Cooperative Extension
Colorado State University

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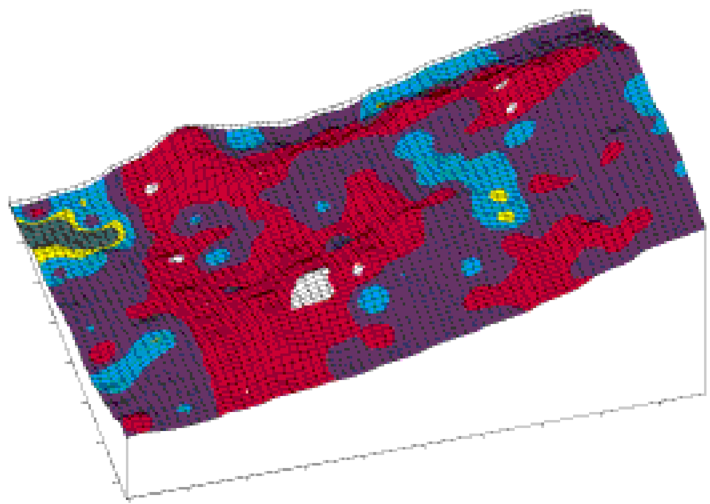
FROM THE GROUND UP

Agronomy News

Managing Variability on Your Farm

Inside This Issue:



Managing In-field Variability

Today we live in the age of information technology and agricultural operations are no exception to the explosion in technology. Crop production variability in farmers' fields has been an age-old problem and modern agriculture stills faces the challenges of managing this variability. There are a number of commercially available technological "tools" in the market to manage in-field variability. Before we proceed further, let's understand what we mean by variability, the types of variability, tools to measure field variability, scale of variability, and finally managing variability.

The term "soil or crop variability" refers to the changes in soil or crop properties across a field. Examples of soil variability could be changes in soil pH, soil texture, soil type, soil organic matter, water holding capacity, or other soil properties, as you go from one part of the field to another. Examples of crop variability could be changes in crop growth and development, crop vigor, crop yield, crop height, or other crop parameters, as you go across the field. This change that occurs across space (distance) is referred to as "spatial variability". There is another type of variability that is called "temporal

Colorado State University Cooperative Extension

Putting Knowledge to Work

Managing variability in the field (continued):

variability" which means variability associated with time. For example, each year yields across the field vary significantly as impacted by weather, pests, etc.; this variation in yield variability across years is referred to as temporal variability.

Variable rate application of nutrients in a farm field.

There are various tools and techniques available for measuring in-field variability. Some of these tools and techniques include: (1) Grid-based soil sampling, in which a field is divided into small grid cells 1 acre or more in size and then soil samples are collected from each grid cell. This allows us to measure the variability associated with soil properties. (2) Yield monitor is a tool, which measures the variability in crop yield across the field. However, variability in yields across a field could be because of a number of reasons. A yield monitor simply quantifies the yield variability. It takes quite a bit of "detective work" to determine the reasons associated with variability in crop yields. [Read a detailed article on yield monitoring and yield monitor sensors in our extension newsletter of November 2002 "Sensors in Agriculture" http://www.colostate.edu/Depts/SoilCrop/extension/Newsletters/2002/Sensors/index.htm] (3) Remote sensing of fields with or without a crop also helps quantify variability associated with soil and crop properties. An image of a standing crop acquired through a camera on an airplane or a satellite allows you to identify areas of crop stress or distribution of weed populations, or non-uniform planting areas, etc., across a field. (4) Soil electrical conductivity mapping is a fairly new tool that helps quantify variability associated with soil properties. Numerous uses of soil electrical conductivity maps are being developed every year. An article in this newsletter provides the findings of utilizing soil electrical conductivity maps for variable rate pre-emergence herbicide applications. [Read a detailed article on soil electrical conductivity in our extension newsletter of November 2002 "Sensors in Agriculture" http://www.colostate.edu/Depts/SoilCrop/extension/Newsletters/2002/Sensors/index.htm] Over the last 5 years in Colorado, we have mapped variability of several farm fields in the Front Range, Northeastern Colorado, Southeastern Colorado, and the San Luis Valley areas. All the fields that were mapped showed variability in soil and crop properties. However, these results should be interpreted with caution. Prior to making any management decision, one should be cognizant of the "scale of variability" associated with a particular soil and crop property. For example, in corn fields we have found that the computer may show a grain yield map that "appears" highly variable across the field. However, a closer look at the "scale of variability" may show that the grain yields varied only from 180 bushels/acre to 210

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FROM THE GROUND UP
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Managing variability in the field (continued):

bushels/acre. Such a small-scale of variability, i.e., 30 bushels/acre across the whole field may not constitute a good enough reason for that field being a good candidate for variable rate management. In addition to the "scale of variability" another important aspect in making a management decision is the reason of the variability. Understanding the reason associated with variability is equally important to determining whether or not the variability can be managed.

