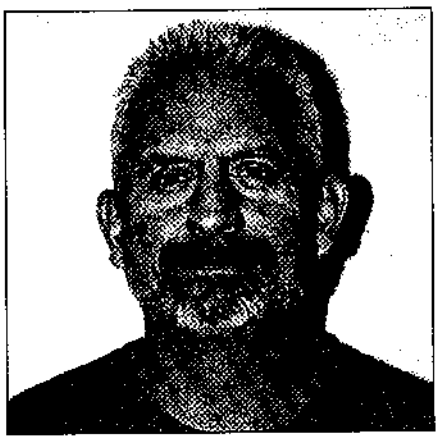
Soil Matters

USDA Agronomist Teaches the Value of Soil as Ecosystem



Agronomist Ray Archuleta's persona as Ray the Soil Guy charms audiences all over the country, blending humor, visual aids and an effervescent personality to persuade people of the importance of creating and maintaining soil health. Yet he is not a roving proselytizer out there on his own, working without portfolio. He works for the Natural Resources Conservation Service, a division of that notorious promoter of industrial agriculture, the USDA. His popularity and success point to a culture change within the NRCS, which began life decades ago as the U.S. Soil Conservation Service. If you had told most people 20 years ago that a USDA man would be all over the place advising farmers to reduce their tillage dramatically and pay attention to soil ecosystems, the average agriculturalist might have told you to quit dreaming. But that is exactly what is happening right now, and Ray Archuleta is the man behind it.

Ray Archuleta

Interviewed by Chris Walters

ACRES U.S.A. How long have you been with the Natural Resources Conservation Service/USDA? Did you always plan to work in the soil science field?

RAY ARCHULETA. Since 1987. As a kid growing up and working on my uncle's ranch in New Mexico, I found my calling in agriculture. Working on the land bucking bales, haying, working cows and just being on the land was a moving experience for me. From that point I knew my vocation. This experience led me to get a degree in agriculture science from community college in Española. After that I attended New Mexico State University in Las Cruces to finish my degree in Agricultural Biology. Then I completed 28 hours of graduate school in soil science, but never completed my master's degree. I inadvertently worked my way into soils.

ACRES U.S.A. How did your academic training prepare or fail to prepare you for working with the Natural Resources Conservation Service?

ARCHULETA. My formal agricultural education taught me how to learn and attain knowledge. The math, chemistry and biology were helpful classes, but my agricultural classes were taught without context. I was taught a very reductionist, linear view of soil and natural ecosystems; reductionist science is a very fragmented way of looking at natural systems. I did not learn critical thinking that embraced a holistic, big picture ecological view of farming systems or agroecosystems. You cannot forget that the parts, the microscopic view, are connected and are part of the whole, the macroscopic view. Natural ecosystems and agroecosystems are dynamic living systems, not predictable-non-linear systems. Not one of my ag professors clearly stated the correct premise for my education. The premise I learned from school was to improve production.

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If you start with the wrong premise you come up with the wrong conclusion. The correct premise is production through biomimicry. Mimic the biology — in other words, farm in nature's image. We need to nurture and understand how our agroecosystems can mimic, collaborate, and facilitate with natural ecosystems. But instead I learned the control and command paradigm which is to force, control and genetically manipulate our agroecosystems (farming systems) to increase production. This premise is taught in most agriculture schools throughout the country. This kind of training did not help me in the Peace Corps and my early years with NRCS. During that early stage of my career I was a technician designing irrigation systems, but the sad thing was that I was designing irrigation systems for degraded soils. The worst part of that story is that I did not realize that they were degraded. I designed conservation practices that were out of context and did not fix the problem. I helped design conservation practices that helped producers be more efficient in being "inefficient" with their conservation practices. I did band-aid work, dealing with symptoms but not healing the problem.

ACRES U.S.A. Does the dominant goal of ramping up production still hold sway?

ARCHULETA. Yes. Modern agriculture has to maintain large infrastructure, which requires large capital outlay and dependency on costly petroleum-based inputs. High yields are needed to sustain this type of treadmill agriculture. I see modern agriculture fraying under this burden. The soil health movement teaches producers to improve soil function by understanding how to mimic nature's architecture by utilizing cover crops — biological primers and energy transformers — and integrating cropping and grazing systems together, coupled with zero tilling. Producers with this type of understanding are drastically reducing pesticides, fertilizer and fuel usage. By doing this, producers help reduce their dependency on petroleum inputs which will help reduce risk and at the same time increase resilience in soils against drought and flooding. Plus the nutrient quality of our food is increased with an intact soil food web. This type of thinking will give our producers real independence.

ACRES U.S.A. Somehow feeding the world means raising an immense amount of corn for ethanol and sweeteners. "We feed the world" used to be annoying. Now it makes informed people want to throw things. Do you agree?

