of Saskatchewan. Phosphorus Fertilization in Crop Production. <https://www.saskatchewan.ca/business/agriculture-natural-resources-and-industry/agribusiness-farmers-and-ranchers/crops-and-irrigation/soils-fertility-and-nutrients/phosphorus-fertilization-in-crop-production>
 Arvid Aasen & Myron Bjorge. 2009. p 241. Alberta Forage Manual. <https://open.alberta.ca/dataset/077326082x#summary>

#RealisticRegenAg



12




Regenerative Nutrient Management

- ▶ Buffalo Bird Woman used fallow and depleted nutrients for farming
- ▶ However the time scale and the amount of people made it regenerative
- ▶ If it were farmed for 50 years and then left for 500 years it could regenerate


The only way that I can see our farming to get truly regenerative is to cut the exports of nutrients off the land to match what we can import.

If you could mine everything you need from the soil and grow without fertilizer you are still depleting the resource and at some point future the generations will run out of nutrients

#RealisticRegenAg




13



How do the celebrity ranchers do it?

- ▶ Investigate the claims: They have converted to a grazing based system
 - ▶ This massively cuts their export of nutrients from the land
 - ▶ They may have decades or centuries of legacy phosphorus to use
 - ▶ Legumes in the system will easily be able to replace the nitrogen lost
- ▶ Cattle farming is a tough business to pay the bills in a commodity market
 - ▶ They capture more of the consumer dollar by direct marketing
 - ▶ Some have vertically integrated the processing, distribution, and wholesale
 - ▶ Most growers are too far from these markets and have no interest in doing this

#RealisticRegenAg



14

Regenerative Carbon Buildup

- ▶ We approximate 1 acre of soil in 6" to be 2,000,000 (two million) pounds (lb)
 - ▶ This means that every 1% of organic matter weighs 20,000 lb
(As a reference a 50bu/ac wheat crop weighs 3,000lb)
- ▶ In **1%** of organic matter there are approximately:
 - ▶ **10,000** lbs of carbon (it's actually a bit higher but easier to remember this way)
 - ▶ **1,000** lbs nitrogen
 - ▶ **100** lbs each of phosphorus, potassium, & sulphur

Real Agriculture. 2021. Soil School: Does organic matter really matter?
<https://www.realagriculture.com/2021/01/soil-school-does-organic-matter-really-matter/>

#RealisticRegenAg

15

But the celebrity farmers claim ...

- ▶ There are some pretty spectacular claims out there
- ▶ Investigate them:
 - ▶ In a grazing system with very little export it may work
 - ▶ But it is highly improbable

31 tons (dry) biomass per acre per year

Also required every year { 470 lb N/ac, 47 lb P/ac, 19 lb S/ac }

1.7% → 11.1% Soil Organic Matter

↓ 15% to soil organic matter

↓ 85% lost

↓ 1 2 3 4 5... 20

—Years—→

Biomass and nutrients needed for 1.7 → 11.1% increase in SOM.

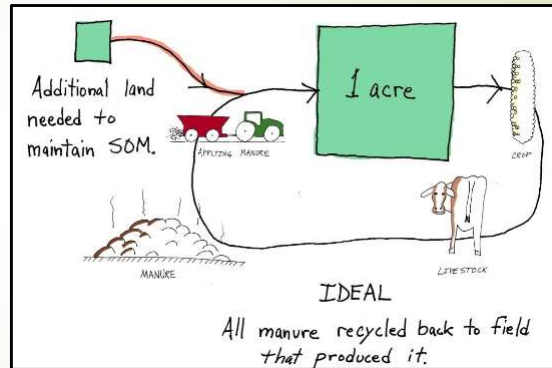
Graphic by Dr. Andrew McGuire. Regenerative Agriculture: Solid Principles, Extraordinary Claims.
<https://csanr.wsu.edu/regen-ag-solid-principles-extraordinary-claims/>

#RealisticRegenAg

16

Regenerative cash crop farming?

