CONTACT
MELINA WATTS
GLENN COUNTY RCD
Office 530.934.4601 x5
melina@glenncountyrcd.org

NEWS & REPORT:

Walnut Orchards and Cover Crops: Daniel Unruh and Kabir Zahangir Tell the Story of the Understory

By Melina Sempill Watts
Photos by Kandi Manhart

Daniel Unruh has a walnut orchard in Colusa, California and his ongoing use of cover crops on his Columbia silty clay loams has given his orchard floor a soil organic matter that varies from 3-4%, with a goal of 6-8%. Unruh started at a lesion nematode count of 5000+ in 2012, now at 2018 he is at a zero, which gets other growers' immediate attention. While Unruh is the first to point out that nematode testing is notoriously variable even on the flip side of a tree, the numbers could be different at other points in the same orchard – still, the zero this last year is compelling.

In partnership with Glenn County Resource Conservation District, Colusa County Resource Conservation District and USDA-Natural Resources Conservation Service (NRCS), Unruh invited growers to come and see his orchard – and the orchard's soil. In addition to growers from Colusa and Glenn Counties, guests came from as far as San Luis Obispo, Stockton and Los Angeles, drawn by Unruh's success with cover crops and a chance to see a rainfall simulation by Kabir Zahangir, West Regional Soil Health Specialist, USDA-NRCS. Kabir's demonstration of the slake test showed growers how soils that have been conventionally farmed in a Cotton-Tomato rotation in Five points, California for 18 years compare to immediately adjacent soils on a farm that have had cover crops and no-till for 18 years on site (Soil samples provided by Jeffrey P. Mitchell, Ph.D., CE Cropping Systems Specialist, UC Ag Research & Extension Center).

Unruh states that trees are most productive when they live in a healthy ecosystem on farm, and this means encouraging biodiversity in soil to create optimal growing conditions. His basic premise on healthy soils is that soils are alive, so you need biota in the structure of the soil. Unruh says, "You cannot have biology without a home and without food, the biology in your soil needs both a home and food." Cover crops provide a central food source for the biology in the habitat of your soil. Unruh adds, "The sugars excreted by the roots play a huge role in the diet of the biology in the soil." Arguably, the waste products of the plant service the biota in the soil in the same way that composts help plants.

Part of the draw of cover crops is how much better rain is absorbed into an orchard with cover crops on site – and how much better the soils fare during rainfall. Unruh says, "Raindrops hit ground at terminal velocity," and this compacts unprotected soil – but hitting all the leaves and stems of a cover crop slows down the rain so rainfall can better infiltrate the orchard floor and seeps into the ground. Unruh explains, "When rainfall hits bare ground at full speed, it causes surface crusts and seals to form as the heavy impact

separates the clay that then settles on site and seals, making it more difficult for soils to absorb water afterwards. Cover crops reduce rainfall impact intensity, preserving and increasing soil structure and thus soil permeability. Using a penetrometer to assess soil compaction can become another way to assess the benefits of cover crops, as the structure becomes more open."

Unruh likes to, "Allow grass to express themselves, the root systems are proportionate to their tops. If you mow or graze the grass, the grass will then slough off roots underneath and start the decomposition process, continuing the carbon cycle." He describes grass as a kind of living pump that can "pump carbon from the atmosphere into carbon in the soil." He continues to explain how grass creates soil structure, "The grass roots that grow, won't go down the same root hole, they have to find an easier route – so that creates pore space in soil. They may do so two to three cycles down the road, but they won't go down that path the next time. Microbes live off of both living and decaying roots and exude the glues that create functional soil structure." Unruh emphasizes that only plants can create food, "everybody" – meaning every other living creature in soil or on top of it – depends on plants. **On Unruh's orchard, "Soil biology creates our nutrients, rather than fertilizer." Over time as soil organic matter (SOM) goes up, this means putting cover crops on in lieu of fertilizer.** In 2018, Unruh used zero synthetic fertilizer for his walnut crop. In addition, the last time he added compost he questions the necessity given his high potassium and phosphorous levels. While he's been mostly polycultural (using multiple species in the cover crop mix) since the fall of 2013, Unruh is not sure where he stands on organic growing; he used insecticides last year for pest control, but looks back and wonders if he could have managed with integrated pest management and brought in more beneficial insects. Unruh's one certainty: focusing on soil health is the answer.

