Newsletter for leading crop producers *Summer 2008*

AgriEnergy Resources

Announcing a new series of Fall 2008 Mini-Seminars!

Instead of just one Renewable Farming Seminar in Princeton this summer, we'll have *seven* new, free "Mini-Seminars" at four convenient locations from Ohio to Nebraska!

That could save you some travel time and expense. Each seminar will have a special guest speaker, plus speakers from the AgriEnergy staff.

(Bring a friend, and please *register to reserve your meal and seating!* See page 2 for info on reservations.)

Fall 2008 Mini-Seminars

Des Moines, Iowa

Monday, September 8, 2008
10:30 am-2:30 pm (lunch included)
Iowa Machine Shed Restaurant
11151 Hickman Road (I-80/35 Exit 125)
Urbandale, IA
515-270-6818
Guest Speaker — Jerry Carlson, Pro Farmer Editor Emeritus:
"The pension-fund farmland buyers are coming"

Grand Island, Nebraska

(During Husker Harvest Days)

Tuesday, September 9, 2008
5:30 pm-8:30 pm (dinner included)
Interstate Holiday Inn
Wood River Room
7838 S. Hwy 281
Grand Island, NE
308-384-7770

Guest Speaker to be announced

Wednesday, September 10, 2008
6:00 am-8:30 am (breakfast included)
Interstate Holiday Inn
Wood River Room
7838 S. Hwy 281
Grand Island, NE
308-384-7770

Guest Speakers: Mike Petersen and Justin Troudt of Orthman Manufacturing:
"Newest results for strip-till"

London, Ohio

(During Farm Science Review)

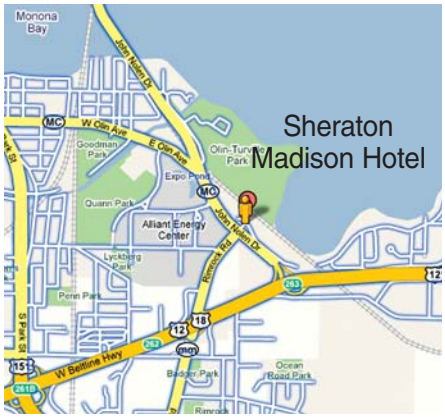
Tuesday, September 16, 2008
5:30 pm-8:30 pm (dinner included)
Red Brick Tavern
1700 Cumberland St.
London, OH
740-852-1474
Guest Speaker: Reggie Destree
"High-Return Hay in Ohio"

Wednesday, September 17, 2008
6:00 am-8:30 am (breakfast included)
Perkins Restaurant
225 Lafayette
London, OH
740-852-4905
Guest Speaker: Reggie Destree
"High-Return Hay in Ohio"

Madison, Wisconsin
(During World Dairy Expo)

Thursday, October 2, 2008
6:00 pm-9:00 pm (dinner included)
Sheraton Madison Hotel
Reflection Room "C"
706 John Nolen Drive
Madison, WI
608-251-2300
Guest Speaker: Doug Gunnink
"More Profits from Grazing"

Friday, October 3, 2008
6:30 am-9:00 am (breakfast included)
Sheraton Madison Hotel
Reflection Room "C"
706 John Nolen Drive
Madison, WI
608-251-2300
Guest Speaker: Doug Gunnink
"More Profits from Grazing"



Please let us know you're coming!

As soon as you can make plans, please let us know you're coming so we can plan enough meals and seating space at each of these Mini-Seminars!

You'll need to make your reservation by these deadlines so we can prepare adequately:

✔ For Des Moines, IA and Grand Island, NE: *By noon Sept. 4.*
✔ For London, OH: *By noon Sept. 12.*
✔ For Madison, WI: *By noon Sept. 29.*

To make your reservation, please:
— Phone us at 815-872-1190 and ask for Ann or Michelle, or...
— Fax us at 815-872-1928, or...
— E-mail us at
info@agrienergy.net
Thanks, we'll see you there!