- Hay and silage crops all export more nutrients than grazing
- It may be possible to close the loop if you can get the manure back from the animals that were fed the hay or silage
- However, it usually costs more to haul manure back than to send the feed away
- There is still the export of meat and there are losses along the way so extra land is needed



Graphic by Dr. Andrew McGuire. Can manure sustain soils?
<https://csanr.wsu.edu/can-manure-sustain-soils/>

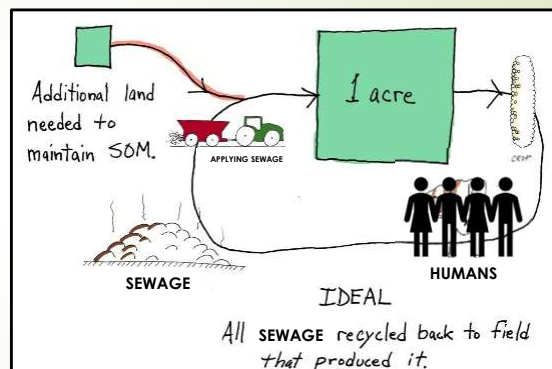
#RealisticRegenAg



17

Regenerative cash crop farming

- Grain, oilseeds, and vegetables all export much more nutrients than grazing
- It may be possible to close the loop if you can get the sewage back from the humans that ate the crop
- However, most of our crops end up overseas and so it's nearly impossible to bring this back to the land

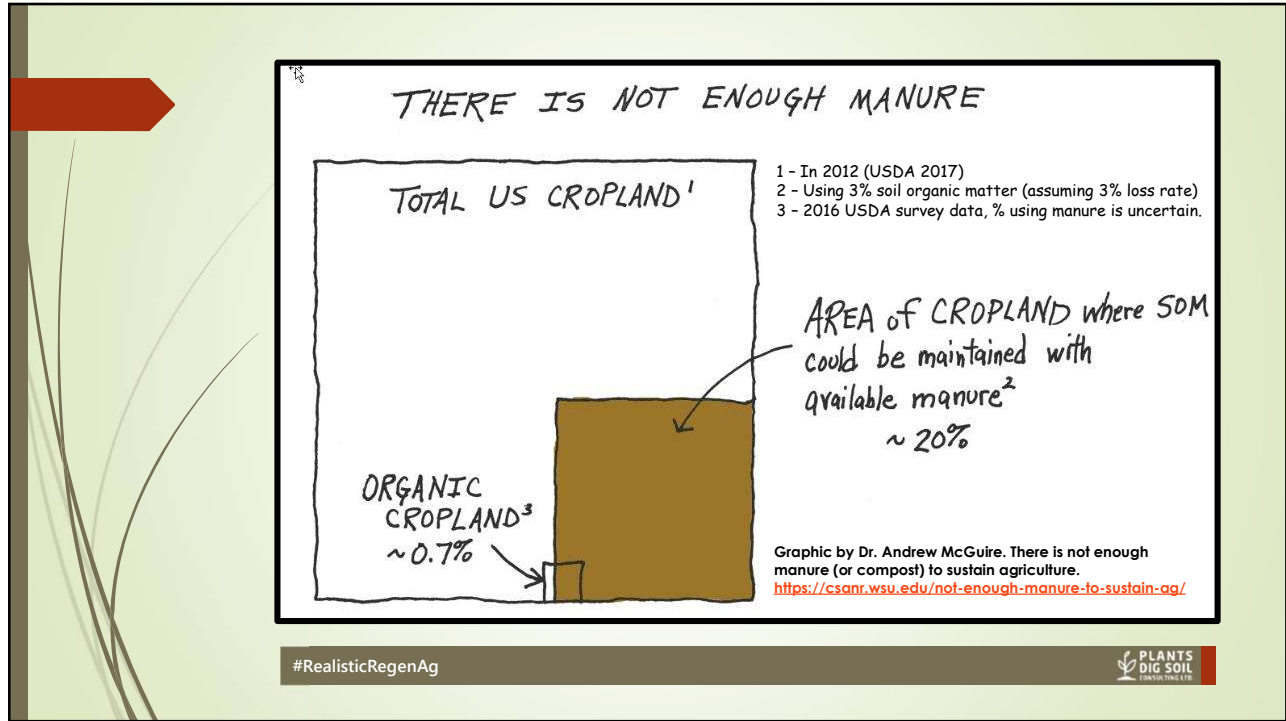


Graphic by Dr. Andrew McGuire. Can manure sustain soils?
<https://csanr.wsu.edu/can-manure-sustain-soils/>

