

The Soil Doctor® System vs. the Veris Cart and Geonics EM 38

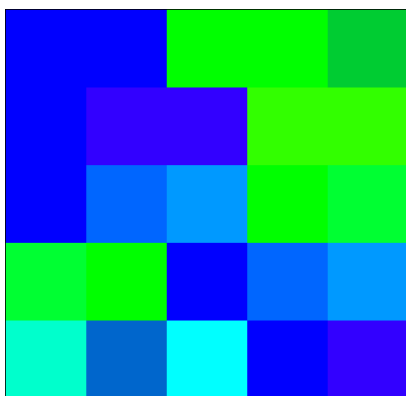
Why is Good Soil EC Data the Missing Link to Increased Profits?

Traditionally, chemical retailers and growers have focused on soil analysis as the first step in determining soil nutrient needs in crop production. On a well-managed farm good nutrient management may only require tailoring crop maintenance inputs, rather than *radical spatial alteration*. Consequently, "precision services" may put-off the conscientious grower, unless these services can demonstrate immediate value over other choices available to a grower. The ability of a dealership to effectively manage the fine details of a grower's fields makes all the difference between adding new and eager customers, or getting passed-up as if you were another "Me Too" vendor.

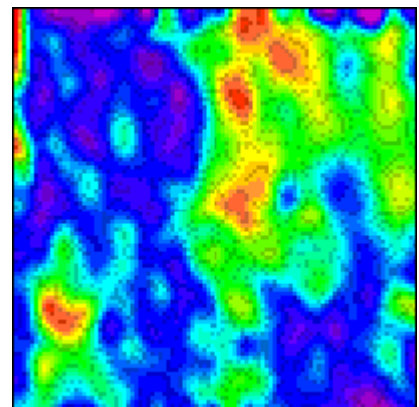
Long-line manufacturers promoted yield monitors to farmers, but those tools haven't been the "cure-all" they were supposed to be. That's because after-the-fact results don't identify the factors that limited nutrient removal, or drove down the yields, or drove down income, especially when poor pest or weed control were factors. Moreover, few growers have the time or patience to get bogged down in cumbersome, calibration-hungry data collection technology.

In contrast, a detailed soil data approach through an on-the-go soil sensor is a lot like what you did before anyone ever heard of "prescription farming", but without the mental drain. It's much better. The twist is to first identify and classify management areas and their yield potentials to a degree not possible with grid sampling, aerial photographs, satellite surveys and other measurement technologies. Field variability dictates the overall strategy required. Then detailed soil chemical analysis can come into play. In some states, new environmental compliance regulations limit phosphate or manure application in portions of a field. So blanket applications are on their way out. Intensive soil data is in demand.

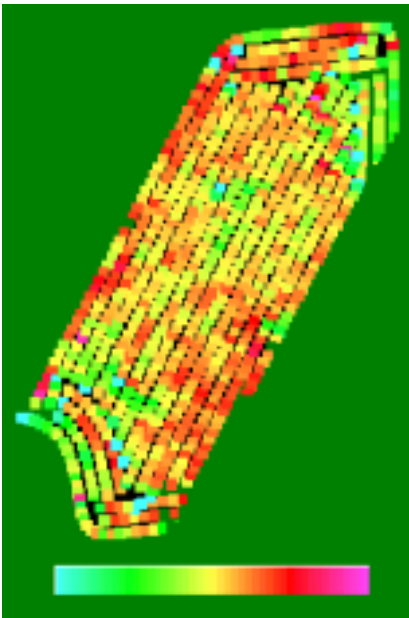
So, what's best for a dealership in the prescription agriculture marketplace? Yield monitors only confirm, once it's *"too late to do anything this year"*, the variation that Sensed Soil Data through the Soil Doctor system reveals immediately, when *"it's not too late"*. These detailed soil surveys reveal the major facts influencing yield variability before the ground is worked, for the next crop season. Why learn *"the hard way" --after harvest, after yield loss?* To improve the bottom line, start with what's best for the crop and the farm, not with what's best for the bottom line of a long-line manufacturer.