AgriEnergy Resources staff members you'll meet at some or all of these Mini-Seminars will include Dean Craine, Ken Musselman, Gary Campbell, Mark Egan and Ray Roettger.

We anticipate that these meetings will give you time to visit personally with our staff, and ask specific questions about your farm.

Yes, soil *is* important to nitrogen fertility

This is the actual lead from an Aug. 12 *Corn/Soybean Digest* release:

> "Contrary to what's been considered the gospel for years in regard to nitrogen rate recommendations, Purdue University agronomists believe that the optimum nitrogen rate is strongly related to the soil's capacity to supply nitrogen."

Wow. Sounds like something we'd print. The more N supplied by your soil, the less you have to buy!

In trials at 47 sites over two years, researchers found that corn yields plateau at about 275 lbs. per acre of *total* N — from the soil and applied.

Purdue researcher Jim Camberato says: "If we know how much N the soil supplies, we can subtract that from 275 lbs. and know how much applied N the plant needs."

Purdue scientists are now looking for ways to predict N release from soil. *We* predict that they'll find a close correlation between the degree of biological activity in soils and the rate of N mineralization during the growing season.

Meanwhile, one tool available to measure nitrogen adequacy in growing corn is an optical reflectance sensor, which emits near-infrared light.

Another reason why we like to visit customers' fields

Sometimes it's difficult to see a visual difference between one treatment and another. It takes a careful yield check to learn the final result. GPS-equipped yield monitors on your combine are a big help for evaluating cost-return benefits.

However, our clients can often see a definite visual difference in the field when they use AgriEnergy nutrients and biologicals. That happened this spring when Phil Cline applied starter fertilizer when planting corn on his farm in Calhoun County, Iowa.

He was using AgriEnergy's 4-21-4 starter with zinc, and left an 8-row strip untreated. When agronomist Ken Musselman visited Phil's farm, those untreated rows were distinctly shorter — in fact, two leaf collars behind the treated corn.

"We found a definite difference in the root structure too," says Ken.

Like much of Iowa, Phil's region had excess rainfall this spring, leading to extra stress and nutrient leaching. Starter fertilizer applied with the planter and side-dressed fertilizer typically produces a consistently positive response under these conditions.

An eight-row "low spot" from lack of starter

Briefs from our agronomists

✔ Gary Campbell reports that John Begun's winter wheat near Kirkland, IL yielded 92 bu. per acre.

"He was pleased with that, especially since the stand didn't look good this spring," says Gary. The wheatfield had Residuce last fall and was top-dressed with fertilizer this spring.

✔ One of our Michigan dealers, Jay McCaman, e-mailed us with this observation after a visit to a client of his in the Grand Rapids area: Soybeans treated with two foliar feedings of SP-1, fish and Foundation helped soybeans stay green through a prolonged stretch of dry weather.

Most of the neighboring fields were yellowing when Jay visited the farm, he reports.

GMO stalks, continuous corn — and yet, residue is recycled early!

Brothers Greg, Kurt and Dan Swartzmiller own and operate Diamond S Farms near Attica, Ohio. They've tested AgriEnergy's Residuce and SP-1 over the past five years, steadily increasing their treated acreage each year. Last fall, they applied Residuce on most of their 296 acres of continuous corn. Here's a summary of a visit with Greg in early July, 2008.

Greg, what do you and your brothers, Kurt and Dan, see happening to residue in your continuous corn fields where you've applied Residuce?

It's helping break down stalks much faster. You can see that in the field photo which Gary Campbell of AgriEnergy took early this spring. Last fall's stalks from a 200-bu. plus corn crop have been digested almost completely.

What is your typical fall Residuce program?

We apply a blend of Residuce Plus Liquid at 2 gal. per acre and Residuce Plus Powder at 0.1 lb. per acre. We also include about 7 gal. of 28% nitrogen and 1 gal. of ammonium thiosulfate per acre in the spray mix.