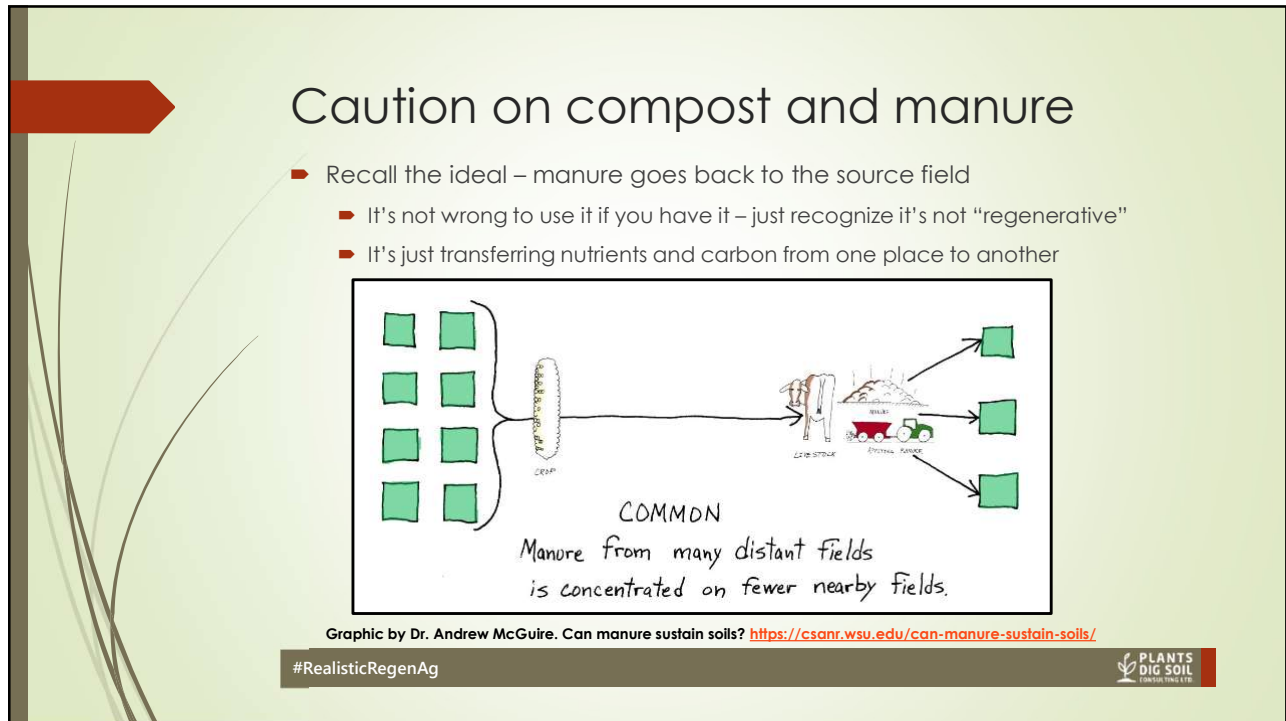
#RealisticRegenAg




18



19




20



Recall the “inexhaustible supply” of plant nutrients by the settlers ...

