Learning Series:
Regenerative Agriculture in Montana Dry-Land Farming

Speaker: Franck Groeneweg

Farm Background and Transition

Franck grew up on a family farm in France, south of Paris, where his parents cultivated 500 acres of various crops. At the age of 17, Franck visited Iowa and developed an affinity for the country, later working on farms in northwest Iowa but finding limited opportunities. In 2003, Franck and his spouse purchased a farm near Edgeley, Saskatchewan, expanding it to 6,500 acres using zero-till conventional methods before selling it in 2019. The couple acquired their current farm in Montana in 2018, which initially spanned 15,000 acres but was reduced to 11,400 acres by dropping some rented land subject to development.

Context

Farm Size and Soil
Frank's farm is 11,400 acres of primarily silt loam and some sandy clay with 3-4 feet of soil depth, though some higher areas are rocky. Organic matter was 2% in 2019, with a goal of reaching 3% by 2032.

Crops and Rotation
Franck grows a variety of crops: spring and winter wheat, chickpeas, flax, mustard, yellow peas, safflower, buckwheat, and Laos. He is continuously experimenting with crop rotations to enhance system diversity and resilience. This is in stark contrast to the normalized wheat/fallow rotation in the area.

Climate and Challenges
The average precipitation per year is about 11.66 inches (8.6 inches rain, 3.1 inches snow equivalent) since 2011, which is lower compared to their previous farm in Saskatchewan. The soil has low porosity, poor gas exchange, and limited water infiltration, which makes it challenging for crops to thrive without proper management.

Farm History and Goals
Historically, Franck instituted a wheat-fallow rotation with 50 bushels per acre yield. When Franck bought the farm in 2019, it was transitioning to a two-thirds wheat-chickpea-fallow rotation. Franck aims to shift to continuous cropping, phase out synthetic fertilizers by 2026, and increase organic matter to 3% by 2032. They have a target yield goal of 35 bushels of wheat per acre (70 bushels over two years).

Minimize Soil Disturbance

No-Till Farming
No-till farming, particularly in their dry climate, helps conserve moisture. This method is vital for preserving every drop of water in the soil.

Seeding Rig and Biological Inputs
Franck uses a disk drill with K-hart openers to seed directly into wheat stubble, avoiding soil disruption. He has also replaced chemical insecticides and fungicides with biological treatments, including compost extracts, biostimulants, and *Beauveria bassiana* (a fungus) to control pests like wireworms and cutworms.

Insect Control through Brix Levels
Increasing the sugar content (Brix levels) in plants helps deter smaller pests like aphids. However, higher Brix levels can attract larger pests, like deer, which presents a balancing challenge.

Herbicide and Fertilizer Reduction
Franck is moving away from eradicating weeds entirely, opting to keep them at an economic threshold instead. He is reducing the use of herbicides and improving fertilizer efficiency through better application methods and water quality.

Fertilizer Use and Soil Health
Franck is working toward phasing out synthetic fertilizers by 2026, having already eliminated phosphate and potash since 2022. Through soil tests, he discovered significant levels of nutrients, such as phosphorus, already present in the soil, which can be unlocked by enhancing soil biology.

Results
By cutting nitrogen use by 75%, Franck has significantly reduced synthetic fertilizer, insecticide, and fungicide use. He now only uses chemical inputs as a last resort when necessary and economically justified.

Maintain Living Roots in the Soil

Photosynthesis and Root Exudates
Photosynthesis captures solar energy to convert carbon dioxide and water into glucose, which is then exuded through the roots as carbohydrates and sugars. These sugars nourish soil microorganisms, which in turn break down parent material like phosphorus, making it available for plant uptake.

Rhizosphere and Soil Biology
A healthy rhizosphere is critical -- this is the area around the roots where soil biology thrives. In fields where biological activity is high, such as Franck's farm, soil aggregates form more readily, improving soil structure and aeration. In contrast, conventional farming systems with high chemical use show poorer root-soil interactions and less biological activity.