We apply this as early after harvest as possible. Then we work down the stalks with two Aer-Way rigs in tandem, plus a following crumbler attachment. The crumbler has rolling baskets which hairpin stalks into the soil for good contact with moisture.

In fields where we did this early last fall and captured the most heat units, our 2007-crop stalks turned almost black in the fall. Where we applied the program just 10 days after the earliest treatments, the stalks also darkened up quite a bit, but not as much as the earliest fields treated.

Vigorous young corn roots are punching deep and early. Even though this soil remained almost waterlogged with heavy rains in Ohio this spring, the aerobic zone was deep enough to encourage strong downward growth in the primary roots. Also, thick filaments of fine roots are building a healthy rhizosphere for nutrient transfer during the heavy demands of rapid early-season growth and later summer ear fill.

Where are last year's cornstalks? You have to look hard to find shreds of 2007-crop stalks in this continous-corn field. AgriEnergy agronomist Gary Campbell shot this photo on Diamond S Farms in late June 2008. The only tillage before planting was with a tandem Aer-Way last fall, and again with the Aer-Way this spring. With stalks digested early, the residue is contributing to 2008-crop nutrition instead of competing for nitrogen for residue breakdown.

The Residuce results show up the clearest where our corn adjoins our neighbor's fields. Their corn stubble was still golden this spring — it looked almost untouched.

You're planting GMO hybrids?

Seventy percent of our corn acreage is GMO, triple stack. Roundup Ready, corn borer and rootworm resistant. The GMO stalks are really tough, which is another thing we've had to learn to contend with in the past — even to tire damage from corn stubble. But we can't be tied up with a lot of insect and disease problems; we have too many acres to take care of. There's a lot of plant health involved, too.

As you've raised the level of soil biological activity under continuous corn, have you seen any improvement in crop health?

We feel there is. That's why we're going more and more the biological route. If you have a healthier plant, its natural ability to fight off disease and insects is so much better.

Have you run any fertility trials to see if you can reduce nitrogen rates due to improved recycling of corn residue?

That's one thing we're going to start looking at next. Years ago, we did some studies on nitrogen, and we proved to ourselves that for higher yielding corn, the nitrogen just has to be there. We've been applying over 200 pounds of nitrogen for corn on corn. We're shooting for over 200-bu. corn, and normally getting it.

But now, we're thinking that by recycling the residue as fast as we are, we're capturing more nitrogen naturally.

How you can rein in runaway fertilizer costs:

Recycle your crop residues for maximum savings!

We find a consistent pattern of purchased fertilizer savings among veterans using the AgriEnergy Resources system of biological soil building and nutrient recycling. Nitrogen "recapture" alone typically replaces 40 to 50 pounds of purchased N. Depending on soil type, other farmers achieve similar savings with P and K. The four farmers in the following summaries built up their soil calcium initially, and have followed a long-term program of enhancing biological diversity in the soil.

Years of biological buildup yield $100 per acre fertilizer savings

More than 15 years ago, Jim Mitchell typically applied 180 to 200 lbs. of nitrogen on corn following soybeans near Eaton, Ohio. "Back then, we didn't raise corn after corn. It didn't work on our timber soils," he says. Now with a biologically robust soil, corn after corn often produces the highest yield.

Jim applies Residuce with a floater rig immediately following the combine, and hires retired farmers to work down stalks with a DMI 520B ripper while he focuses on harvest.

That accelerates fall residue recycling.

He says the primary reason continuous corn yields are high and consistent is this: A substantial part of the 80 pounds of N, 30 pounds of P and 190 pounds of K in the stalks of a 180-bu. corn crop is being converted to stable plant-available nutrients for the next growing season.

Jim Mitchell

"We have excellent residue breakdown," says Jim. "As of mid-August, you might find remains of a few cobs, but you'd have to look hard."