Managing variability is the final step in the process of site-specific farming. Once you know how much variability exists in your field, what type of variability it is, and whether or not you can manage it to improve production, the next logical step is to manage that soil and/or crop variability via variable rate input management. There is a perception that variable rate management of soil and crop variability minimizes variability across the field. This is incorrect. Variable rate management of agricultural inputs (nutrients, irrigation, herbicide, seeding, etc.), allows you to maximize the efficiency of farm inputs and thereby minimize the variability in net $ return from across the field.

The overall concept of site-specific management is application of farm inputs at the right time, in the right amount, and at the right place. This issue of the newsletter provides an insight into managing variability in fields. Articles were invited from specialists around the country (North Dakota, Georgia, Texas and Colorado). Hopefully, it will provide you with new production information and stimulate some thoughts as to how you can manage and take advantage of variability that exists in your fields.

For specific question, please do not hesitate to contact me.

Thank you,
Dr. Raj Khosla
Precision Agriculture Specialist
Colorado State University.

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Site-Specific Nutrient Management

Zone soil sampling as a practical method for directing variable rate nitrogen applications in North Dakota.

I grid-sampled fields most of my agricultural career, first as an agronomist for a fertilizer retailer, then as a graduate student. When I came to North Dakota in 1994 I had no other thought but to repeat the work that I had done on grid sampling in Illinois. I thought that I would probably come up with the same answer regarding grid size as we had derived earlier; one sample per acre was needed to show fertility patterns in a field. The first year that I sampled I was pleased to see that the field we happened to work in showed a very distinctive pattern of nitrate levels. However, I expected the pattern to be different the next year because I was always told that nitrate levels changed. My view of the world, at least in regards to sampling, changed when I sampled the same field again the next fall and saw similar patterns as the previous year (Figure 1).

The only explanation for seeing similar patterns in two successive years following two different crops (wheat the initial year, sunflower the next) was that there was some underlying physical and logical reason why nitrate levels tended to be consistently high or low in certain areas. It seemed logical from our short experience in that field that landscape, or topography, might have something to do with residual soil nitrate patterns.

We measured the elevation using a standard surveyors transit. **After overlaying the topography surface map with nitrate levels, we could see that the higher nitrate areas were in depressions and lower nitrate areas were on the sandier ridges** (Figure 2). Our statistical analysis showed that if we divided the field into five topographic zones, then we could give a similar or better representation of nitrate levels as a one sample per acre grid.

Since 1994, nitrate has been related to topographic zones each year we have studied this field. It is logical that topography and nitrate are related because topography helps control the movement of water through the soil. Since nitrate is an anion and is very soluble in water, nitrate readily moves with soil water. Water always moves to the same places within a field. Depressions receive the most surface water, and also have the highest water table. Hilltops shed the most water, and therefore less water enters the soil to leach nitrate. Slopes are usually somewhere in-between.

There are other methods that have been investigated that help delineate the boundaries for nitrogen management zones. One of the most commercially successful applications has