- ▶ Looking at what it takes to make organic matter you can see how valuable it was to the early settlers – it could seem inexhaustible.
- ▶ The only way we can build it back up again is to tie up nutrients
- ▶ This isn't going to be something you'll see big change on in your lifetime
 - ▶ Remember that these soils took millennia to form
 - ▶ They were depleted in decades
- ▶ Evidence is emerging that cover crops concentrate organic matter near in the surface layers and can lower it in the deeper layers
 - ▶ This calls into question carbon sequestration models
 - ▶ Still good for the farmer – it's in the rooting zone and holds nutrients & water in place

#RealisticRegenAg



21



The only way to make new organic matter is to grow it

- ▶ A living root in the ground for as long as possible
- ▶ Leaves are taking the sun's energy and creating sugar from CO₂
- ▶ The plant material can become organic matter
- ▶ The root exudates to the microbes may become organic matter
- ▶ Many of the sugars are burned for energy and go right back to CO₂
- ▶ I shorten this to: **Plants dig soil.**

#RealisticRegenAg



22

Cover Crops

- ▶ Living roots as long as possible are a great way to start
 - ▶ In the very wet areas using up the excess moisture may help the cash crop
 - ▶ In the very dry areas there will be years when no cover crop is possible
- ▶ Priority #1 is always to hold onto the soil
 - ▶ It doesn't matter what you are growing as long as you are holding your soil.
 - ▶ If your soil is blowing it really doesn't matter what is going on below the surface
- ▶ Priority #2 is scavenging nutrients, unlocking legacy P, & fixing N
 - ▶ This is their real value – making your nutrient cycle more efficient
 - ▶ Be cautious: Seed costs can quickly get higher than the nutrient return

#RealisticRegenAg



23

Monoculture vs Diverse Mixture

- ▶ In 9 of 10 studies reviewed there was no statistical difference between single species & mixes
- ▶ In the remaining 1 of 10 studies the statistical difference was **in favour of the monoculture** over 80% of the time

Andrew McGuire. 2020. Contrary Science; Cover Crop Mixtures, Monocultures, and Mechanisms. <http://csanr.wsu.edu/contrary-science-cover-crop-mixtures-monocultures-and-mechanisms/>



imgflip.com

JAKE-CLARK.TUMBLR

#RealisticRegenAg



24

Diverse cocktail blend of species

- Full season cover or annual forage?
- Enough feed for cattle?
- Diversity will be good for the soil
→ but will it pay?
- Green manure? Will you make as much back on nutrients, water holding, and yield next year to justify?
- What about weeds? There are no herbicides and the biomass is more variable – where there are gaps there are weeds.

#RealisticRegenAg



25

Another cocktail blend of species

- Green manure intention before potatoes (was harvested as silage)
- 15 species were planted
- 2 species dominate (sunflower and tame oats)
- Did you get value for your money?

#RealisticRegenAg



26

Simple mixes

- After processing peas (the ones you buy in the frozen food aisle at the grocery store) as soil restoration
- Field is left compacted from the harvesters
- Deep rip (18") then plant the mix – Fall rye, tillage radish, buckwheat, clover and phacelia in early August
- Fall rye still going in March (pictured)
- Rest died over the winter
- (Radish died in August – flea beetles moved in and destroyed it!)