Here's his fertility program. Total N on continuous corn is 150 lbs. in four applications:

Fall: 10 lbs. of N as ammonium sulfate, which is more stable against leaching than liquid 28%.

Spring field cultivation: 50 lbs. of 28%.

With the planter: 30 lbs. of 28% as row support.

Side-dress: 60 lbs. applied with the cultivator.

On corn following soybeans, Jim reduces N rates with the field cultivator. That brings total N on corn after beans to about 120 pounds. "This way, there's no need to change mixtures or rates between fields at planting or side-dress time," he says.

Jim soil tests every year, and runs several strip checks each season to test response to lower N rates. "Once we get up to 100 pounds of N, strip tests usually don't show much economic yield difference beyond that," he says.

However, that final 50 pounds of side-dressed N is good insurance against wet, stressful summers like this one, Jim reasons. "I still prefer to err on the high side, just in case. In a really wet season a couple of years ago, we didn't get some fields side-dressed, and corn yields were off 10 to 15 bushels."

Bottom line: His current fertility program reflects a total reduction of about 80 pounds of N per acre on corn after soybeans, compared with rates before converting to a biological program.

His corn yields have continued edging upward, consistently averaging above 170 bu. across all 1,200 acres of corn on the farm. Soybean yields typically average above 55 bu. per acre on 400 acres of soybeans.

"On continuous corn ground, our P1 and P2 rates have been rising consistently over the years, to 58 and 94 respectively," Jim tells us. "The only phosphorus we use is 50 pounds of 11-52-0 in the fall and 9 gal. of 7-22-5 in the spring with the planter. That's about 46 lbs. of phosphorous. By the book, that's less than corn takes out.

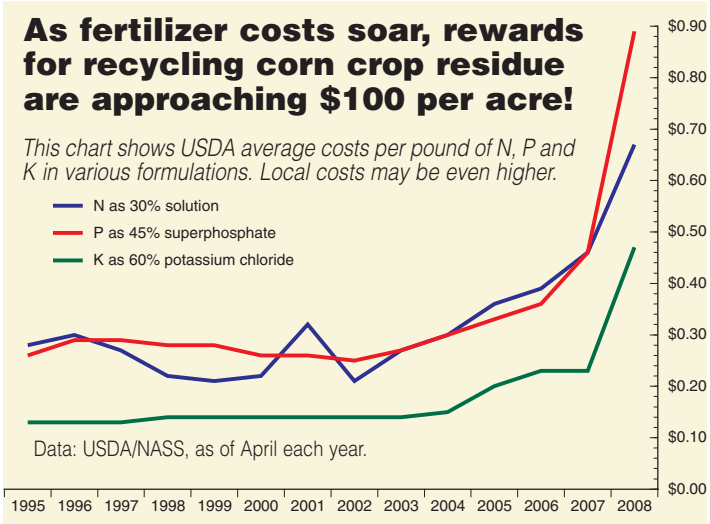
Jim says the fall Residuce program — even including the nitrogen and everything — "only costs me about $20 to $25 an acre. You can't buy much phosphorus for $25. I can't even get a price on it; the last I heard was $1,200 for a ton of 11-52-0. Nitrogen for next year was $405 per ton of 28%."

That makes 2009 nitrogen costs around 72¢ per pound as liquid 28%! In the Eaton, Ohio area, potash was $825 a ton, making the per-pound cost of N and K almost the same.

"On our timber soils, you don't dare cut back too sharply on potash," says Jim. The recommended potash rate used to be about 200 pounds of P in the fall. Under the biological program, Jim reports that "we've been able to cut down to a fall application of 100 to 150 pounds."

Thus at current fertilizer costs, safely trimming out 80 pounds of N on corn after soybeans saves more than $57 per acre. And there's roughly an equal savings on potash, adding up to more than $100 per acre. That's more than a 400% return on biological components in his program.