Unruh calls what he does, "Farming the sun." As guests ate the extraordinary walnut sticky buns his wife Rachelle Unruh had made for the event, the phrase felt more realistic than poetic. **Unruh emphasized a key side effect of the beautiful flowers on his cover crops: healthier bee and pollinator populations.** The interesting thing is, unlike almonds and nearly every other crop, walnuts use air movement to pollinate and thus do not require bees to pollinate. Nevertheless, a healthy population of pollinators like bees, butterflies and beetles is beneficial for biodiversity, for other food crops and is also key to biological control of pest bugs. While Unruh buys his seed from Lockwood Seed & Grain, he pointed out that Apis M. is *giving* away cover crop seeds to willing farmers to provide habitat for bees and other pollinators. In addition, California Department of Food and Agriculture (CDFA) has grants to fund cover crop seed for three years, while USDA-NRCS funds 50% of cover crop seeds via the Environmental Quality Incentives Program (EQIP) grants.

Unruh observes that leaves with a high brix (sugar) content are not something most pests can eat as many insects lack pancreas, so increasing the plant sap brix content is a winning recipe for growers. "The more biologically active your soil, the higher the brix content will be in the tree sap. You are delivering soil nutrition to the tree biologically." **Unruh restates his experiences, "The healthier your soil, the healthier your plants."** He uses a refractometer to check brix level in plant sap – if brix is consistently above 12%, many insects such as aphids and scale cannot eat the sap. He thinks if he hadn't gotten compost high in ammonia, he might not have needed to spray, assuming the compost changed the overall health of the orchard allowing pests a foothold.

So, to go back to 2012, when Unruh first took on management of the farm, there was a serious nematode infestation in the soil. He decided to try brassica cover crops (mustard and radish) as studies indicate that as the plants decompose both underground and aboveground, they give off a natural fumigant that would resolve the nematode problem. **As stated, now that he's using brassica cover crops, Unruh's orchard has had a year of what appears to be … zero nematodes.**

Unruh provided a schedule to growers of one year growing an orchard with cover crops. He started by observing that he is "real concerned about harvest," meaning that getting to a bare floor by October 1 is critical.

He uses solid set sprinklers for irrigation and emphasizes that, **"When the soil stays covered, the surface of the soil stays moist a lot longer."** His advice to growers starting out with cover crops is that this is, "Not a situation where you have to do the whole thing before next year. Implement little steps. Try it. Go for it with new ideas or…bingo moments."

Summer

Unruh suggests mowing in middle to late summer, though dates are flexible. The schedule begins with the moment when it appears the cover crops' flowers are about to set to seed: he rolls it with an Unruh roller and then he goes over it twice, in opposite directions. Four to six weeks later, he'll come back and shred the detritus. The plants begin to decompose in dry conditions (post rain). His comment about mowing too early, was that the detritus would sit in wet conditions and decomposition would go anaerobic, creating a hostile environment for aerobic biology in soil.

Fall

Around the first to the middle of September, he will spray the orchard floor with an herbicide (glyphosate) to prevent regrowth and, "Let it set right there."

Harvest

Right before harvest, most of the cover crop has decomposed and become part of the soil. We blow the strips clean when we harvest to get a completely clean floor because weed skeletons from weeds dying in the strips need to be cleared.

After Harvest

As soon as possible, plant winter cover crop seed between mid-October and by the second week of November.

The Mix

Unruh described his current brassica-dominant mix and talked about the benefits and difficulties of other cover crop mixes. He's in favor of veering towards a wide array of seeds, even up to three dozen plant species if he could, as this mimics biodiversity in nature and different plants do different things for soil health. He said that a triticale and rye mix can be beneficial in excessively compacted soil and he likes daikon for opening up the soil. Grass has a higher root pressure and can dig into compacted soil, building potassium and phosphorous. He likes Phacelia, Bell beans and peas for nitrogen. To determine the right mix of cover crop seed types, Unruh recommends trying the (free) smart mix calculator from Green Coverseed in Nebraska as you can use it as a guest.