#RealisticRegenAg



27

Potato production

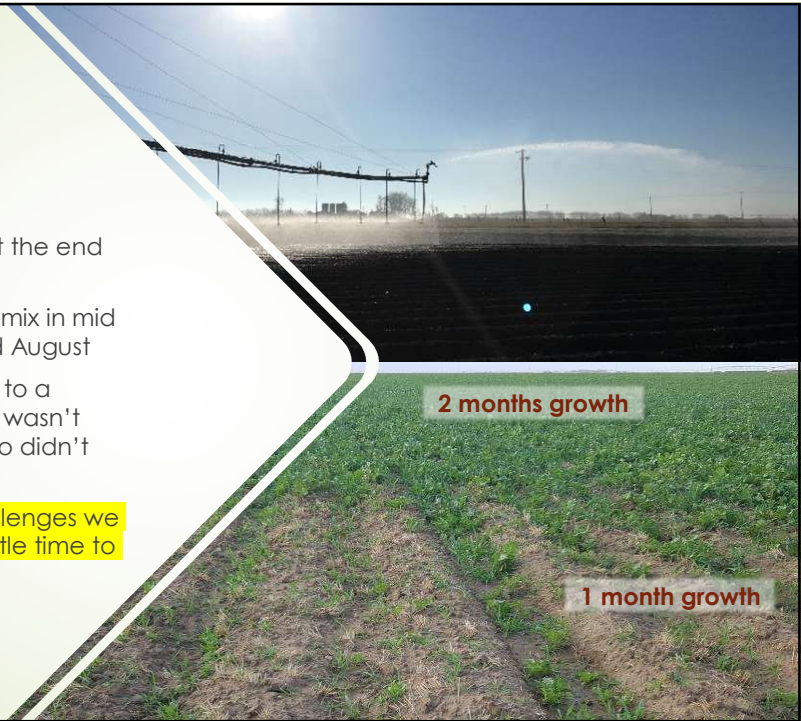
- 620hp Quadtrac
- Toolbar only 18' wide and going 12-18" deep
- Lots of erosion potential
- Lots of disruption to the soil
- Rows are usually marked in the fall
- What can be done to help repair the soil?



28

Cover crop the hills in the fall

- Top picture shows an end gun at the end of centre pivot for reference
- Bottom picture shows a cocktail mix in mid October that was planted in mid August
- The bare area to the front is due to a malfunction of the end gun that wasn't noticed when establishing and so didn't germinate until mid-September.
- The bare area illustrates the challenges we have here in the Prairies – very little time to grow anything worthwhile



29

Cover crop the hills in the fall

- In November after a cold snap the cold hardy species are holding on
- Powerhilling will still be required (roto-tilling and reforming the hills)
- Until potato planters can cut through and drop the seed in this is the best options (though there are growers working on this!)



30

Cover crop the hills in the fall

- ▀ Instead of the diverse cover crop mix what about just volunteers?
- ▀ No cost – just made the hills as soon as possible after barley harvest (mid August)
- ▀ If really wanting to get technical you could use the variation across the field to create a fertilizer prescription using an NDVI
- ▀ Crop will winterkill on its own



31


Relay cropping

- ▀ Usually applied to planting the next cash crop in the existing crop
- ▀ In the Prairies double cropping is rare
 - ▀ However the principles can be applied to cover cropping
- ▀ Idea is to seed the cover crop in the cash crop
 - ▀ When it's harvested the cover crop is ready to go
 - ▀ Also most growers tend to not have time/labour to seed while harvesting
- ▀ Think of how a field looks clean at harvest only to be weedy in a few weeks
 - ▀ This is because the weeds are small and established under the canopy
- ▀ Broadcasting by plane or spreader can work in wetter climates but most growers in the northern United States and the Prairies find it's not reliable

#RealisticRegenAg



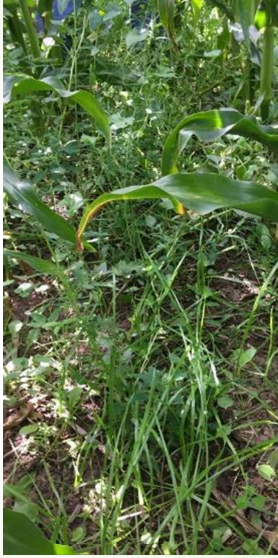
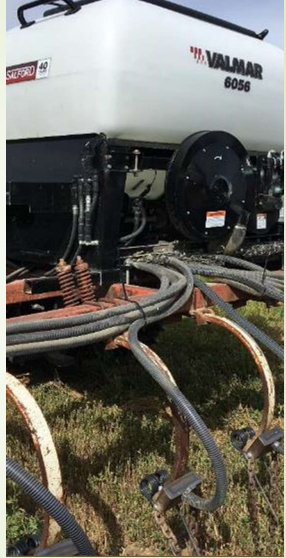
32




Irrigation Interseeder

- Valmar blows seed to the shanks between rows
- Small harrow that the seeds blow onto
- Chain behind that drags over the seed
- 22" spacing for corn
- Broadcasting and/or harrowing only works well with irrigation and/or reliable rain

Gemstone Cattle Company on a tour by Union Forage August 2019.