After having spent years carving up fields into smaller sub-fields for grid sampling, trying but failing to improve yields, what's best for the crop and the farmer is now pretty obvious. First of all, grid sampling was just too hard, too expensive, and too unrewarding to the dealership and the grower. The CEC sampling strategy on the left explains why. That map shows a field sampled on coarse 2.5-acre grids, *just like some in the industry recommended*, as if it were a simple checkerboard, not a

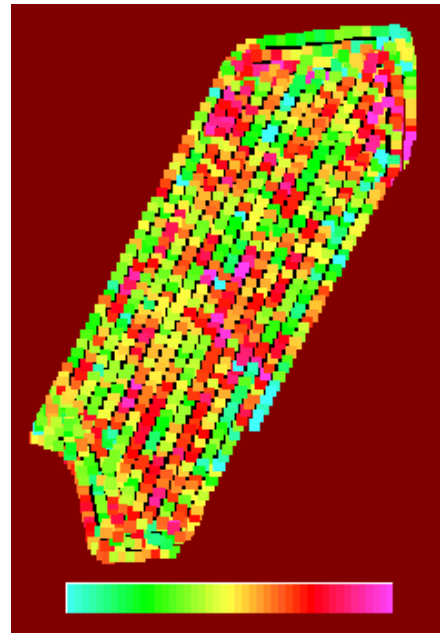


typical farm field. The map on the right shows a Soil Doctor System survey of the same field. The difference is clear. Sampling on grids masks-out variability details, which you must have if you are serious about effectively treating farm fields to positively impact yields.



Soybean Yield

Soil electrical conductivity reveals variations in soil texture and moisture, and can even be used as a measure of soil CEC as just described. These variations show where crops will grow best if provided proper nutrition. Soil conductivity measured at any time of the season can reveal at least 50% of the intrinsic variability in a farm field. Measured at particular times in the crop growth cycle, soil conductivity can reveal over 75% of this variability.

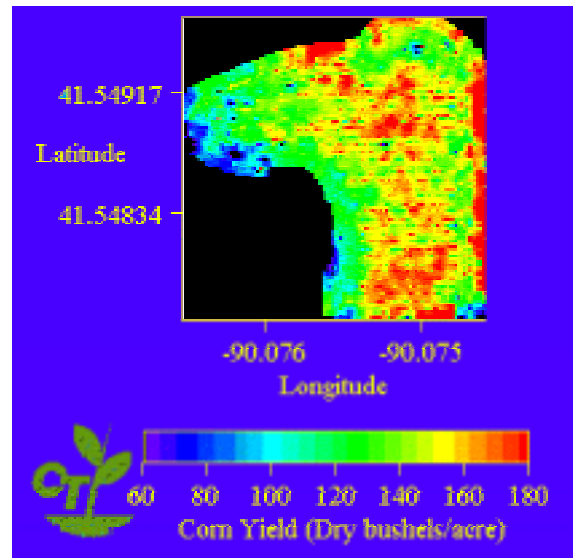
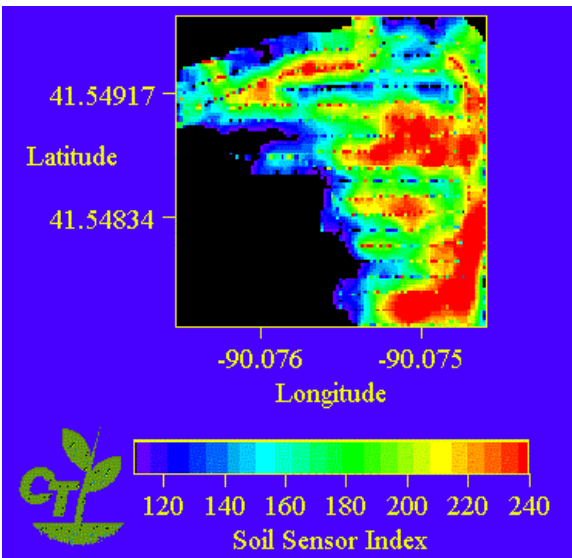


Soil Cation Exchange Capacity

In fact, after recently performing in-depth studies, scientists have concluded that soil conductivity is an excellent substitute for

conventional soil testing. They believe that it can be relied upon to determine where yield potential is good in a field and where yield potential is poor.