Challenges with Full-Season Cover Crops

Due to Franck's farm's dry climate, full-season cover crops are challenging to implement. With an average annual rainfall of just 8.6 inches, cover crops would consume moisture that could otherwise be used for the main crop. He favours a continuous cropping system that admittedly has less diversity than a cover crop but is an improvement over a monocrop/fallow situation and is more economically viable. Franck also noted that without livestock to make cover crops more economically viable, the utility of full season covers remains limited in a grain-focused operation. Despite this, he continues to seek ways to incorporate living roots through continuous cropping.

Moisture Efficiency and Crop Yield

Franck shared a formula from Elston Solberg on the water required to grow crops: it takes about 4 inches of water for a crop to grow from seed to the reproductive stage. The remaining moisture can be used to produce grain. With his average rainfall, Franck calculates potential wheat yields of 34-35 bushels per acre, based on the available water. His farm has closely met these theoretical yield numbers, providing confidence in his approach.

Continuous Cropping and Photosynthesis

By practicing continuous cropping, Franck ensures that the soil always has living roots, thus doubling photosynthesis compared to conventional fallow systems. This increased photosynthesis feeds soil biology, helping to improve soil health over time.
However, the challenge lies in managing moisture levels to ensure consistent crop production without depleting the soil's water reserves.

Keep Soil Covered

Importance of Soil Coverage

Keeping soil covered is critical for reducing evaporation, maintaining cooler soil temperatures, preserving soil biology, and mitigating the impact of rainfall. A heavy rainstorm in summer can cause soil erosion and compaction, but a covered soil surface can significantly reduce that impact, protecting soil structure and health.

Providing Food for Microorganisms and Reducing Erosion

Covering the soil helps feed microorganisms by providing organic matter (like crop residues), and it also reduces soil erosion. This is important for long-term soil fertility and for reducing the loss of valuable topsoil.

Snow Coverage in Winter

Similar to other regions, Franck's farm experiences winter snow that naturally covers the soil for several months. During this time, no crops are growing, but the snow acts as a protective cover, preserving soil moisture and controlling pests. This is an advantage that farms in warmer regions like Texas do not have.

Straw Management with Stripper Headers
To maintain soil coverage during the growing season, Franck uses stripper headers on his combines, which leave straw tall and intact rather than chopping it. This practice offers multiple benefits: it reduces fuel usage by 30%, increases the capacity of the combines (since the straw doesn't need to be processed), and creates a microclimate that helps trap snow in the winter, reducing evaporation and providing protection against wind in the spring.

Microclimate Creation
Franck's use of tall straw, like in flax or wheat stubble, helps create a microclimate around the plants by reducing wind exposure and minimizing evaporation. This also helps retain moisture in the soil for the crops.

Disking for Residue Management
Franck uses a disk drill to manage straw after harvest, ensuring that some of the straw stays on the surface while other parts are incorporated into the soil. This combination of maintaining residue on top and incorporating some into the soil creates a protective cover that reduces evaporation and supports soil life.

Integrate Livestock

Challenges of Integrating Livestock
Franck's farm has very little fence and water access, which makes livestock integration difficult. He is not as experienced with livestock management but is working to find solutions to integrate them effectively.

Why Integrate Livestock?
Franck referenced the natural systems of the past, particularly bison herds, which played a significant role in maintaining healthy ecosystems by grazing, trampling, and depositing manure. The bison were constantly on the move in large groups, surrounded by predators, and their grazing had a profound impact on the grasslands and soil. Unless managed adaptively, modern cattle do not replicate this effect due to reduced grazing intensity and the use of pesticides and insecticides.

Challenges with Current Livestock and Manure
Limited livestock on the farm means that the natural benefits of grazing and manure deposition are not fully realized. While Franck uses manure from local cattle producers, he points out that the use of insecticides and the lack of dung beetles means the manure is not as effective for improving soil biology.

Mimicking Livestock Benefits: Microbial Composting (Johnson Su Bioreactor)
Franck is focusing on creating high-quality microbial compost to mimic the benefits of livestock. He is using the Johnson-Su Bioreactor method, which involves large totes with a false floor and PVC pipes for aeration to maintain the right conditions for composting.