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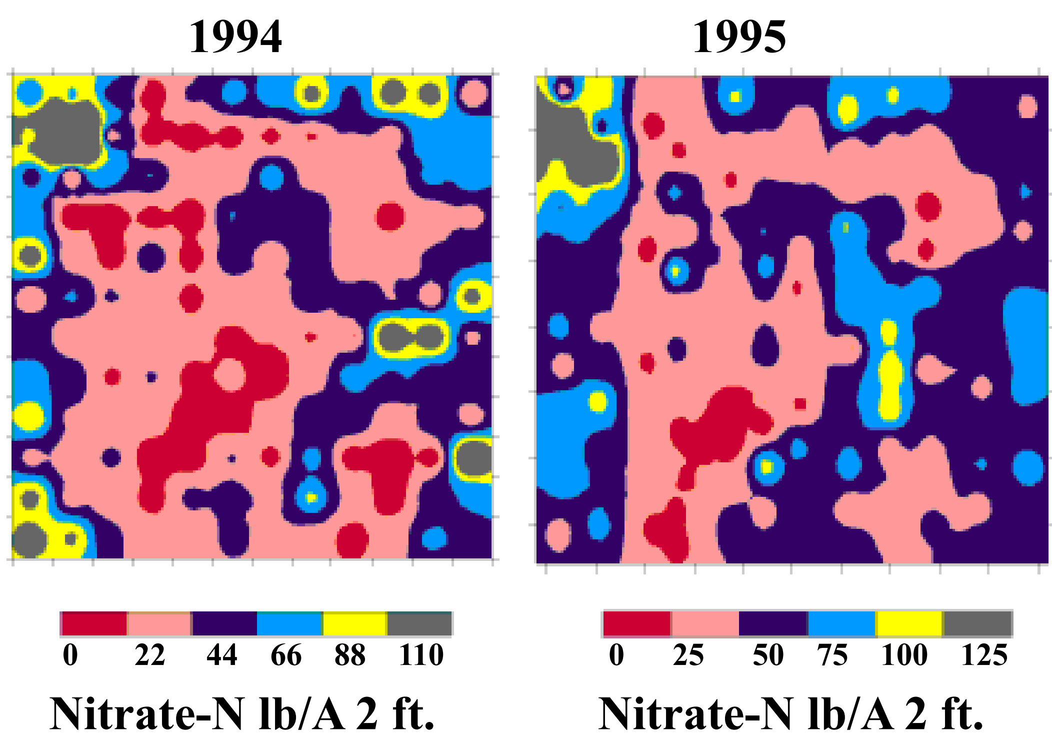

Figure 1. Nitrate-N at Valley City , ND in 1994 after wheat and 1995 after sunflowers. Similar patterns are seen in each year, and stimulated to move to a zone approach to sampling for variable-rate N application.

Site-Specific Nutrient Management (continued)

been the use of remote imagery in sugarbeet to site-specifically reduce N applications to the following crop using sugarbeet leaf color. North Dakota State University soil scientist Dr. John Moraghan related sugarbeet leaf color at harvest with nitrogen credit potential. This principal is being used to delineate zones using satellite imagery. The foliage color is ground-truthed by sugar company field agriculturalists. **The grower can then have a fertilizer spreading map developed to site-specifically reduce N applications to parts of the fields.** Satellite imagery can be used in other crops as well, such as wheat (Figure 3).

Other methods that have been found useful are aerial photographs of the growing crop (Figure 4), electrical conductivity sensors (Figure 5) and yield mapping (Figure 6). Our current research is looking at ways to automate the zone delineation process and determine whether one method, or a combination of methods provides greater reliability than just a single method.

Dr. Dave Franzen,
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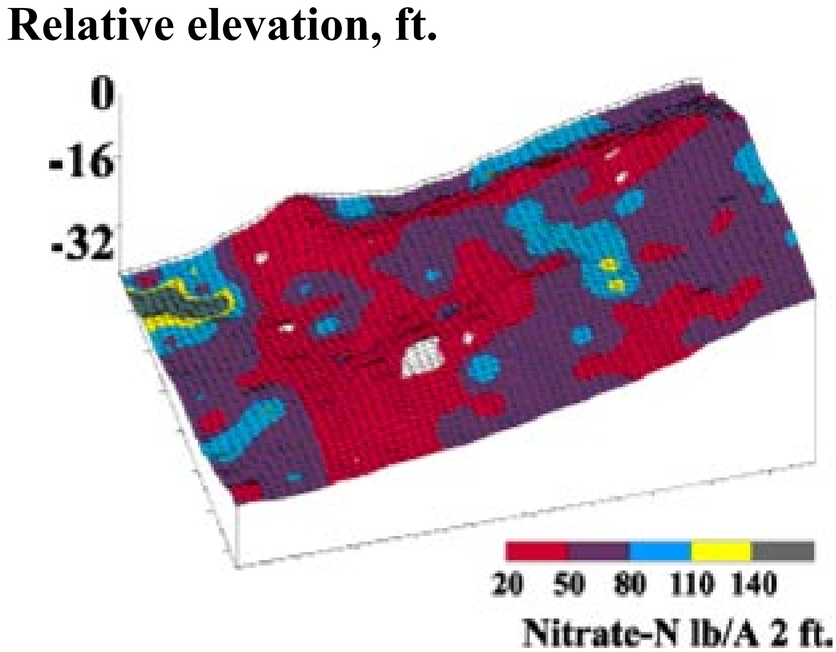

Figure 2. The Valley City field in 1995. Nitrate-N contour map overlays the topography surface map. Low N areas tend to be on sandy hilltops and ridges, while higher N levels are in gentle swales between ridges and in depressions.