That kind of saving is becoming increasingly vital. Soaring costs for fuel, fertilizer, rent and seed means that many Ohio farmers will need a $13.75 per bushel local cash price on soybeans to break even in 2009, calculates Jim. "And the typical farmer here won't be able to break even on $5 corn in 2009. That's what we face, even though our cash rents aren't as high as Illinois and Iowa."



Lauber Seed Farms in Nebraska "turns farms around" biologically

Lauber Seed Farms near Geneva, NE, began testing AgriEnergy's biological soil-building approach more than 15 years ago. The 3,000-acre-plus irrigated farm is in continuous seed corn production.

The Laubers followed longtime AgriEnergy recommendations to build calcium levels and thus improve soil structure plus nutrient availability. This plus maintaining a wide diversity of soil organisms provides a stable nutrient supply with only 90 pounds of purchased N each year. Like many Nebraska farmers, the Laubers use ridge-till.

Here's a quick Q&A visit with Brad Lauber, CEO of the family farm, on his extended experience with fertilizer efficiency under a biological soil-building program. Their website: (www.lauberseedfarms.com)

Brad, do you have data or field observations on how much applied nitrogen you're replacing by improving your residue recycling and building soil humus?

I quit doing test plots years ago because I could see that the AgriEnergy concept of recycling nutrients is working for me.

I do have a recent observation, though: This season, a lot of denitrification happened out here in Nebraska because of excess moisture. But my cornfields didn't show yellow spots. As of mid-August, everything's nice and green in our corn.

How do you explain that difference between your farm and the neighboring fields?

Two things: We have built up soil microbial life. That means applied nitrogen is more stable in our soil. We ridge till, and apply 90 pounds of N into the ridge in March, about three weeks before planting. Every year, our growing corn shows signs of excess nitrogen. Dave Larson showed me how to read the corn plant for signs of excess nitrogen, and I have it every year. But I'm raising a high-dollar crop, so I don't try to cut back from that 90 pounds of applied N.

What have you noted longer-term on consistency of production?

The consistency is real good. Our farms were leveled for gravity irrigation years ago. That originally left a lot of yellow clay soils where topsoil was scraped off. We used to have three-foot-tall corn in the yellow spots and eight-foot-tall corn in the good spots.

Now after more than 15 years on the AgriEnergy program, we've pretty well evened out the field. The old yellow clay spots have turned brown.

We cultivate everything twice every year, rebuilding ridges with the layby cultivation.

Everything is mellow and fluffy when we cultivate. And the pH on our soils is rock-solid, coming in between 6.5 and 6.8 all the time.

How does your soil tilth experience compare with other conventionally managed farms in your locality?

Well, every year or so we rent another farm. It takes two or three years on the AgriEnergy program to turn a new farm around and mellow out the soils.

When we first cultivate a new rented farm, it's slabby and sticky. This spring we applied Bio-Aid on a new farm. That made it work better and it utilized nitrogen real well.

We didn't have any yellow corn from denitrification. So in my opinion, in the first year out the Bio-Aid saved me a little nitrogen leaching in the wet weather. In about three years we'll have the soil on this farm turned around and the tilth will come back. That's when yields within the field will even out.

Do you apply Residuce every fall?

Not every field, every year. We watch stalk decomposition and apply when it's needed.

How have your phosphorus and potassium tests held up — how much do you apply?

Our phosporus levels test high to very high. Our crop consultant doesn't recommend any P in our starter, but I always put on two or three gallons because it may be needed right there in the row.

Our K levels are always naturally high. Even so, we put in a little potassium with the side-dress to help release K that may be tied up. Also, it's a cation; most everything else applied is anionic. I'm probably the only guy in the county that's buying any potassium.

2 bushels of corn (or more) from 1 pound of applied N

Darel Hein raises corn and soybeans on about 1,350 acres of gently rolling land in southeast Iowa near Stockton. He has studied and practiced biological nutrient recycling for many years. Another priority has been building available soil calcium levels with ag lime and gypsum.