Carefully study the next two maps. Woodlands shadow the left (blue) edge of the field. The electrical soil conductivity (soil sensor index) distinctly identifies 75% of the soil variability at sidedress time. It classifies the most and least productive areas of the field, prior to field treatment, *not after harvest*. EC identifies, far better than any existing NRCS soil map, the field regions which will be more responsive to your management attention. So, it's only logical. When you add more nitrogen to identified nutrient deficient areas you increase yields, CTI's routine, yet unique, field performance since 1987.



Without question, soil conductivity offers and delivers the highest data value for guiding precision agriculture practices. It confirms not only "good" and "poor" soils, but also the quality of all soils throughout a field. Soil Doctor® System surveys enable precisely graduated treatments to match the graduated soil quality, opening the door to greater profit margins for grower and retailer alike.

So, If Soil Conductivity Data is Key What Are My Choices?

Data Collection and Data Value: Not all Sensors are Created Equal

You have several sources for soil conductivity data. You have a number of international choices for electromagnetic induction soil conductivity instruments and two domestic choices for direct contact instruments.

There are absolutely no restrictions in using data obtained from an electromagnetic soil conductivity measurement as you see fit. In the case of direct contact methods, however, you take two enormous risks in using a Veris instrument. First and foremost, farmers using Veris services in contrast to Soil Doctor® System customers don't seem to be satisfied with their final results. Veris customers are mostly "hopeful" about the potential that something might eventually pay off in the future.

Second, under the law, you cannot use Veris data for most precision agriculture applications. In particular, purchase of Veris technology or data violates patent law. Purchase provides no legal rights to derive any relationship between EC data and conventional soil tests to make prescription maps or to make actual fertilizer application to a farm field from that data. From both a benefits standpoint and a point of law, use the technology proven in the field since 1990. Use the pioneer, the original, the Soil Doctor® System, available for step-wise licensing under U.S. Patent 6,484,652.

In either case today you can view raw data, but you can lawfully collect and use the data to explore data relationships and subsequent application only if you seek a license to use Soil Doctor technology. The method, from beginning to end, is the property of Crop Technology, Inc.

Regardless of the legalities, make no mistake, if soil conductivity data is not used or interpreted properly -- with the assistance of Crop Technology, people who know how to use it, benefits will not be forthcoming. You need to know how far EC can take you and where you need other facts to solve the problem. Education is key to implementation of a profitable program.

Is a Soil Doctor System Survey *really* Better than a Veris Cart Survey?

*Soil Doctor systems have been proven --on operating farms-- to increase relative yield in side x side tests. No such test comparisons have ever been made regarding Veris technology. Yes, there's a lot of puffery, smoke-blowing, and technical papers out there acquiring Veris data, but no actual proof that it has ever resulted in crop benefits to real growers. **From 1987** to this day, the Soil Doctor system still stands alone in providing on-farm results.*

There are three simple reasons the Soil Doctor® System stands alone in reliably providing benefits:

First, Soil Doctor® Systems investigate the soil sample depths that are important to the crop, instead of the depths important to geological applications, picked by the manufacturer to appeal to geologists as well as USDA theoreticians. Soil Doctor systems are designed and targeted to meet agricultural crop needs in the farm field, not needs of other fields of science. Design details make a big, big difference.

Second, Soil Doctor systems have always addressed soil chemistry facts. Where EC alone helps determine the best prescription, EC is used. Where soil nitrate is the key, soil nitrate sensing is used. Unlike some, Soil Doctor systems do not ignore science facts for the sake of selling equipment to a marketplace hungry for answers.