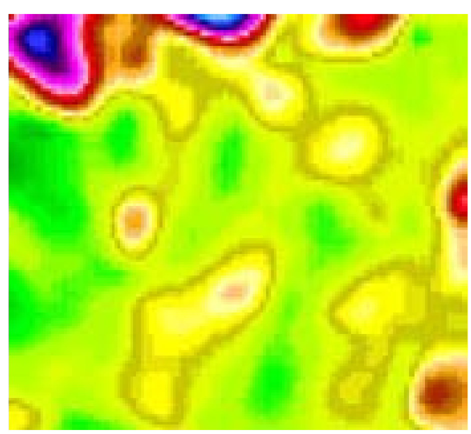

Figure 3. Satellite (Landsat 5) image of the Valley City, ND field in wheat taken just prior to heading. Green is related to high vigor and best wheat productivity . Brown and purple are from drowned-out or non-productive areas.

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Site-Specific Nutrient Management (continued)

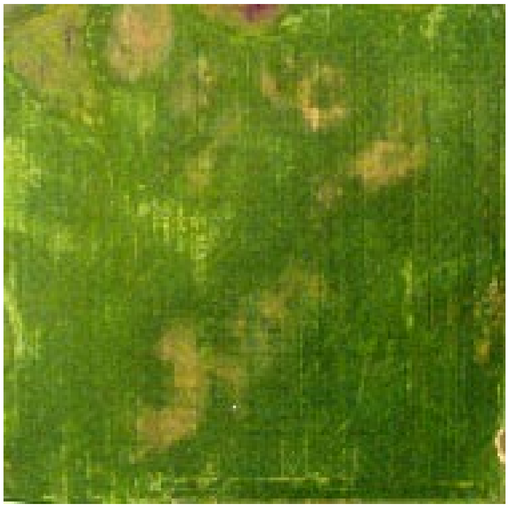

Figure 4 (left). Aerial photograph of the Valley City field in barley, 2002. Photo taken when the plants were in the late tillering stage. Picture was taken with Ektochrome color film from an altitude of 5,000 feet.

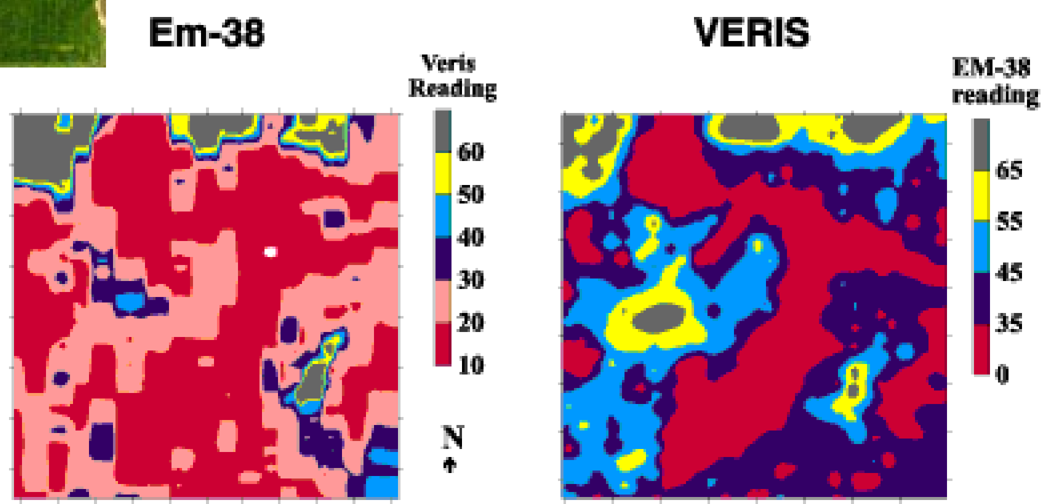

Figure 5 (above). Soil electrical conductivity of the Valley City field. Readings taken using a Veris® EC sensor.