Composting Process
Franck's compost mix consists of hay, sawdust, dairy manure, and water, with the goal of maintaining 70% humidity. The mixture is aerated and heated to around 65.6-71.1°C (150-160°F) to kill pathogens and weeds. The balance of nitrogen (manure) and carbon (hay and sawdust) is critical to achieving optimal composting conditions.

Enhancing Microbial Activity with Earthworms
After the compost reaches 26.7°C (80°F) (around 4 weeks post-fill), Franck introduces earthworms to further break down the material. Adding them sooner, when the compost is too hot, would result in worm death due to the high temperatures. The presence of earthworms helps promote the right biology in the compost, including fungi, nematodes, and protozoa, which are key to soil fertility.

Compost Tea Production and Application
After about 12 months, the compost is ready for use. Franck places the compost in large tea bags and uses air bubblers to extract beneficial biology, creating a nutrient-rich compost tea. The tea is enhanced with fish hydrolysate, molasses, and trace elements (like boron). The compost tea is applied to the fields using a sprayer at 10 gallons per acre.
Important Note: The compost tea is most effective when used within 12 hours of brewing, as it begins to lose its potency shortly after (i.e., the microorganisms begin to die off).

Biodiversity

Transition to Continuous Cropping
Franck moved from a wheat and fallow rotation to continuous cropping with a mix of diverse crops, including chickpeas, flax, and mustard. While yield advantages have been variable, this transition has had positive impacts on biodiversity.

Intercropping for Increased Biodiversity
He has experimented with intercropping flax and chickpeas. While the dry environment limits the yield advantage, this practice has helped reduce the need for fungicides.
Key Benefits of Intercropping:

- Flax and chickpeas together improve the carbon-to-nitrogen ratio, slowing the decomposition of cover crops and supporting better soil health.
- The diversity of crops encourages different microbial communities, benefiting the soil and ecosystem.

Alternative Fungicide Use
Franck has avoided traditional fungicides and instead used biological products like chitosan and yucca to combat diseases such as Ascochyta blight. This practice helps preserve soil biology while managing plant health.

Winter Canola and Mustard
Franck has worked with winter canola and mustard, crops that are uncommon in his region. These

crops have generated local interest, particularly when planted near highways, enhancing the farm's biodiversity. The visibility of these crops has sparked curiosity and appreciation from passersby.

Soil Health and Organic Matter
Franck uses soil infiltration tests to monitor water retention. Organic matter has increased from 2% in 2019 to 2.6% in 2024, remaining on track to reach 3% by 2032, reflecting positive progress in soil health.

Use of Plant Sap Analysis
Franck utilizes plant sap analysis to monitor crop health and adjust practices when necessary. Despite consistently low boron levels in tests, he is addressing this by adding boron where needed to correct deficiencies and optimize crop health.

Soil Test and Microbial Health
Franck uses various soil tests, including the Total Nutrition Digestion Test and microscopy, to assess soil microbial diversity. While some tests (e.g., Haney Test for respiration) haven't yet met expectations, overall microbial diversity is improving, indicating positive soil changes.

Biodiversity Indicators – Earthworms and Predators
Earthworm populations have increased on the farm, a key sign of improving soil health and biodiversity. Although earthworms are still sparse in some areas, their presence is a good sign. Franck has also seen more braconid wasps, which are beneficial predators of pests like sawfly larvae. The stripper header has supported these natural predators by enabling them to parasitize sawfly larvae effectively.

The Power of Observation

Continuous observation and adapting to local conditions is crucial when practicing regenerative methods. Franck stressed that it is imperative to use the “shovel test” for regular field assessments, noting that understanding soil health isn't just about hard data but about engaging with the land through sensory observation.

Important Quote

"*When I started looking into regenerative agriculture, I wanted hard numbers. I didn’t want just to feel the dirt. But now I go to the field with a shovel anytime I can. It’s the shovel, the feel test, the nose test—that's really what tells you what's going on. Constant observation is key. I feel like I’m about sixty to seventy percent of what I need to know by just using a shovel.*” - Franck Groeneweg