Responsible recommendations and application require knowing a) what to look for, b) where to find it, c) where to place the inputs and d) what amount of input to put in those places.

And third, the "secret" that most still fail to understand is that precision, real "precision" agriculture is hard work, much harder than conventional agriculture. Results can't come from a steam roller approach of "going through the motions". They come from careful attention to detailed data. The devil is, in fact, in the details. **Dense** soil data opens the door to beneficial prescriptions. Responsive application to this dense information can then lead the growers you service to higher profits. The Veris skip and miss approach to understanding a farm field can make the difference between a customer that can blow your whole marketing program or a satisfied Soil Doctor customer that praises your service. No grower wants a service that doesn't provide a tangible return on his investment. Only Soil Doctor Systems have the proven track record for providing grower-measurable benefits.



Surely I can get the Same Soil Data from Both Domestic Companies, Can't I?

Don't both Systems Use the Same Rolling Electrodes?

"Rolling Electrodes" is a trade term first coined by Crop Technology, Inc. in its December, 1991 brochure. The term was chosen to distinguish earlier model "sensor knives" pioneered by CTI, from the later invention of "Rolling electrodes," a novel use for coulters pioneered by Crop Technology, Inc. While it is

correct to state that both systems use coulter which do, indeed, roll as all coulter are designed to do; it is inappropriate to apply the trade term to Veris Technologies, Inc. products.

But, Overall they Look about the Same. Aren't they the Same?



Yes, each system uses at least four coulter to make soil measurements. The common feature is that when two coulter are close to one another, a shallow soil EC measurement is made. When two coulter are more widely separated, a deeper soil measurement is made. If you are doing your homework, you have visited the Veris website and have been mesmerized by the complex electric current pattern between four electrodes, illustrating how the Veris system operates. *That complex*

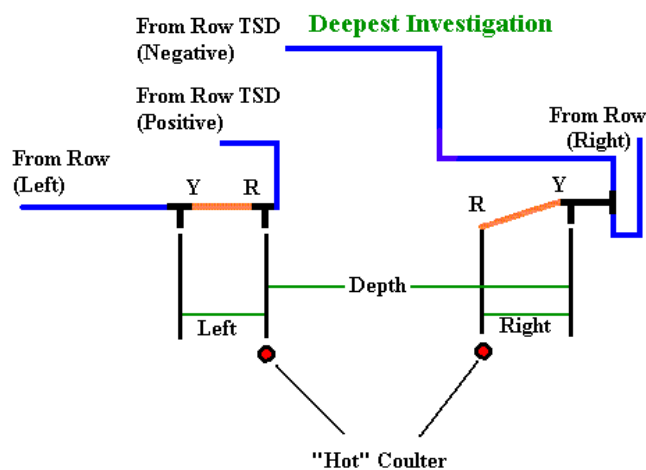
pattern, however, does not mean that the arrangement provides any advantage for agriculture. That speculative pattern for illustration of their concept actually limits utility, as explained below.

First, our priority patent covers the exact configuration of four coulters that Veris has selected to market with its system. By choice, the Soil Doctor® System uses two separated sets of two electrode arrays, one on the left of the implement, one on the right, to make two "rooting depth" conductivity measurements. Coulters are typically separated at an adjustable width, normally set for 30" corn rows.

Second, on-the-go, electronically, one coulters from each pair can be instantaneously connected (multiplexed) to perform double duty. The separation between the left and right pair (two to three crop rows) provides the width necessary to make deeper soil measurements. This center measurement (*between one inner and one outer coulters*) is typically used to make the Soil Doctor System's third conductivity reading, suitable to aid interpretation of yield maps and survey topsoil depth.

In contrast, if you purchase the Veris four coulters model, you must make two passes over the field to obtain two soil conductivity measurements: one pass for a shallow reading, a second for a deeper reading.