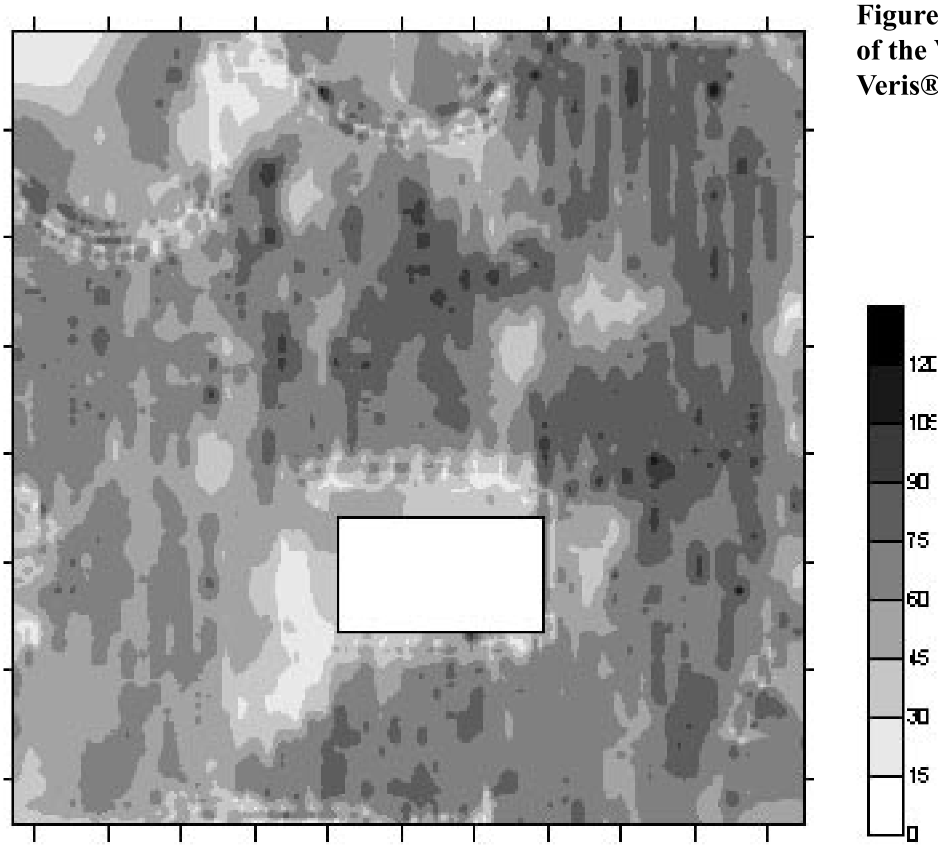

Figure 6 (left). Barley yields, 2002. Square area in the center is an internal study not associated with the rest of the field. Yields are in bushels per acre on the scale bar.

Site-Specific Insect Management

Quantifying insect pest population and distribution across management zones has potential for site-specific insect management.

The variability observed in insect pest distributions across a field and over time has been one of the major challenges for insect pest managers. Because of this variability, the cost of getting an adequate picture of an infestation is often too high for use in production agriculture. Much effort has gone into developing more efficient sampling methods, such as sequential sampling and remote sensing, that allow accurate assessment of the infestation in a given field.

The next problem insect pest managers face is to determine the economic significance of the sampled infestation, which is done with the economic injury level (EIL) concept. The EIL relates pest abundance or damage to expected yield with the following formula:

$$EIL = \frac{CC}{YL \times MV \times EY}$$

EIL = economic injury level
CC = control costs
YL = yield loss per insect
MV = market value of corn
EY = expected yield (bushels/acre)

The calculation results in some measure of abundance (corn borers per stalk, mite-infested leaves) or damage (% damaged plants, tunnels per stalk) that is expected to result in a yield loss equal in value to the cost of treatment. Because it is economically undesirable to actually reach the EIL, treatments are generally made at a somewhat lower level of abundance or damage referred to as the economic threshold (ET).

Sampling costs have limited the compatibility of insect pest management and precision agriculture. Given that the cost of obtaining an adequate sample for an entire field is often prohibitive, the affordability of sampling smaller units as required by grid sampling approaches would be even lower. Sampling production management zones may offer a compromise. This involves grouping areas of the field with similar production potential together into management zones, and sampling each zone separately. This concept has two features that enhance compatibility with insect pest management. The first is reduced sample effort relative to the grid sampling approach, although more sampling still is required than for the whole field approach. However, our initial observations indicate that insect densities vary with management zone so it may be that sampling management zones may be more accurate than sampling the whole field because insect densities are more uniform within zones. The other feature is a better assessment of yield potential which improves the accuracy of EIL calculations. This, in turn, would lead to more efficient insecticide use.