#RealisticRegenAg



33



Dryland Interseeder

- Valmar blows seed to disc openers
- Packer behind to ensure good seed-to-soil contact
- 10" rows to go between air seeder rows
- Clover established between the wheat but is isn't competing with it


Josh Beck July 2020. Also see: <https://www.grainews.ca/features/no-such-thing-as-failure-its-all-a-learning-experience/>




#RealisticRegenAg




34




Supercharging The System

- Wide row cropping* – started with 60" corn (yes – 5' row spacing)
 - Sacrifice some yield on the cash crop
 - Tend to gain 2-3x the amount of cover crop biomass
 - Works well when animals can graze the residue & cover crop in the winter
- Intercropping**
 - Best fit seems to be a pulse and an oilseed (Peola = peas + canola)
 - Growers are finding less disease and insect pressure – studies are ongoing
 - Challenges – seed rates/ratios, fertilizer placement, harvest and separation

*Practical Farmers of Iowa. 2019. Planting Corn in 60-in. Row-Widths for Interseeding Cover Crops. <https://practicalfarmers.org/research/planting-corn-in-60-in-row-widths-for-interseeding-cover-crops/>
 Lana Shaw. 2020. Beginners Guide to Intercropping for the North. <https://youtu.be/eDX0THTtZQ>

#RealisticRegenAg 


35



Supercharging The System

- Biostimulants & Humic Acids
 - Not worth the money – yet
 - Must do better than native biology and/or hold nutrient more efficiently
 - Best fit seems to be in seed treatments and/or in-furrow
- Top up your hail insurance
 - Don't put any money into rescue products (well proven there is no value)
 - Instead – be happy – you are getting paid to grow a green manure crop!
 - If you have relay crop and it survives you get even more growth than usual

Farming Smarter has started a multi-year study on biostimulants in cropping systems so we should see more local work on this soon. In the meantime check out: Farming Smarter. 2019. Hail Damage Recovery Relies on Timing and Early Preparation. <https://www.farmingsmarter.com/hail-damage-recovery-relies-on-timing-and-early-preparation/>


#RealisticRegenAg 

36

Summary

- ▶ Prairie soils took millennia to develop and supported humans for just as long
 - ▶ 1% organic matter = 10,000 lb C, 1,000lb N, 100lb each of P,K,S
- ▶ Three pillars propping up regenerative agriculture
 - ▶ Inflated expectations of microbial mining
 - ▶ Using the legacy nutrients from decades of fertilizer application
 - ▶ Faulty accounting of nutrients
- ▶ Focus on cover crops and keeping a living root – remember: Plants dig soil!
 - ▶ Keep it simple – single species or 3-5 species in a cover crop are enough
 - ▶ Watch your costs – you can quickly spend more than you'll ever recover

#RealisticRegenAg



37

Further learning

- ▶ Slides with references at: www.plantsdigsoil.com/media
 - ▶ Plus recent presentations on carbon building & nutrient management
- ▶ Search "Plants Dig Soil" in your podcast app or go here for links: www.plantsdigsoil.com/podcast
 - ▶ 016 What is Regenerative Agriculture?
 - ▶ 013 Caution on Carbon Payments
 - ▶ 012 Simplicity in Cover Crop Mixes
 - ▶ 010 Plant Green? Plant Brown?
 - ▶ 005 Soil Health Tests: Are They Worth It?

Stay in contact

- ▶ Monthly newsletter: www.plantsdigsoil.com/contact
- ▶ Direct contact:
 - ▶ Twitter: @scottcgillespie
 - ▶ LinkedIn: scottcgillespie
 - ▶ Email: scott@plantsdigsoil.com
 - ▶ Call/Text: 403-654-3096
- ▶ Contact me anytime about:
 - ▶ Consulting for your farm
 - ▶ Mentoring in agronomy
 - ▶ Follow up questions

#RealisticRegenAg



38