A Veris four-coulters model just cannot be adjusted to make two simultaneous measurements. To have two simultaneous measurements you'd have to purchase their more expensive six-coulters model. With Veris, you need four "specially arranged" coulters to make just one measurement.



In summary, with the simplest, four coulters mechanical installation of a **Soil Doctor system**, you get three separate measurements, but you are limited to a *single measurement with a standard Veris approach*.

The Soil Doctor® System Requires Only Four Coulters

Third and most importantly, the Soil Doctor data you collect can be verified while in the field, but Veris does not offer a way to verify the data collected before you're expected to spend money on physical soil samples and analysis efforts. Blindly using their "four electrode array", with four coulters committed to a single array, interferes with validation of that data.

With the Soil Doctor® System, two pairs of individual "rooting depth" readings are compared, and each validates the other. With Soil Doctor coulters wiring, the deeper "tap root depth" measurement is also automatically validated. With Veris, you have no independent validation of the deeper soil reading, but even if you did; the Veris design is not set out to make measurements of greatest importance to grower's crops. It's set out to emulate the Canadian EM38, used primarily by geologists.

Fourth, independent testing has proven that soil conductivity measurements made with pairs of "electrodes (coulters)" are better than those made with "four electrode arrays", with four coulters that work as a single, simultaneous unit. In fact, you can penetrate electric currents more deeply into the soil between two coulters, when no other "active" metal (like two more measuring coulters) are in the way. Our coulters are multiplexed and electronically invisible when not in active use. That's another reason why the multiple coulters array adopted by Veris limits its efficacy. Confusion arises from the early USDA research in the 60's, where "four electrode arrays" of individual metal stakes were driven

into the ground. From that old work with stationary stakes, USDA determined that four were better than two. In the case of moving electrodes for crop production, two pairs of two coulter arrays are better than a single complex, four-electrode array. "Keep it Simple....." is nowhere more true.

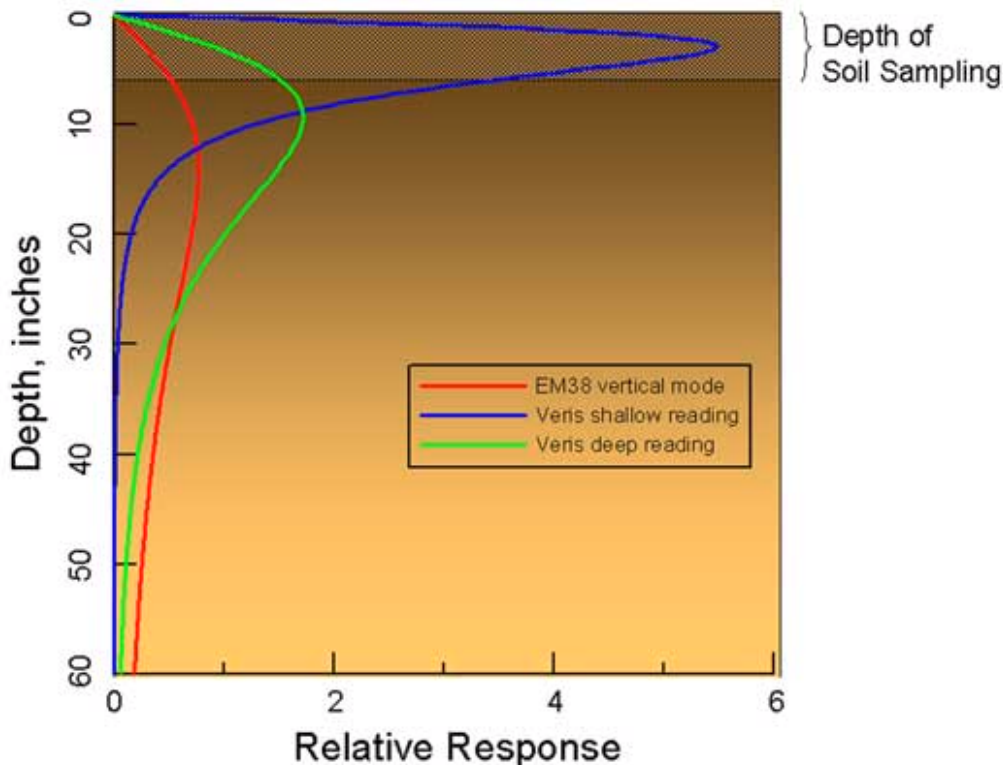
Finally, with the particular alternating current Veris system uses, Veris technology cannot measure more than simple soil conductivity, without additional violations of CTI patents. The Veris system is limited to a total soil conductivity measurement only. It offers no ability to break down the components of soil conductivity to reveal the independent effects of soil moisture, texture, organic matter or other factors on the measurement. Only the Soil Doctor system can provide this additional information.