For these reasons, our research is focusing on relating insect pests of corn to production potential management zones. If insect damage is proven to correspond to management zones, insect treatments could be targeted towards specific management zones instead of the whole field, thus reducing the amount of insecticides used and saving the grower money.

Objective 1:

Determine if insect pest (western corn rootworm, European corn borer, western bean cutworm, Banks grass mite) abundance differs among management zones.

Surveys of these pests were conducted in 2001 and 2002 within management zones in cooperator fields in Wiggins, Yuma, Brush, and Greeley, Colorado.

Study Findings

- Western corn rootworm larvae and adults were more common in high productivity management zones than in low productivity management zones.
- European corn borer larvae were more prevalent in the high productivity management zone at the most heavily infested field.
- Western bean cutworm egg masses were evenly distributed among management zones at one field, but at this same field larvae were most common in the high productivity management zone.

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Site-Specific Insect Management (continued)

Objective 2:

Determine if production potential management zones influence insect damage.

This research is being conducted with the same corn pests at a field at ARDEC (Colorado State University Agricultural Research Development and Education Center) in Fort Collins. Because we are on university land we can infest plants with insects to determine if the observed differences in pest abundance among management zones is due to differential survival related to some management zone property rather than due to differential choice by adult pest insects. Also, our infestations assure that insects are present every season, which is not always the case in growers' fields.

Study Findings:

In 2002, plots were infested with equal numbers of European corn borer larvae. When stalks were split, a differential rate of survival was observed among management zones.

Management Zone	High	Medium	Low
Larvae per plot	20.0	12.8	8.8

In 2003 we are trying to relate abundance and damage of these pests to the following variables: Productivity level management zones (high, medium, low); moisture levels (irrigated, dryland); and nitrogen levels (irrigated 50,100, 200 lb N/ac and dryland 50,100,150 lb N/ac).

The research will give us a better understanding of how insect pest variability is related to production potential management zones. This, in turn, could lead to improved insect pest sampling as well as more efficient and economical insecticide use.

Mr. Silas Davidson and
Dr. Frank Peairs
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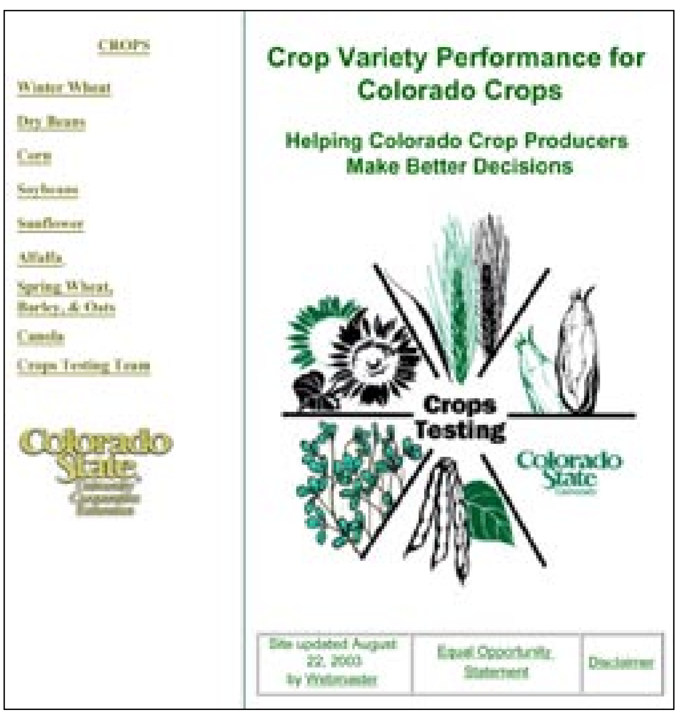

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Site-Specific Weed Management

Using soil electrical conductivity maps to modify soil applied herbicide rates.

Most farmers know that there can be tremendous variability in the type of soils within a field. Although pre-emergence herbicide activity is highly dependent on soil type, most are applied at the same rate across the whole field leading to over application on some soils and not applying enough in other areas. This increases not only costs, but the possibility of contaminating ground and surface water as well. Utilizing the tools of precision agriculture, farmers may be able to vary the application of pre-emergence herbicides based on soil variability, applying less on lighter soils (coarse texture soils) and more on heavier soils (fine texture soils) within a field while maintaining good weed control. This would not only reduce the cost of herbicides for the farmer, but would reduce the possibility of water contamination due to the over application of herbicides to areas that do not need them.

