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Soil Biology Revolution

Jim Ruen | Article is from August 5, 2011 issue of Ag Professional magazine. Reprinted by Perfect Blend, LLC

Charlie Walthall and Jerry Hatfield are rebels with a cause. As top-tier researchers with the USDA Agricultural Research Service, they are part of what Walthall describes as a revolutionary approach to plant health and productivity. It is one that could be key to meeting present and future food, fuel and fiber needs. If so, it will also be key to full-service ag retailers, independent crop consultants and other agronomic service providers meeting their customers' needs.

“We are approaching soil now as a living entity, examining the feeding, care and health of the soil,” said Walthall, national program leader, USDA ARS. “If the soil is healthy, it will be able to sustain healthy plants and good yields. Genetics and genomics are an important part of the equation, but it is clear that how we care for and manage the soil is an even bigger part.”

Jerry Hatfield, director, National Laboratory for Agriculture and the Environment, (formerly Soil Tilth Lab), Ames, Iowa, points to variations in crop yield across any given field as evidence of a need to look deeper than genetics, tillage or traditional nutrient applications. “When we watch a yield monitor as a combine crosses a field, we can see yield variations from 75 bushels to 100 bushels to 250 bushels,” said Hatfield. “A lot of that is due to poor soils in parts of the field. If all that was missing was nitrogen (N), phosphorus (P) and potassium (K), then adding them should alleviate the yield difference. But we need to approach the problem from a more holistic viewpoint.”

The viewpoint suggested by Walthall and Hatfield is one of soil biology. Rather than viewing soils as an amalgamation of clay, sand and nutrients, they advocate including the biological activity, bacteria, fungi and other subsurface life forms that feed plant root systems.

“The bottom line is that by promoting a healthy biological system in the soil, we are adding the glue that holds the sand and clay together in a more resilient state,” noted Hatfield. “We need to build up the aggregate stability of the soil in order to increase aeration and the capacity of the soil to increase water infiltration and absorption and decrease erosion. Then we can incorporate the best genetics and nutrients.”

Examining Biotic Fertilizer



The biotic fertilizer processing, which is now in its fourth generation of improvement, is being done at a production plant that easily could be duplicated for converting chicken litter other than Washington.

The two researchers are not alone in their interest in soil biology. Walthall noted that a number of companies have approached him or made him aware of work they are doing in this area. Researchers, some of them private and some USDA ARS scientists, are looking at everything from manures and compost to soil inoculants and the impact of biochar on soil quality and productivity. One commercial product being examined is Perfect Blend biotic fertilizer (“Manure Based Fertilizers,” AgProfessional, Aug., 2008). Introduced originally as an organic fertilizer, the chicken litter based product is processed into a uniform chelated product with added mycorrhizal inoculants and select micronutrients.

The result is, as the name implies, a “blended” fertilizer. The chelated form of the nutrients makes them immediately available to soil flora and fauna, “living” microorganisms, hence the biotic descriptor. The company offers chicken-litter based organic and conventional products including 4-4-4, urea supplemented 8-4-2 and a 16-3-7, as well as other component-supplemented products. The goal with biotic fertilizer is to enhance biological activity, not

simply feed the plant directly. The chelated fertilizer is designed for a diverse population of soil bacteria including cyanobacteria or blue-green algae in the soil. According to the company, as their populations explode, they feed other soil microorganisms, all of which in turn feed the crop.

“It’s a regenerative protein cycle,” explained John Marler, senior vice president, Perfect Blend. “As the amino acids and minerals enter the soil and are consumed by soil bacteria that are 90 percent protein, they in turn generate new sources of protein. You can’t have perpetual energy, but the cyanobacteria use sunlight and CO₂ to add energy to the cycle. By hitting the soil with nutrients focused for resident soil microbes, we are growing thousands of pounds of soil microbes that are 14 percent N.”

Testing In-Field Plots

Hatfield has included the biotic fertilizer in a number of plots this summer at different rates. He is also comparing it with conventional fertilizer applications, as well as combinations of Perfect Blend and conventional components.

“What intrigued me about Perfect Blend was the interesting mix of materials to sustain biological activity,” said Hatfield. “If we can marry improving the overall soil biology and the capability of the soil, how does that couple with different forms of nitrogen and N availability?”