Hasn't the Soil Conductivity measurement of the Veris Cart been confirmed by the USDA, but the Soil Doctor System has not?

Regardless of the impression created, the USDA has only compared the Veris readings to those of the EM38 (Canadian electromagnetic geological survey instrument). The studies concluded that the two readings made by each instrument were similar. They did not determine the value of either data set.

The EM38 itself is neither a soil conductivity standard, nor a proven technology for production agriculture. It is a geophysical instrument designed for valid geological purposes. It is not designed to move continuously, nor to measure soil data at depths agronomically essential for crop health and growth. Inexplicably, it is just the test design that USDA chose for its Veris system comparisons.

In the theoretical illustration that follows, courtesy of USDA/ARS, the responsiveness of the EM38 readings is compared with the Veris system. Note that the EM38 is virtually insensitive to the conductivity of the first foot of soil, focusing its investigation on much deeper depths. USDA's theoretical model shows the Veris system as very responsive at shallow testing depths.



In contrast to theory, independent tests of the Soil Doctor system, the Veris system, and EM38 have shown that only the Soil Doctor system is clearly responsive to discrete bands of N fertilizer treatments (soil chemistry change). The USDA has verified that the EM38 is weakly responsive to changes in N fertility, consistent with the above illustration.

Although USDA theorized (in the previous chart) that the Veris system would be able to respond strongly to soil electrical conductivity changes, Veris admits that its system is inadequate to directly respond to changes in soil nitrates.

***If I Rent a Veris system, then I have only a one-time charge
I can Rely on that Same Data forever and for Whatever I Want, RIGHT?***

From what we can gather, this appears to be the representation that Veris and some using a Veris system make to prospective customers.

The Truth is, however, that Soil Electrical Conductivity data, even when obtained under similar field conditions on the same field, varies from year to year and even season to season. It's not the same, as they seem to imply. What you intend to do with that data determines whether you can rely on the data you collect in the fall for field operations in the future.

Crop Technology, Inc. incorporates different interpretations for soil conductivity data based on when the data is collected. Soil Nitrates are a particularly important example and soil conductivity (when properly tested) varies significantly with nitrate content. The normalized pattern of soil conductivity variance is similar when measured in the fall or spring, but the dynamics of nitrogen application and soil nitrogen production markedly change soil conductivity patterns.

If you rely on either a fall or spring survey for EC to define CEC or topsoil depth and management zones, you can rely on this map for many years, until future factors alter CEC or subsoil characteristics. Increased crop production alters organic matter levels and traffic or deep tillage alter soil porosity and permeability. You simply have to keep up with your client's field history to continue to provide him the highest degree of service.

Can I Rent a Soil Doctor System for Data Collection?

Crop Technology, Inc. offers two types of lease programs. Programs vary between the types of clients. Each program includes patent licensing and equipment arrangements.

For a grower, the program is set up on a rent-to-own basis. If after a season of rental for data collection on your own farm, you decide to buy a new Soil Doctor system, all of your rental fees can go toward your purchase of a real-time Soil Doctor system, capable of step-wise GIS operation on the ground you farm. If during the rental, you decide not to purchase a real-time applicator, then you must have a license to use the data for the purposes set forth under applicable CTI patents.