ARCHULETA. I stopped drinking that Kool-Aid years ago — once I started thinking for myself and after I did a two-year Peace Corps tour in Guatemala. I realize that this mantra is pernicious to our country and the world. I say let the world feed itself, and let us teach them how. I understand that Chinese proverb about teaching a man how to fish keeps him fed for a lifetime. With 9 billion people coming in we're going to need everybody to feed everybody, so let them feed themselves. Let's teach others how to restore the soil so that the world feeds itself and restores our planet at the same time. This will give purpose and dignity to the human race.

ACRES U.S.A. Is that why you start a lecture by showing the slake test and other soil demonstrations, such as that corker where you drop a chunk of soil on the floor that's more like a rock?

ARCHULETA. Absolutely. If I do not start my talks with these soil demonstrations people will not believe the soil health message. In the words of Mark Twain, "It ain't what you don't know what gets you in trouble. It's what you know for sure that just ain't so." These soil demonstrations dispel what ain't so about soils. I let the soil resource speak for itself without offending the audience. These soil demonstrations are much more effective and articulate than I will ever be.

ACRES U.S.A. You've evolved a friendly, appealing personality for talking to groups of people. Did this come naturally?

ARCHULETA. No, it was a painful process learned by doing it over and over and over. I think part of it is due to my church upbringing. I used to try to force people to believe the Gospel, which was wrong and arrogant of me. I've learned to speak to people in a way that shows concern and love for the recipients and not force my opinion. Learning is a two-way street; both the messenger and recipient have to be ready for the message. It is all about approach. My opinion is not important. The truth speaks for itself and does not need me; I just get in the way. My goal is to get out of the way and not force it — it took me awhile to learn this, and I'm still learning. I want the focus to be on them and the resource. So to me it does not matter if you are an organic farmer, conventional farmer, no-till farmer, rancher, grazer, or other type of producer — I love you just the same.

ACRES U.S.A. What are the contrasts or parallels between trying to persuade a subsistence farmer in Guatemala to do something different and trying to persuade a production farmer in the United States to try something new?

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ARCHULETA. I think one of the things common between subsistence farmers in Guatemala and any type of farmer in the United States is that they both want to provide for their families and at the same time avert risk. Their whole livelihood is based on how they farm, and it scares them to try something different. Also, it is hard to think outside of the box. Wherever you learned your concepts of farming, it is hard to initiate a change because of fear and ignorance. If I'm a subsistence farmer in Guatemala and I am going to change the way I farm, I'm risking whether I am going to have food for my family that year. It's the same thing in United States — will I be able to pay the mortgage, pay off the equipment? Most producers are working with tight margins. If you're growing and learning, you have to take risk. Risk-takers have learned to embrace failure, which makes them strong. Society as a whole benefits from their strength. So I see farmers all over the country, all over the world, doing the same thing. Pretty much universal — they do what they've been taught. Before attempting anything new they have to have a change of mind, a new paradigm. Taking on risk and accepting failure is a part of the process of change.

ACRES U.S.A. Where do you start with people? What are the early steps to turning around a typical degraded soil situation?

ARCHULETA. First, it starts with the way you think about the soil resource. We teach that the soil is a complex living ecosystem, a sub-aquatic habitat for a myriad of organisms. It is more than a growing medium. Second, it is a habitat energized by carbon, or food. This living ecosystem cannot handle chronic stress of continual physical (tillage), chemical (pesticides) and biological (over-grazing) disturbances that diminish function. This subterranean elegant universe is interconnected to our climate, to all ecosystems, and to us. Third, I stress that everything is connected and is one. I learned this by studying ecology, quantum physics and theology.

ACRES U.S.A. Assuming you're over that hurdle, what's the next step?

ARCHULETA. The farm has to be ecologically and economically resilient. Resiliency comes through redundancy of diversity. What do I mean by redundancy? Redundancy is overlap in function. Soils have over 50,000 species of bacteria in 1 gram of soil. Many of these organisms can carry out the same function in the soil. A resilient farm should have diversity of income as well: sell cows, pigs, chickens, cover crop seed, etc. Lack of ecological and economic resilience leaves your family and farm fragile. The pathway to an anti-fragile life and farm is redundancy through diversity. So when an economic disturbance of two-dollar corn comes, your operation can bounce back quickly.

ACRES U.S.A. You've said in your lectures that you run into quite a few organic farmers who practice too much tillage. Why is that, what do you tell them, and how do they handle it when you tell them?