Darel applies Residuce with UAN and ammonium thiosulfate on last year's cornstalk ground with spring field cultivation just ahead of planting. Spring application of Residuce fits his operation best, as it's hard to get all the crops harvested and fall tillage done before fall temperatures drop below freezing.

"If spring weather would always let me side-dress, I'd apply only 70 pounds of nitrogen as 32% liquid for corn with my field cultivator," he says. "Since that's highly uncertain, I've increased my spring broadcast nitrogen rate to 90 pounds the past couple of years."

Darel has often seen his biologically active cornfields yield over 200 bushels. Sometimes areas within a field show 250 bu. on the yield monitor — with only 70 to 90 pounds of applied nitrogen.

"The most cost-effective nitrogen rate is still a guess in any given year because of weather variables," says Darel. "This spring, we had heavy rains early in the season. Even so, late-spring nitrate tests showed a need for additional nitrogen on only about 20% of our corn."

In the 2007 growing season, July and August rains probably leached away nitrogen needed for ear filling. "The higher ground did well, but the lower and normally more fertile soils lost some yield potential," Darel recalls.

We asked Darel: "If you had to estimate how much nitrogen you're saving on average over several seasons with residue recycling — what would you say?"

His reply: "Fifty pounds a year."

That translated to more than a $25 per acre saving for nitrogen alone in the 2008 season. His early-purchased 32% nitrogen was just over 52¢ per pound. That means the application of Residuce to maintain a biologically active soil returns roughly $2 per $1 of outlay.

And in the 2009 season, nitrogen costs will be significantly higher. We're hearing of 28% and 32% N solutions priced at about 75¢ per pound locally.

Also, Darel's long-term buildup of calcium has apparently helped increase availability of phosphorus and potassium.

He hasn't applied any significant amounts of P or K for years, with no apparent loss of either showing up in soil tests.

Larry Endress: Fertilizer savings are in the $100 per acre ballpark

Larry Endress and his family farm near Buda, IL, and they have as much experience with the AgriEnergy approach as anyone we know. We asked him about nutrient management, and here's what he told us:

I've read that the stalk residue from a 180-bu. corn crop, if recycled completely, would provide the equivalent of an 80-30-190 fertilizer application per acre.

Our experience is that we're recycling at least 25% of that potential on continuous corn. In our case, the digested residue would equal an application of 20 pounds of N, 7 pounds of P and 47 pounds of K.

At current prices, we figured we're saving $25 per acre on DAP; $40 on potash. And over the years, we've been able to safely trim back from 180 pounds of N to 140 with no yield reduction or signs of nitrogen deficiency. That's a saving of 40 pounds of nitrogen — which at 2008 prices is at least another $24 an acre. Next year it could easily mean a $30 saving or more for N, so let's use $30 there.

Add it up, and the total "credit" for recycling our corn residue is $95. Remember we're being conservative here. The added stability of nutrients provided by the soil, rather that from applied fertilizer, probably brings the real value beyond $100 per acre. These are just rough estimates, but I know it's important to get the nutrient recovery cycle going as soon as possible, every fall.

To accelerate this process, I've been chopping stalks with a flail chopper every fall for the past six years. My reasoning is that the microbes in Residuce may work more quickly if they have smaller pieces to work on.

We always apply Residuce on cornstalks in the fall. We'd like to apply the program right behind the combine, but that's not always possible. We don't stop the combine for fall fieldwork!

Since 1984 when I started raising corn, our average corn yield trend has risen from around 160 bu. to 190 bushels. There may be some enhancement from improved genetics, too. We've stayed with non-GMO hybrids.

We raise only about 100 acres of alfalfa and 500 acres of corn, so I don't think the relatively small rotation onto alfalfa ground has affected our corn yields much.

