Newsletter for leading crop producers *Fall 2005*

AgriEnergy Resources

2005 enhanced Residuce products

Throughout the year, the microbiology laboratory has been actively evaluating microbial cultures isolated from decomposing residues.

These isolates of bacteria, fungi, and actinomycetes are included in each of the RESIDUCE, RESIDUCE PLUS, RESIDUCE DF and ORGANIC RESIDUCE products.They aid in residue breakdown and the conversion of cellulose and lignin into nutrients that will be available for the 2006 crop. In addition, soil microbes transform residue into humus, build soil organic matter, reduce nutrient leaching and cleanse soil by breaking down chemicals.

Apply a RESIDUCE program as soon as possible after harvest to speed the rate of fall residue decomposition. If delayed, don't hesitate to put on a late fall application, because microbial activity can occur at cooler temperatures and even when a blanket of snow insulates the ground. A fall application puts the residue in place for spring when the soils warm up.

USDA focuses on increasing soil mycorrhizal activity

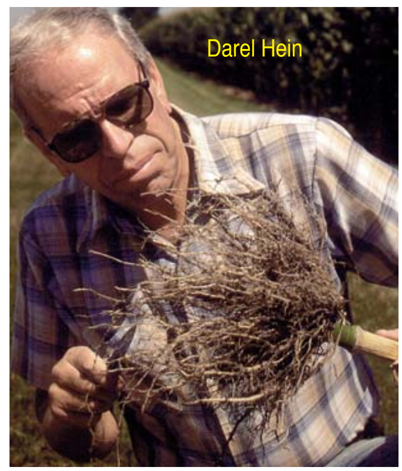
Kathleen Draper, Microbiologist for AgriEnergy Resources, recently attended a USDA workshop emphasizing the importance of soil life in crop production, with the main focus being on mycorrhizal fungi. This group of fungi live symbiotically in the root rhizosphere with most plant species that exist The focus of their research is to find ways to increase mycorrhizal populations in row crops and grains and enhance their overall benefits to plant growth. These fungi have been widely researched and their overall benefits to plants and soil include increased stress tolerance, nutrient uptake, photosynthesis, crop yield, soil structure, water holding capacity and soil carbon sequestration.

AgriEnergy Resources continues to research products that will provide our customers with beneficial soil microbes. MYCO SEED TREAT, MYCORRHIZAL ROOTLOCK and MYCO BIO BOOST are all products that include mycorrhizal fungi. Remember to use these products when doing your fall seedings of wheat, cover crops and pastures, and for fall transplants.

Cashing in on almost "free" nitrogen in 2006

Farmers with several years of Renewable Farming experience are showing their neighbors one way to cope with two problems: Corn is selling for only $1.80 per bushel, while nitrogen fertilizer costs almost 30¢ per pound.

By capturing more nutrients in crop residue, you can gradually cut applied nitrogen from the common rate of 150 lbs. per acre to 100 lbs. *or less* without yield loss. Darel Hein of Walcott, IA normally raises 200 to 215 bu. or corn per acre with only 70 lbs. of N as 32% liquid on corn after soybeans. Depending on late spring N tests, he may add up to 40 more units of N.



In seasons with good rainfall, some of his fields top 250 bushels. With record low rainfall in the first seven months of 2005, he expects this year's corn to slip back into the 160- to 170-bu. range. "With our record drought, it's surprising we don't have a total crop failure," says Darel. "Our yield monitor shows a soybean yield of 67.7 bu. per acre."

Darel's agronomy consultant, Bob Boehle of Bloomington, IL confirms that Darel is "definitely able to cut back on purchased fertilizer because he has excellent soil biology and good fertility balance."

Boehle adds that in past years, he has typically saved his consulting clients about $30 an acre on purchased fertilizer costs by improving fertility balance, calcium levels and active digestion of crop residues in corn-soybean rotations and continuous corn. That saving could be even greater as prices of nitrogen rise through 26¢ per lb. while P and K both cost around 22¢ per pound.

Here's a guide to how much you might save: Six tons of corn stalk, leaf and root residue per acre contain about 80 lbs. of N, 30 lbs. of P and 190 lbs. of K.

Not all of that converts to plant-available form, but AgriEnergy Resources agronomist Ken Musselman cites Pat Muir, Oregon State University, who says that biologically recycling residue from a 150-bu. corn crop could replace 33% of the N, a third of the P and all the K typically applied to those fields in an inorganic form.