For a commercial operator, the program is set up for license fees applicable to the grower's ground that the operator serves, and applies to step-wise collection and use of collected data. Real-time application is also offered to some commercial operators at this time under a lease program.

What Else Can be Tested While I'm Making Whole-Field Soil Surveys?

Beginning summer 2005, CTI will offer a new generation of advanced soil sensor knives that can be used in conjunction with its four-electrode-array soil survey systems. These sensor knives mount behind the ground coulters on the soil conductivity array. Sensor knives can be set up to measure phosphates, pH, and a host of other chemical species. At typical travel survey speeds, these sensors offer an unmatched detailed density of 750 samples/acre far exceeding the professed potential of any other methodology.

What is the Value of All of this Sensed Soil Data Once I Collect It?

First, you will likely want to convince yourself that the general conclusions reached by others are true under your particular conditions. A Grower that knows his land well may look at a map and recognize it immediately as valid, but some of your customers may not know the parcel like the back of their hand. Some may need other assurance as well.

In general, growers are not the most trusting group of guys. You may need to record other spatial data, including physical soil sample analysis and yield data to make your comparisons and prove your point under your climatic conditions.

You have a variety of collected Soil Doctor® System data you can map and compare, including two rooting depth soil conductivity measurements and tap root depth soil conductivity, and independent soil chemistry measurements.

Beyond an obvious yield map comparison, the most basic comparison you can make of the sensor data, however, is to compare it to soil CEC or topsoil depth in thin soil regions. Whether you called it that or not, you have used CEC to guide the prescription of treatments before precision agriculture came along; and you can do the same today, only precisely. On this most fundamental level, you can readily create management zones compatible with the custom application equipment you already have. You can also soil sample these zones to confirm fertility variance, and prescribe fertilizer and lime treatments.

And, you can improve the accuracy of your custom application by pointing out the newly identified zones that you are going to treat on the grower's farm, presenting detailed management areas that had not been revealed to the grower before Soil Doctor data collection.

If your client has kept meticulous and accurate yield map records, you can refine the prescribed treatment to respond to the detailed yield history of the field. Or you can start him on a good yield history program that complements your interests.

With new management data in-hand, you can even offer new custom application services at non-traditional times such as custom spraying using pH data, advanced manure management with phosphate guidance, or even post-emergence or high clearance N sidedressing. You can offer precision maps to guide fall N application with your anhydrous toolbar fleet, or you could offer maps to guide variable rate planting if seeds or seeding are products/services that you render.

Best of all, some of these applications are royalty free because we excluded them in our 1991 patent application. We excluded insecticides, so use your EC data freely to prescribe insecticides. Even Variable Rate (VR) seeding has no strings. VR seeding, after EC data is acquired, requires no further fees to be paid to CTI. And, if you want to custom prescribe tillage for a grower using Soil Doctor EC data, there are no royalties for that prescription either.

And, here are some more benefits that won't cost a dime. Soil Doctor PC software includes the ability to record GPS records alone, so you can map field boundaries for clients. Moreover, the software also includes a scouting mode, where you can log field or crop features while you are collecting data. All of these extras are there to complement the most accurate scientific data obtainable in precision agriculture.

Finally, you can follow up on the grower's farm with statistically valid yield tests to prove the value of the management practice you promoted to the grower. Your plans for the grower from the get-go to the bin demonstrate to your client your interest in his well-being, rather than on a perception that you only want "pounds on the ground". A Win-Win marketing approach places you in the Winner's seat offering your customers true benefits to gain an edge over your local competition, rather than selling the latest gimmick.

Knowledge of the underlying science, track record, strength, differences, and intrinsic value of all technology products on the market today is the place to begin your decision process. We welcome the opportunity to serve you.

Crop Technology, Inc.
Bandera, Texas
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