Report on CSSHP Farm Field Day 7/31/24

The Citizen Science Soil Health Project hosted a fantastic, well-attended, hot and smokey Farm Field Day on Wednesday July 31st, 2024. 41 farmers and ag professionals attended.

We toured 2 farms: **Michael Moss's Kilt Farm** and **John Schlagel's Niwot Farms**. Niwot Farms and Kilt Farm have taken very different approaches to improving their soil health and running their operations.

We started at **Niwot Farms,** where **John Schlagel and Jeff Anderson** raise alfalfa, corn, hay, silage, and pasture for their beef cattle. They use chisel plowing, aftermath grazing, manuring and Pivot Bio to decrease their N inputs and increase their soil health. This is John's 50th crop year. John and Jeff are able to manage 1000 acres and 200 head of cattle with just 2 people. They showed us some of their machinery which makes that possible. John sells his cattle to Meyers Natural Angus, who supplies Chipotle and Oscar Blues among others with antibiotic-free all-natural choice beef. John feeds his cattle Bovamine probiotic to cut down on the e. coli in his cattle's gut, as well as a seaweed based mineral package that helps to lower their body temperature and make them more heat resistant. He applies 20 tons/acre of manure annually to his corn field and has been using no-till methods for over 20 years. He grows hay, silage, feed corn and alfalfa to both supply his own herd and to sell to local dairies and farms. He keeps his soil covered in the winter and spring with corn stalks post-harvest, and uses aftermath grazing in his corn field in the winter to amend his field with even more manure from his cattle. He applies **Pivot Bio** as well as a preplant fertilizer and 32-0-0 through his pivot to add 150# of Nitrogen for a 250 bushel/acre yield.

Niwot Farms has embraced Pivot Bio, a microbial product that takes nitrogen from the atmosphere and fixes up to 40 pounds of plant-available ammonium per acre. Pivot Bio is derived from 2 naturally occurring, nitrogen-fixing soil microbes, called **Kosakonia sacchari** and **Klebsiella variicola** . These two microbes take nitrogen from the air and fix it into the soil, where it then becomes plant available ammonia. In the wild, when there are already high levels of nitrogen in soil from fertilizer, these 2 microbes will stop fixing nitrogen. The scientists at Pivot Bio have identified the gene that is the **OFF-switch** for nitrogen fixation in these microbes. They have edited and turned **OFF** the **OFF-switch** gene, causing the microbes to endlessly fix nitrogen, no matter how high the soil levels of nitrogen are. They have only

disabled the microbe's nitrogen-fixing gene and have not inserted any other genes from any other organisms into the microbe. They then figured out how to grow large quantities of these gene-edited microbes to use in Pivot Bio products.

Pivot Bio 40 can be applied in-furrow or as pre-inoculated seed at planting. It must be applied every year next to or on the seed, as the microbes need a living root to survive. The microbes adhere to the plants' roots and do not leach away like traditional nitrogen fertilizers can. The liquid Pivot Bio product must be stored between 32^0 and 70^0 F away from direct sunlight, and can be tank-mixed with pop-up fertilizers and insecticides. The product has a limited shelf life and must be applied within a limited time-window, which can be a problem if planting is delayed by an exceptionally rainy spring or by Fed Ex mishaps.

Pivot Bio markets 2 products, one for corn and corn silage, and a second for spring wheat and small grains including sorghum, barley, millet, oats, and sunflower. Pivot Bio does not currently have organic certification, but the company is "working on it." The company is also developing a product that could replace 80 lbs. of nitrogen. John reports that Pivot Bio just got a very large carbon credit pledge from Nabisco, to reimburse growers who use Pivot Bio to replace 40# of Nitrogen in their fields. John says that he will be receiving a $10/acre carbon credit payment for all the acres where he is using Pivot Bio in 2024. (The production and use of Nitrogen fertilizers account for ~5% of global greenhouse gas emissions, which is why John receives a carbon credit payment for the Pivot Bio he uses to reduce the amount of Nitrogen he applies.)

Next, we crossed the Diagonal to nearby **Kilt Farm,** where **Michael Moss** has been raising certified organic mixed vegetables in an intensive rotation on 7 acres of his 47 acres of Boulder County leased land for the last 9 years. Michael uses compost teas and sprays, cover crops, fungal soil inoculations, and re-mineralization to boost his plant and soil health.

Michael described some of the challenges he faced as he began farming this land. His field is a low spot where water from the west pools underground and bubbles to the surface. The County installed drain tiles in the field many years ago, but many of the tiles have broken since then and his fields have very uneven soil quality as a result. Michael uses applications of sea salt, lime and gypsum with trace elements to "balance" his soil. He says that the plentiful magnesium in his soil and irrigation water causes his soil to "lock up", so he applies amendments to raise his calcium, sodium and trace elements to make his soil more friable. Even though his pH is high, he applies lime which is alkaline. However, he says the gypsum he also applies contains sulfur, which is acidic and tends to counteract the alkalinity of the lime.