Darel Hein is doing even better than that on N savings. He knifes in 70 lbs. early, followed by up to 40 lbs. if indicated by a late spring nitrogen test.

Hein's biologically active soil is far more effective in capturing carbon than a biologically inert soil which allows nutrients to oxidize in the weather or leach away with rainfall.

Residue to the rescue! This fall, more than any previous season, we're encouraging farmers to apply Residue to save fertilizer dollars, stabilize yield performance and gradually enrich soils. Each year, our AgriEnergy Resources microbiology researchers improve this blend of biological and nutrient ingredients. This fall we can provide Residue in four convenient forms, including a dry flowable product.

Many Illinois producers will harvest crops early, offering an opportunity to apply Residue and get residue worked into the top few inches of soil. We expect that to pay off very well in the 2006 season.

What you can learn from the "Dean" of composting

Malcolm Beck is probably America's most widely known mentor of composting for farmers. He began composting as a part-time farmer while also holding a full-time job with a railroad for 32 years.

Just north of San Antonio, TX, he built one of the nation's largest commercial composting operations, called Garden-Ville. He recently sold it to an operating firm, but still lives on the site as a consultant while he roams the country educating farmers on the rewards of composting.

One of his sons operates another major composting enterprise at Austin, Texas.

At our summer seminar, he shared highlights of what he has learned over all these years.

"Once, back when my sons were in their teens, I had them haul manure from neighboring farms so they could earn money for a car.

"We got quite a pile of manure, which gradually composted. One day a friend asked if he could buy a pickup load of this mellowed-out stuff. He paid me $40 for it.

"That seemed like pretty easy money. Before long, we were in the business of selling compost."

Beck developed an inexpensive composting method: mixing carbon-rich materials with clay and sand in large piles, then turning the piles with a front loader at least five or six times over eight months.

"People noticed that my farm didn't have many weeds, because the heat of composting destroys weed seeds. By 1998, we were selling $4 million of compost annually. And I had intended to farm, not get into the compost business."

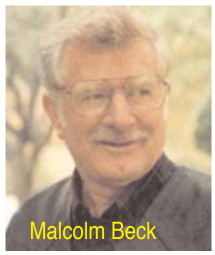
He bought a closed-down feed mill so he could blend organic fertilizers containing compost, bone meal, blood meal, brewer's yeast and other ingredients.

That broadened his market for natural fertility materials.

"One greenhouse operator told me that he never lost a plant to root rot after starting to use our compost-based fertilizer," Beck said.

"When I started farming, the university specialists told me it makes no difference whether you use chemical fertilizer or natural organic fertilizer.

"But there is a difference. The microbes need a source of energy to convert that fertilizer into ionic forms available to the plant. If you use chemical fertilizer, the microbes and other soil organisms have to extract energy, such as carbon, from the soil. Soon you've burned up the organic matter in your soil, and you run into disease problems in your crops. When microbes break down organic fertilizer like compost, it provides an abundance of energy. Also, compost contains micronutrients which are balanced for plant health."


Malcolm Beck

With extensive testing at Trinity University in San Antonio, Beck also learned what his compost does *not* contain: pathogenic types of bacteria. The high temperatures of composting kills such organisms.

Benefits of compost were quick to show up in southwest Texas. "We have either too much rain or not enough, very low organic matter, tight soils which don't absorb rainfall well, and lots of wind and water erosion," said Beck.

He explained how a higher level of organic matter and biological activity in the soil saves moisture by bathing the crop in a higher concentration of carbon dioxide from the respiration of soil organisms.

"One researcher found that crops grown on soils rich in organic matter don't need to leave their leaf stomata open very long to take in the carbon dioxide they need to build carbohydrates.

"In such soils there's an abundance of carbon dioxide under the crop canopy from the respiration of microbes and other organisms in the soil food web.

"Since a plant transpires through its stomata about 99% of the moisture it takes from the soil, reducing the time those stomata need to stay open to take in carbon dioxide can *also reduce moisture loss*. It helps drought-proof the plant."

Beck used this principle when he built a greenhouse.

"Instead of a gravel floor, I used wood chips, compost and the inert mineral perlite. For fertilizer in the potting plants, I used fish emulsion.