I believe another support for our yield uptrend is that we applied a lot of limestone in the early years. We built up our calcium, as AgriEnergy Resources has always recommended.

Our soil gradualy took on a more mellow texture, and our soil analysis has moved into a healthy balance.

Visit our new website at www.agrienergy.net

You'll find a wealth of valuable information at our new AgriEnergy Resources website at **www.agrienergy.net.**

Since our new site launched in March, we've seen more than a 10% increase in visits to the home page.

We've also noted a 25% increase in the number of visitors browsing the site for more than 30 minutes, which indicates that people are digging into the rich layers of content such as our newsletter archive and product information. And we're pleased that there has been almost a 40% increase in the number of visitors who've added our site to their favorites for future reference.

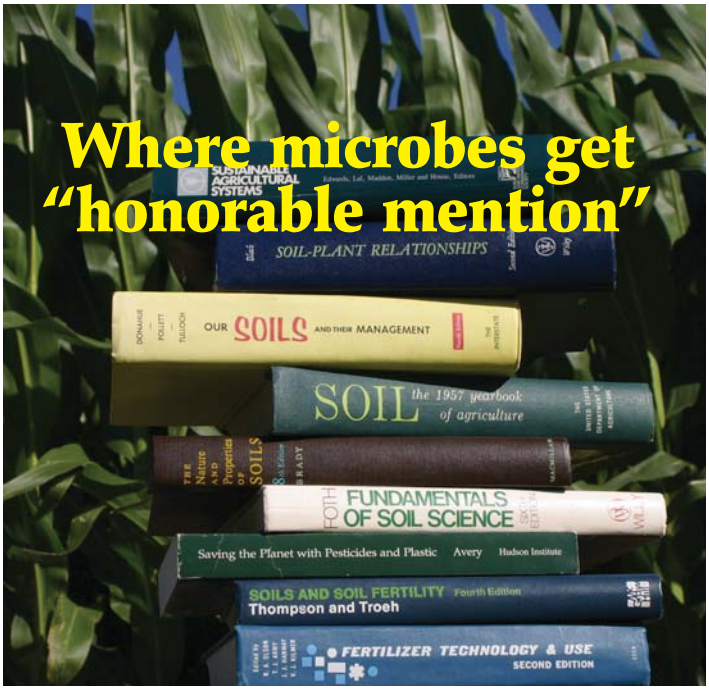
Our new home page is shown above. When you visit the site, click on the links such as AGRIENERGY CENTRAL to pull up timely, money-making pages with:

✓ Renewable and organic agricultural information.
✓ Complete product listings.
✓ Descriptions of services we offer.
✓ Specific directions for soil and tissue sampling and testing, along with forms and pricing for tests. You can download forms to include with soil and tissue samples sent to the testing laboratory.
✓ Current and archived newsletters in PDF format.
✓ A photo gallery "slide show" describing benefits of biological agriculture. (We'll add other galleries from time to time, so check back with us.)

You'll also note on the site that we're including an easy way to sign up for electronic delivery of our newsletter in PDF format (Adobe's Portable Document File format).

We'll still provide the printed and mailed version of our newsletter, but some clients prefer the PDF format because they get it faster and they can forward it to friends. In case you want to refer back to previous newsletters, many of them are available for reading online or downloading from the website.

Please visit the site, and e-mail J. P. Aley (jaley@agrienergy.net) with suggestions for improvements or content you'd like to see on the website.



Where microbes get "honorable mention"

Farmers and fertility specialists who graduated from college with agronomy degrees learned that bacteria, fungi and other soil organisms are critical for effective plant nutrient uptake.

But then — most fertilizer texts presume that soil life doesn't need management because it takes care of itself. For years, the best college agronomy books like those above focused almost entirely on soil chemistry and physics. Soil ecology was typically relegated to the biology department, where students learn how to correctly spell "mycorrhizae" and "azobacter."