One of the obstacles to implement variable herbicide application is gathering the extensive amount of information necessary to accurately determine where to apply different rates of herbicide. What is needed is an inexpensive and efficient way to thoroughly map soil variability and relate it to factors that affect herbicide performance. Veris Technologies has designed a trailer unit that can create intensive field maps of bulk soil electrical conductivity (EC) (See Farahani, HJ. 2002. Soil Electrical Conductivity Mapping of Agricultural Fields. http://www.colostate.edu/Depts/SoilCrop/extension/Newsletters/2002/Sensors/SoilEC.htm). The EC of a soil is a measure of how easily an electrical current passes through the soil and is dependent on water content, soil texture, soil organic matter, salinity and exchangeable calcium and magnesium. Under non-saline conditions, soil EC has been used to estimate many factors, including herbicide behavior.

We have been conducting research to determine the relationship between soil EC and herbicide behavior in three different fields in eastern Colorado. We have maps of the EC zones within these fields (Figure 1) and have taken soil samples representing three different zones within the field and determined both the binding and biological activity of three pre-emergence herbicides, metolachlor, EPTC and metribuzin. Our results show that there is a good relationship between soil EC and herbicide binding, particularly for metolachlor and EPTC. These herbicides bind less tightly to soils taken from low EC zones compared to soils taken from high EC zones. This behavior is not unexpected because in these fields there is a strong relationship between EC and soil organic matter: the higher the EC the greater the organic matter. Since the binding of herbicides is highly dependent on soil organic matter, then one would expect to see more binding in the high EC zones compared to the low EC zones. The biological activity of these herbicides also varied depending on the EC zone. **In soil taken from low EC zones, it took approximately 40% less metolachlor to give the same level of activity compared to soil taken from the highest EC zone.**

We took the data that we generated from these relationships between soil EC and herbicide binding and created new zones within the three fields that predicted soil binding of the herbicides. We then went back to each of these fields and took new soil samples from areas of the field to determine how accurately we could predict herbicide binding. We found that we accurately predicted herbicide binding and biological activity about 80% of the time. This is very encouraging.

However, were the differences we measured in these fields enough to justify the cost of gathering the information? On the Dual Magnum label there are instructions on how to vary rates based on soil texture and organic matter. Using the recommended herbicide application rates for different soil types, we determined the difference in rate for the low and high EC zones in all three fields. In two of the fields (Wiggins 1 and 2), the differences between the low and high EC zones varied by less than 10%. It is unlikely that herbicides could be applied accurately enough to do this. In the third field (Yuma site), differences between the low and high EC zones were large enough that the application rate of the herbicide varied between 1.2 and 1.5 lb/a. Using this information,

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Site-Specific Weed Management (continued)

we constructed a theoretical application map (Figure 2). In this particular case the low application zones accounted for approximately 25% of the field. The savings in herbicide was approximately 1 gallon of formulated product, which translated into a savings on herbicide cost of approximately $1/ acre.

How would a farmer use this type of approach? The first thing to do would be to make a soil EC map of a field to determine the pattern of variability. Then soil samples would be analyzed to determine the relationship between soil EC and soil organic matter and texture. Once this relationship is known, a new map can be drawn of the field delineating the field into different herbicide application zones based on the predicted variation in herbicide availability. We are currently conducting further research to determine if this approach is practical and can accurately predict herbicide efficacy and behavior.