"I had a lot of residue breakdown in the greenhouse from both the flooring mulch and the soil, so there was plenty of carbon dioxide. Plants had balanced nutrients, ideal moisture and abundant carbon dioxide.

"And I've never had an insect problem in the greenhouse."

Beck grew curious about the underlying reasons why clients were getting better yields and fewer disease problems by adding compost and inoculating soils with beneficial, residue-digesting organisms.

One farmer who used this system grew cotton which consistently looked excellent, especially when compared with conventional fields during dry weather.

Said Beck: "I knew there was more to this story, so I took soil samples of his field and neighboring conventional fields. On the soil analysis report, there was very little difference between the nutrient levels in this farmer's soils and the neighbor's. So the answer wasn't in the fertility level."

Beck asked USDA scientist Dr. Don Marx what could be causing the striking difference between the composted, inoculated cotton fields and conventional fields.

"Dr. Marx asked me to dig up root balls from the crop in each field and send them to him for analysis. Three weeks later I got a fax from him, saying there was a striking difference in the amount of mychorrizal fungi in the two fields.

"The fields which had been inoculated several times had large colonies of mychorriza, and ten times the root mass of the conventionally farmed field. With more roots, you can grow more cotton. It's really pretty simple."

New research reveals benefits of "biological buffering"

Renewable Farming enthusiasts have observed for years that "healthy soils lead to healthy crops" — along with reduced weed and insect pressure.

Now, replicated research is verifying that experience and helping explain how biological systems help crops fight off disease and insects.

Dr. Larry Phelan has pioneered this research at the Ohio Agricultural Research and Development Center (OARDC) for 20 years. Here are some recent findings he reported to farmers at our Renewable Farming Summer Seminar.

Factory vs. Ecosystem: Phelan said that when scientists design experiments with the understanding they're working with a complex and interactive ecosystem which can't be reduced to individual components, it "leads to a different way for us to do research: All components are interconnected."

The OARDC teams saw farmers with years of experience as mentors.

To conduct controlled greenhouse experiments, they took representative samples of soil from organic farms, plus soils of identical types from nearby conventional farms.

They filled greenhouse pots with these soils, planted corn and soybeans in the pots, and began testing for insect resistance.

First corn borer trial: Pots with corn growing in organic and conventional soils were fertilized three separate ways: Chemical fertilizer, fresh cow manure, and a control with no added fertility.

"Then we released corn borer moths in the greenhouse and counted egg masses to see which corn plants the insects preferred," said Phelan. Moths significantly preferred corn on soil from *conventional* farms, fertilized with fresh cow manure.

Second corn borer trial: Soils from the two types of farms were fertilized in the greenhouse with compost, ammonium nitrate, and a control with no fertilizer.

"Clearly, we saw low egg laying on the corn growing in soils from the organic farms, irrespective of the fertilizer added in our trials," reported Phelan. "There was much greater variability in egg laying on the corn grown in soil from conventionally fertilized farms than organic farms. The difference is not from the current fertilizer — it's the history of how each soil has been managed."

Phelan observed that corn on conventional soil also had greater incidence of diseases. "Diseased corn attracted insects," he said.

Greenhouse research at the Ohio Research and Development Center verifies the disease and insect resistance benefits of a healthy, living soil with an abundance of beneficial organisms.

What's the explanation for less insect pressure on corn growing in biologically active, carbon-rich soils?

Phelan explained the logic: "Crops are designed to get nutrients slowly from the soil food web, not suddenly from chemical nutrients.

"The food web gradually breaks down raw residue into smaller and smaller nutrient fractions. Natural soil nutrients need to go through this community before they're available to plants. As part of this process, crops produce a surprisingly large amount of exudates from their roots, stimulating organisms in the belowground ecosystem."

But if the crop suddenly receives a surge of applied nitrogen, "the plant system becomes out of balance, compared to obtaining nitrogen as needed through the soil food web."

On organic farms, spring nitrate tests show the soils usually have enough nitrate for early season growth; about 28 parts per million.

On conventionally fertilized soil, there's often two to four times the amount of available nitrogen needed for early spring growth.

"This gives rise to what we call the biological buffering concept," said Phelan. Organic matter buffers biological interactions.