Planting

Unruh's rows are 30 feet wide; his roller is 21 feet wide and the planter is 17 1/3 feet, so the whole plant fall out can be about 20 feet. He commented that you will want to "Narrow your strips up and still be able to navigate." He only plants an inch to 1 ¼ inch deep; as general advice, he says not to plant cover crops on beds but to plant flat. **Financially, Unruh points out that his reliance on cover crops – and lessened need for fertilizer and product to kill nematodes – has moved his costs "from $1200 - $1500 dollars an acre to just a few dollars over $800 an acre."**

Advice

At the end of this detail of his own practices, **Unruh observes, "Not one size fits every farmer. Know your situation and understand what is going on in your soil."** Looking forward, Unruh observes that out of about 95 nematode species, only about eight or nine are pests, and that beneficial nematodes rely on the remaining nematodes as food. These friendly nematodes serve as a critical part of the overall ecosystem within living soil. So, he's planning on changing out his mix of cover crop seeds to cut back on mustard and add more legumes and more grasses to up the nitrogen in the soil.

Unruh believes, "If you don't ever make any mistakes, you don't know if you did wrong or right." His closing advice, "Don't let the roadblock in the road end your journey. Find a way around it. Take baby steps."

Kabir Zahangir's presentation becomes the perfect balance to standing in Unruh's lush walnut orchard, focusing on soil. He used two trays of soil for the demonstration – one from an adjacent row crop field, with conventional farming practices, one from Unruh's orchard. After these differing life stories, these two soil samples, from nearly identical soils appear to have different visual

personalities – one is tan and compacted, the other has more visual soil structure and is the color of an excellent moist chocolate brownie. It is the darker soil that came from Unruh's orchard.

For the slake test, Kabir brought soil samples from Fine Points, California, where one sample came from a Cotton-Tomato rotation that had been conventionally farmed, and one sample came from an adjacent field that has had cover crops and no-till for 18 years. Kabir conducts the slake test with two large tubes of water, about 24" tall, with a clear tray parked in the top 10% of the water. In each, he puts a clod of soil from one of the two fields. Immediately the tan clod begins to crumble and fall apart. Soon the water beneath looks like tea with cream in it, then a muddy café au lait. The chocolate clod holds its shape and little tiny bubbles of air rise from the interior of the soil up to the water's surface. By half an hour the clod from the conventionally farmed orchard is nearly gone while the water below is murky. The clod from the field that has had 18 years of cover crops and no-till is remarkably stable. A few pieces are at the bottom of the tube of water – but the water itself is nearly clear and the soil still pops up the occasional air bubble. The implications to water quality, to topsoil erosion, to access to air for in-soil biota are stunning.

Meanwhile the two trays of local soil samples are sprayed by an overhead sprinkler that goes back and forth, watering each with fictional rain. Each angled tray is perforated and has a big clear glass jar underneath and, tilted, a glass jar at front.

Kabir Zahangir, West Regional Soil Health Specialist, USDA-NRCS

Most of the water runs off the top of the surface of the conventionally tilled soils, some percolates through without staying in the root zone, leaving little to stay in soil to hydrate plants. In front, the run-off is immense and the water coming off this soil sample is the color of a chocolate milk shake. It is sobering, to say the least. Meanwhile the water going into the soil from Unruh's orchard only passes through in part. The soil captures and holds the facsimile of rain – and the little that does run off is nearly clean.

At simulation end, both trays are dumped upside down. The one that was conventionally farmed is barely damp and crumples at the touch while the one with cover crops is gently moist; that pile of soil from the Unruh's orchard is irresistible. Audience members' faces reflect their assessment over which soil sample fared better in the rain simulation.

Top Soil, Conventionally Farmed

Bottom Soil, Unruh Farmed with Cover Crops

If you are interested in learning more about Soil Health or receiving information about Glenn County Resource Conservation District's field days, held in partnership with the USDA-Natural Resources Conservation Service and UC Cooperative Extension, please contact Melina Watts via email at melina@glenncountyrcd.org or by calling the Glenn County RCD's office at 530-934-4601 x5.

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