ARCHULETA. Actually organic farmers are among the more knowledgeable groups that I deal with because they know soil biology. The majority of them are very well read. Using the slake test and other soil demonstrations help me show that tillage is not their friend. Tillage disrupts, diminishes, and creates disorder to the soil ecosystem. Tillage is a tool, a sledge hammer. You must use it with caution. Soil microbiologists and soil ecologists theorize that tillage breaks up soil aggregates, which exposes them to oxygen, which stimulates r-strategist or copiotrophic — opportunistic — bacteria to consume the biotic glues, organic mineral complexes, and other forms of organic matter in the soil ecosystem. All soils have opportunistic bacteria. Under normal soil conditions this type of bacteria help break down residue, manure and other carbon sources. These organisms are needed in soil ecosystems. But tillage stimulates the soil organisms to consume the soil house. Old-timers used to call cancer of the body "the consumption." Chronic tillage is a consumption of the soil. Cancer is a normal metabolic process in the body gone haywire. Tillage does a similar thing; it makes a normal metabolic process go bad. This consumption stimulates exponential microbial growth within hours. Plus, weed seeds are brought back to the surface through tillage. When microbes die off, inorganic nitrogen is released in the nitrate form which stimulates weed growth. Tillage destroys macro-aggregates, severs the mycorrhizal network, and diminishes the soil food web. Nature does not invert itself. Once organic farmers understand how tillage diminishes the ecosystem, they respond well.

ACRES U.S.A. Why do many organic farmers — not to mention conventional who are utterly bound to it — still practice excessive tilling? The no-till rationale is not a state secret.

ARCHULETA. I think the majority of people don't realize how diminishing tillage is. A lot of people go to no-till because it saves them time. I speak across the entire country, I have taught thousands, and rarely has anybody said, "Oh yeah, I went to no-till because I could see tilling was destroying the soil." People who went to no-till did it because it saved money initially, and time. Later on at NRCS we could see that we had better aggregation, water would infiltrate better, and not as much weeding either. We promoted the drill but we didn't promote understanding.

ACRES U.S.A. Are animals essential to your vision?

ARCHULETA. Nature does not farm without animals. We have to integrate animals back into our cropping systems. You can't expect organic no-till to work without them, especially for controlling weeds. One of toughest challenges facing organic farmers is weed control. The best way to control weeds is to use cover crops and grazing. If you do not fill the niche, nature will fill it with weeds. Animals make the farm more resilient.

ACRES U.S.A. Do people in the conventional world need to make a crucial shift from regarding weeds as attackers to regarding them as signals that tell you to do something different?

ARCHULETA. I like that. I call them nature's healers and scabs. They're indicator species. They are telling me that I'm doing something wrong. If you have weed issues, I tell my farmers, you're tilling too much or you're over-grazing. If you have a lot of weeds in the pasture you are not giving it enough recovery time; you're over-grazing. The natural system is de-

signed to allow those species to dominate when we do too much chemical, biological and physical disturbance. I call weeds first responders. They start the healing process. Some weeds have over 24 percent protein, and some weeds can bring up minerals from lower depths of the profile to redistribute them to the topsoil! We need them. I have a total different view of weeds ... they serve a purpose.

ACRES U.S.A. "The soil is naked, hungry, thirsty, and running a fever," you said in one of your lectures. Does it help jolt people into a new way of thinking when you personalize it by talking about the soil as if it was a person?

ARCHULETA. It does. I think it connects. We are part of the soil, we're made out of soil, and we are the soil. We are part of the whole ecosystem.

ACRES U.S.A. What are farmers not hearing from the mainline agriculture press and the people that talk to them the most?

ARCHULETA. Soil ecology and soil biology. I used to think that NPK were the most important things in the soil, the most limiting factors. Now I say it is carbon. Carbon drives the soil ecosystem. That's one of the things they don't hear. It's about carbon. It's about the soil organisms, the micro-herd. But this is changing, and now you see lots of magazines talking about cover crops.

ACRES U.S.A. What do you mean by decoupling the carbon-nitrogen cycle?

ARCHULETA. Soils are one of the largest sinks of carbon. We need to store the carbon in the soil. The point is how we're treating the soil ecosystem and how we're managing it. We need to revegetate our planet. If we heal our soils we fix the carbon cycle, nutrient cycle and water cycle.

ACRES U.S.A. Do you worry about people missing the larger point of soil health?

ARCHULETA. Yes. I am concerned that people will miss the mark about soil health. Soil health is an educational movement driven by the producers, a journey of understanding. This is not

about throwing money, conservation programs, and government process at the problems only to fix symptoms. This is about healing the land by illuminating the mind and convincing the heart to change. Soil health is connecting people back to the land through understanding of how the soil ecosystem functions and learning the wisdom of how to make right decisions on the land according to each person's ecological, economic and social context.

ACRES U.S.A. But is it helpful when research proves the effectiveness and profitability of building soils?

ARCHULETA. Certainly. The research had been around for many years. We have enough research to fix our problems, but do we have the political, social and emotional will to fix our problems?