Michael counts on 2-3 cash crops/season in his fields for a $90,000/acre gross. He rototills between crops, and occasionally uses a deep shank tiller. His tillage scores are high, and he recognizes that his frequent tillage is hard on his soil health. He tries to compensate for that by adding frequent cover crops to his rotations and supplementing his soil with compost teas and biological inoculants to replenish the soil biology. Another challenge Michael faces is finding enough workers to plant, tend and harvest his crops. His intensive cultivation requires many hands per acre. The work is hard, hot, and many people quit or don't want to do it.

Kilt Farm focuses on remineralization using the Albrecht Method to balance their trace elements and grow nutrient dense food. **The Albrecht Method of Soil Balancing** holds that a soil should be composed of 45% minerals, 5% humus, 25% water and 25% air. The relative percentages of calcium, magnesium, potassium and sodium cations are first measured with a Base Cation Saturation Ratio (BCSR) soil test. Then amendments are applied to correct the percentages and move the Base Saturation percentages of the cations into the ideal range. For most soils, these ideal Base Saturation percentages are Calcium 68, Magnesium 12, Potassium 3-5, and Sodium 0.5-3. The ratios are slightly different for very sandy or very heavy clay soils. The Albrecht Method holds that once the chemical makeup of the soil is balanced, the physical structure of the soil will be correct, with enough pore space for optimal air and water. The method places particular emphasis on calcium and magnesium, to a much greater extent than in typical soil management. Calcium increases flocculation, increases pore space and improves soil structure, while magnesium does the opposite and makes the soil tighter. When both the chemical and physical properties of soil are corrected, then soil biology can flourish and provide plants with their necessary nutrients.

We videotaped Michael's talk to our group and have it on the CSSHP's YouTube Channel.

A fun highlight of the afternoon was Fredrick the trans-elk who has adopted John's cows as his kin. Frederick's mom was killed on the Diagonal when Fredrick was very young, and he then started hanging out with John's cattle. A year later he spends all his time with his cow-buddies, and easily jumps the fences to get in with them. Fredrick put in an appearance at the Farm Field Day and obligingly posed for photos.

At both farms we divided into groups led by Vanessa McCracken (OSMP), Lauren Kolb (OSMP) and Trent Kischer (BCPOS). Each group dug soil pits in John's corn field and Michael's cover crop field. Vanessa, Lauren and Trent helped their groups assess and score the soils at each location and fill out their soil health score cards, using the Colorado NRCS Soil Health Cropland Resource Concern Assessment v. 1.8.

After dinner, we conducted a slake test for aggregate stability on two soil samples from each farm. In a slake test, you drop a pre-dried clod of soil into a wire sling suspended in a column of water and watch to see how long it takes for the clod of soil to disintegrate in the water. If the soil is healthy with good aggregate stability, it can take a very long time for that to occur. The next photo shows the results of our slake test.

a. The soil with the greatest aggregate stability was the sample take from the **LAWN** at Niwot Farms. This soil from a mowed irrigated lawn has not been disturbed for many years.

b. Surprisingly, the **TILLED** soil sample from Kilt Farm performed very well too. This sample was taken from a row of kale. The field had formerly been in a mixed cover crop for 18 months, and was then rototilled with several passes, and planted into kale this spring. Kilt Farm applied home-brewed compost teas and biological inoculants to this field in 2023. Perhaps the fungi in these products produced a lot of glomalin, a soil glue that holds soil aggregates together, leading to very good aggregate stability.

c. The **COVER CROP** sample from Kilt Farm did not fare quite as well as the tilled sample, which was also surprising. The cover crop sample had plenty of living roots, but the cover cropped field had not been in a cover crop for as long as the TILLLED field had. Perhaps that explains why its soil aggregation was not as strong. Perhaps it also did not receive the same biological amendments as the tilled field did.

d. The **CORN** field sample from Niwot Farms disintegrated the fastest, with less aggregate stability than the other 3 samples. This was very surprising. The corn field soil had very large organic matter inputs and bits of organic matter were visible throughout the clod of dark brown soil. It also had the most earth worms of any sample, with 1-5 worms in every shovelful of soil. We did not expect this lack of aggregation. (However, this clod disintegrated slower than other samples we have tested from other corn fields.) Perhaps the lack of a living root in this field through the winter and early spring every year means that there are fewer fungi producing the glomalin glues which hold the soil particles together and form soil aggregates.

Our Farm Field Day got a lot of conversations going and showed that there are many ways to skin a cat and improve soil health. We hope you agree and that this report broadens your own horizons.

The Citizen Science Soil Health Project

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https://soilhealthproject.org/index.html

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