After several years of whole-field applications of Perfect Blend at different rates, Jason Baumberger and his customers don’t have to rely on plots to compare biotics with conventional fertilizer. The Moses Lake, Wash., Crop Production Services branch manager has been distributing the organic and non-organic certified products for several years. Initially he was attracted to the product line as a way to deliver nutrients in a carbon form to the crop in an effort to enhance biological activity in the soil.

“I am very interested in carbon chemistry and its effect on conventional NPK utilization, but it was very tough to put a finger on the impact of raw or even composted manure,” said Baumberger. “Perfect Blend made my job easy. The nutrients are in a form that is easy to handle, offer a uniform consistency and will provide predictable results.”

Use of kinetic composting

Much of that handling ease is due to the company’s high-speed kinetic composting that breaks down ingredients to a consistent molecular structure before further processing. Baumberger wanted this consistency and ease of handling compared with mined gypsum that varies from dust to pebble size. He saw that the Perfect Blend process could deliver it.

“I believed if we could get carbon, gypsum and phosphate to work together, we would see tremendous improvement in crop nutrition and health,” said Baumberger. “I told Perfect Blend management their triple four with added gypsum would be the best of both worlds.”



Success has been shown in using biotic fertilizer in various crop production including fields of potatoes.

The company responded with a biotic-calcium, and last fall Baumberger initiated a study with the new product, making fall applications for a group of progressive growers. Farms included a wide variety of sizes and most crops grown in the Columbia River basin, from grass for seed to row crops like peas, corn and potatoes as well as timothy and alfalfa hay. Yield data is yet to be gathered, but visual indicators are positive enough that growers have said they want more of the product.

“The formulation was easy to handle with standard equipment,” said Baumberger. “The gypsum is giving the soil the conditioning and water penetration we expected, and the

biotic fertilizer is improving plant health and vigor, producing a beautiful dark green color. The increased plant health and nutrition is making it easier to manage diseases too.”

Bill Cisneros, marketing vice president, Perfect Blend, said the biotic-calcium, like the urea-supplemented products, is opening new markets for the company. Product use is expanding from high-value crops to conventional cropland use, and distribution is set to expand from the Pacific Northwest into the Midwest. The company also has lowered cost of production with a fourth generation of process improvements. USDA and other studies are reinforcing what Baumberger and current growers have experienced, showing improved quality and yield with the biotic approach.

“The mindset of the agricultural community has been very fixed on isolationist chemistry,” said Cisneros. “We offer a systems approach that includes readily available macronutrients, pH amendments and micronutrients—in some cases infused with microorganisms. We are also looking at other inoculants and multiple forms of calcium as well as a biotic-phosphorus.”

Healthier plants better able to fight off disease are a key part of the biotic fertilizer product offer. When early customers cited reduced powdery mildew in salad greens and reduced clubfoot in cole crops, Marler, Cisneros and company president, Dan Hazen took note. As more reports came in, the company began to fine-tune their process and their patent on the health consequences of biotic fertilizer. The results have helped encourage the company’s transition from organic to conventional.

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“After one of our large growers noted no fungus in his organic fields treated with Perfect Blend while conventional fields across the road were loaded, they started using it on the conventional fields, too,” said Marler. “Their yields have gone up 23 percent over a five-year average, and acceptability has gone sky high. Total solids and sugars have gone up, and fungus has dropped off the radar.”



Defining the Concept

For the past decade, Perfect Blend has struggled to define itself and gain acceptance with the biotic fertilizer concept. With Hatfield and Walthall taking the biotic concept seriously and distributors like Baumberger getting user endorsements, biotic fertilizer appears to be at a tipping point. Perfect Blend appears positioned to lead the way.

Hazen said those 10 plus years have allowed the company to develop its process and refine a scalable plant easily duplicated and licensed. Revenue has shifted from solely organic to 70 percent conventional sales. Perhaps most important is sustainability. If the company is competitive with conventional products today, what happens as those conventional products continue to increase in price? As Marler pointed out, the basic ingredient in biotic fertilizer is in abundance.

“We produce 300 million tons of manure in the U.S. each year alone,” he said. “Last year we used only 50 million tons of fertilizer. Every technology has an S-curve. Right now biotic is at the bottom of the S, where it rises steeply before it flattens out again. I would suggest that within 50 years, current N, P and K technology will be used at much lower rates as biotic fertilizer supplants it.”