OARDC noted that in high organic soils, adding fertilizer didn't change the nutrient levels within young corn plants very much. But in low-organic, conventionally fertilized soils, the plant tissue's nutrient balance changed drastically with added nitrogen.

This is evidence of biological buffering: the moderation of nutrient movement when there is an active soil food web. One benefit of this buffering is enabling a crop to allocate its energy in balanced amounts between growth and self-protection against insects and disease.

Plant breeders are familiar with this tradeoff: A bean variety resistant to disease may have lower yield than ones which don't resist disease. In fact, plant breeders who select primarily for yield can find those varieties more vulnerable to disease.

But we can trigger insect and disease vulnerability in plants with applications of highly available nitrogen or other soil nutrient imbalances, said Phelan.

For example, high levels of nitrate relative to potassium cause young corn to channel a distorted share of nutrients to growth, versus self-protection. Its leaves load up with free amino acids and simple sugars.

Observed Phelan: "Where corn was in balance nutritionally, we had low levels of free amino acids in the leaves. Corn out of balance had high levels of free amino acids — and the highest level of insect infestation."

In a separate study of iron, boron and zinc ratios on soybeans, OARDC research found that the ratio of these three micronutrients which resulted in the best plant health also resulted in the lowest infestation of insects such as soybean looper and Mexican bean beetle.

Phelan concluded: "When the plant is in good nutrient balance, insects don't do well. When it isn't, insects have a field day."

AgriEnergy Resources

This letter is brought to you by your AgriEnergy Resources consultant

Home office —
21417 1950 E St.,
Princeton, IL 61356
Phone — 815-872-1190
Fax — 815-872-1928
E-mail — info@agrienergy.net
Website — www.agrienergy.net

"We're on the edge of a revolution in nitrogen fertilizer recommendations."

That's the view of University of Illinois researcher Saeed Khan, who says farmers must estimate applied nitrogen needs with a "system that quantifies the main source, which is the soil."

University of Illinois soil fertility professor Richard Mulvaney adds that traditional proven-yield recommendations "are not only wrong, they are scientifically indefensible. What matters most is how much nitrogen comes from the soil."

Mulvaney says, "There is an inherent link between microbial cycling of carbon and nitrogen that has long been overlooked in managing nitrogen fertilizers."

Saeed Khan is co-developer of the Illinois Soil N Test, or ISNT, which estimates the amount of *organic* nitrogen available for conversion to plant-available form.

The new ISNT test first treats a soil sample with a strong alkaline solution. Then the sample is heated for five hours. The amount of nitrogen driven off as ammonia is measured as an estimate of the soil's nitrogen supplying capability.

This should help minimize a common error of previous tests, which could lead to under-fertilizing corn after soybeans and over-fertilizing corn following corn.

We're encouraged by the U of I's increased appreciation of "microbial cycling" in soils. It's precisely what AgriEnergy Resources has emphasized for almost 20 years.

Our own soil testing laboratory uses an array of tests to analyze how much nitrogen will be available from the active humus and recycling raw organic matter during the growing season.

But even more important, we encourage enhancement of the soil's biological life to accelerate nutrient cycling. That requires a balance of microbes, fungi and actinomycetes, plus adequate calcium and a favorable soil pH.

The most profitable rate of microbial recycling, and release of nutrients, doesn't "just happen out there" — especially in soils which are toxified and compacted from years of chemicals and salt-based fertilizers.

We're excited to see more and more land-grant universities, and USDA, realigning their tremendous research and educational abilities toward analyzing and managing the *biological* complexities of soils as ecological systems.

Meanwhile, we're gearing up our own analytical capabilities, both in our soil testing lab and our microbiology lab.

We've learned enough since 1988 to know that we've just begun to tap the soil's full potential.

New talent arrives at AgriEnergy Resources

We welcome back agronomist Mark Egan, who worked at AgriEnergy Resources in the mid-1990s before moving to Colorado for six years to manage a large farm producing potatos, lettuce, alfalfa and grain.

Mark will be working alongside agronomist Ken Musselman and our other staff members.

Bruce Weidner has also joined our staff as an agronomist. He has a wide array of professional experience since he grew up on a grain and livestock operation in Illinois.

In recent years he has managed a retail fertilizer plant and served as district sales manager for a seed company.

Earlier, Bruce ran his own independent crop and soil consulting service for farmers.