This near-void in agronomic training is one reason why most producers today, even those with advanced degrees, face a steep learning curve when we show ways you can *manage* microbial and fungal organisms to enhance your soil nutrient cycle.

At AgriEnergy Resources, we look at soil as a biological ecosystem (rather than just something to hold up the plant while you apply whatever fertility it needs). For many producers, that view poses what's called a paradigm shift — a whole new and sometimes opposite understanding of how a system actually works. But that learning curve isn't your fault. It's a worldview resulting from decades of reliance on chemical fertilizer, herbicides, insecticides and fungicides.

We're seeing the global food marketplace swinging away from the chemistry-only paradigm toward working *with* natural soil life. Organic production is an important sector of this ecologic trend, but only part.

Much of it's driven by consumers who want healthier, more highly nutritious food they can trust. Often that's part of the "Buy Fresh, Buy Local" grassroots groups who are opening new market channels for local communities.

The emphasis is on quality food and feed, which virtually requires a fully mineralized, biologically active soil.

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National Soil Tilth Lab data shows value of nutrient recycling

Research by USDA's National Soil Tilth Laboratory reveals three major scientific reasons why biologically active soils make more effective use of nutrients and water.

1. Almost half the carbon required to grow a 200-bu. corn crop *comes from respiration of soil organisms*. "Really big plant growth comes when large amounts of CO_2 are given off by organisms in the soil," says Dr. Jerry Hatfield, Director of the Tilth Lab. Atmospheric CO_2 averages about 385 parts per million. Leaf stomata pull this below 300, which is inadequate for best growth. But just above the surface of a living soil, the CO_2 concentration rises to around 1,000 parts per million.

In a full-canopy corn or soybean crop, says Hatfield, leaf stomata absorb this rich supply of CO_2 so quickly that it doesn't even escape into the atmosphere.

Recent USDA and university research indicates that soybean yields typically rise 13% to 17% when atmospheric CO_2 is artificially enriched to 550 parts per million. The current level of atmospheric CO_2 is around 385 parts per million.

Jerry Hatfield

2. A healthy root system, enhanced with a microbially robust rhizosphere and good humus levels, *delivers abundant soil moisture to leaves.*

National Tilth Lab field sensors have found that the more water vapor a leaf can exude, the more CO_2 it can absorb via leaf stomata because gas exchange is more active. Much of this exchange occurs early in the morning of each day.

Hatfield says Tilth Lab fields have produced 300-bu. corn on just 108 pounds of added nitrogen where the corn respired large amounts of water vapor and absorbed abundant CO_2 from soil life.

A current feature in *The Furrow* magazine, "Living with less water," emphasizes that farmers make the most yield per inch of soil moisture by maximizing leaf transpiration while minimizing evaporation from the soil surface. This is crucial to irrigated farms, where pumping costs are high and water is often limited. But it's also important to all farmers because rainfall isn't always abundant when it's needed most.

We've long recommended working crop residue lightly into the soil surface, where it can protect against erosion, sponge up fall and spring rainfall, then digest into crop nutrients as corn and soybeans create a protective summer canopy against soil evaporation.

Cultivating row crops also helps break up soil capillary action that otherwise transfers deep moisture to the surface. That's one reason Jim Mitchell (see page 4) says, "We love to cultivate."

3. Biologically active soils with good humus content show *much less yield variation across fields* which have varying soils, nutrient tests and moisture levels. Hatfield cites an Iowa field where soil biology has been built up for years: Average corn yields are often near 225 bu., and variation across the field is typically less than 30 bu. per acre.

This consistency is especially important in seasons like this one, when many low areas were stressed with too much moisture.

Illinois and Iowa growers checking their maturing corn are often seeing fewer than normal rows of kernels. The row count was established earlier in spring, when soggy soils imposed stress on the growing corn. That's a handicap which is hard to make up later in the season, even though July-August weather was more favorable.