ACRES U.S.A. The USDA is a house with many rooms. What roles do the ARS and NRCS play, and what is your job description? Are you a free roaming ambassador of soil health?

ARCHULETA. NRCS is the biggest private land agency. We deal only with private land and work directly with producers all over the country. I'm a Conservation Agronomist at the East National Technology Service Center on the Soil Health Sustainability Team. There are three tech centers. The centers were set up to provide technical knowledge along with training to our field staff, and to work closely with universities and other research agencies like ARS. ARS — Agricultural Research Service — is our sister agency. They do the research, and we help implement the science to help develop soil resources.

ACRES U.S.A. When did you start teaching soil health across the nation?

ARCHULETA. About six or seven years ago. Initially, soil health started for me with the help of Jay Fuhrer, Jon Stika, Gabe Brown and the Burleigh Soil Health team in North Dakota. The North Dakota soil health team helped me change the way I looked at agriculture. Then I started doing extensive reading on my own. Providentially reading the right books and research papers and meeting the right people changed my view of agriculture. Conservation districts would call and ask me to teach a workshop or a field day for their landowners. The response was so good that I was invited to big venues like the National No-Till Conference. The demand for this knowledge kept growing. There is an incredible hunger out there for facts about agroecology and soil biology.

ACRES U.S.A. You're describing a change in agency culture that came from the people you serve rather than an administrative decision?

ARCHULETA. Absolutely. You got it. The grassroots farmers and ranchers demanded this. They changed it, they drove it! Farmers like Raymond McCormick talked to David White, then

chief of NRCS. "We want soil health," he told him. Farmers and ranchers like Gabe Brown, David Brandt, Gail Fuller and many more drove this soil health bus. This was driven from the bottom up. This is why it will last for a long time. This is not a flash in the pan like many say.

ACRES U.S.A. One of the natural resources you can't do without is water. Why is looking at wasted water as a runoff problem the wrong approach as opposed to calling it an infiltration problem?

ARCHULETA. The moment you say we have a runoff problem you focus on symptoms, not on the problem. Runoff is a symptom of poor soil function. Dealing with runoff is reactive; dealing with infiltration is proactive. That's a huge distinction. Once the water reaches the buffer it is too late. We have to deal with the raindrop the moment it lands on the soil. We have to intercept the raindrop with residue or a living plant. Soil has to be covered all the time.

ACRES U.S.A. Do you think reorienting the way you look at it can improve the way that the EPA and the NRCS help head off the next crisis-level flood? Apparently climate change makes the moisture gather for a time in the upper atmosphere, where it turns into a thick soup before releasing all at once.

ARCHULETA. People focus so much on carbon dioxide. I think they don't focus enough on the soils that are naked and uncovered. We changed the microclimate, and it changed the macroclimate. They're connected. When you have this huge land mass that is uncovered, you're going to change the climate. We stress what comes out of the end of an exhaust pipe so much I think we miss the mark. My concern is that we don't capture enough solar energy using living covers. Can you imagine what it would do for our climate if we covered hundreds of millions of acres at the end of every year? How we could sequester nutrients and bring CO_2 back into the soil and hold it there? It would be huge. If we fix the microclimate we will fix the macroclimate by healing the soil, and bring back the rain in a more normalized fashion.

ACRES U.S.A. What gives you a sense of optimism?

ARCHULETA. I've never seen so many young people getting back into agriculture. I see an incredibly bright future for agriculture. I see the power of community kicking in and people wanting to buy their food locally. They want to know their producer; they want to know who is producing the food. They want to know that it's not saturated with pesticides and fertilizer. People want to connect back to the land, and I see that happening more and more. That's what the soil health movement is — getting people to connect. You can see more communities growing large gardens. I think the wave of the future is people doing more gardening, a great way to connect to the natural ecosystem.

ACRES U.S.A. What's next for you?

ARCHULETA. I have four or five years before I retire from NRCS, and what I want to do is facilitate learning. I think we have reached a tipping point in our agency. I want to see this movement become a permanent way of doing business in our agency. NRCS now is planning to create a soil health division, hire 16 more people like myself and place them all over the country to be point people and teachers. I want the soil health movement to carry over to the general public, where people are becoming more knowledgeable. I want to see TV commercials on soil health. There has been a lot of talk about the soil, and we've seen a lot of soil documentaries, but we need to personalize the topic. We need to show how farmers' lives are changing as they heal the land. I want to promote soil health all over the world. I have received requests to teach in Australia, South Africa, France and Germany. I see this movement continuing to grow. I want to continue to be part of the soil health movement until I am part of the soil food web.

To check out some of Ray Archuleta's "Soil Health Lessons in a Minute" videos visit *www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/health/?cid=stelprdb1048858.*