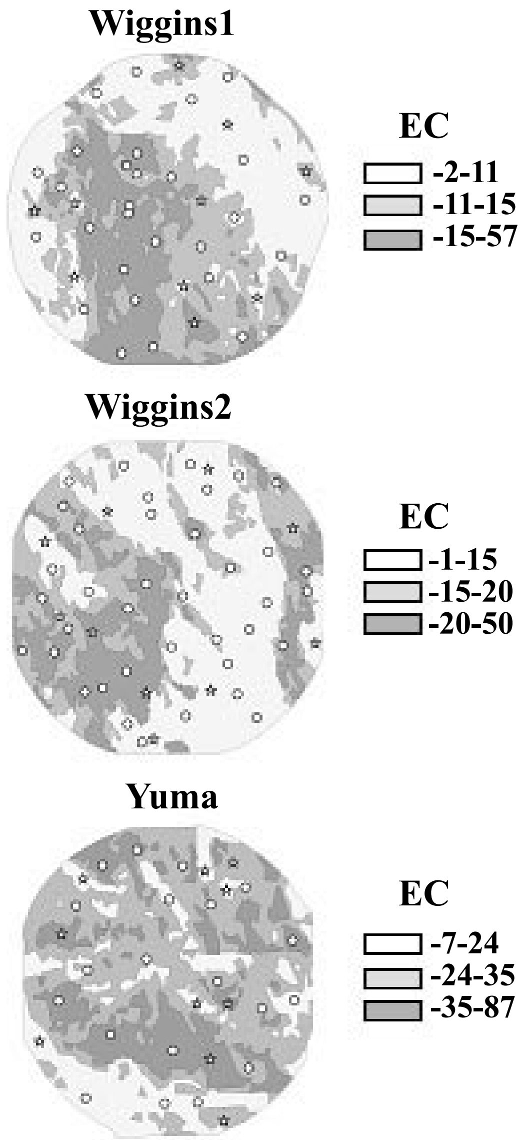

Figure 1: EC maps of three fields in eastern Colorado

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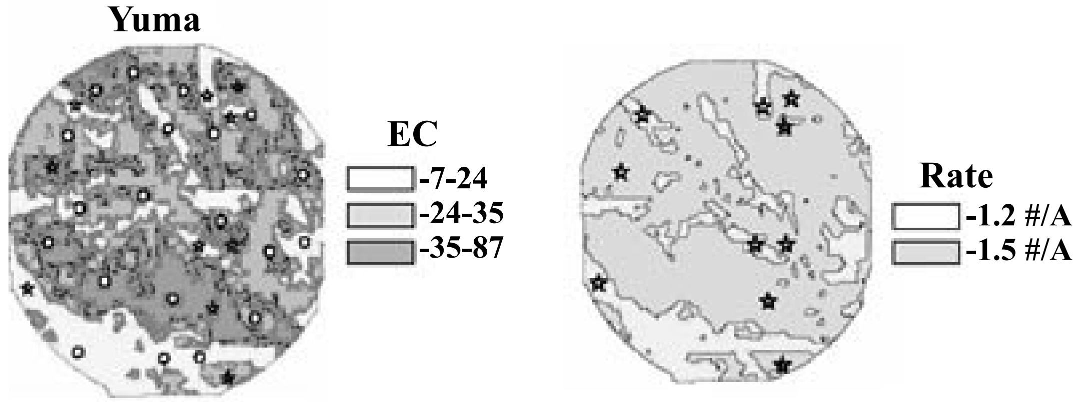

Figure 2: Application Map for metolachlor

Site-Specific Irrigation Management

Efficiency variable-rate irrigation controls for center-pivot irrigation to enhance water use.

What is Variable-Rate Irrigation?
Variable-Rate Irrigation (VRI), also called site specific or precision irrigation, is a relatively new concept in agriculture. Variable-rate irrigation is a tool of Precision Agriculture that involves the delivery of irrigation water in amounts that match the needs of individual areas within fields.

Most center-pivot (CP) irrigation systems currently in use apply a constant rate of water. Some systems can provide variable application rates in wedge-shaped sections of a field by varying the travel speed of the system through those areas. However, the ability to vary application rates over segments in an entire field has not been possible with current systems. With VRI, each area in a field can receive the proper amount of irrigation water.

Do I need VRI?
Very few fields are uniform - most have variable topographic and soil conditions with corresponding soil water variations (water holding capacities, drainage rates, infiltration rates). Many CP systems do not make complete circles or overlap other pivots. Similarly, many CP systems have areas, such as waterways, ditches, ponds, or roadways, that are not cropped and do not need to be watered. Other fields may be irregularly shaped or have multiple crops planted. All of these scenarios could benefit from a system with the ability to apply varying amounts of irrigation water to specific areas in a field.

One should not immediately assume that they must purchase new hardware to implement VRI. Some things that could be done inexpensively include:

- dividing a pivot into pie sections with different water needs and manually changing the pivot travel speed through the sections (this can also be done with newer control panels)
- using end-gun controls more effectively
- using manual valves to turn off individual sprinklers
- installing VRI controls on only part of a pivot, rather than on the entire pivot

How does VRI work?
Researchers have been working for several years on systems to control water application rates from either individual sprinklers or groups of sprinklers. The VRI system being developed by University of Georgia researchers at NESPAL varies water application by a combination of pivot speed control and cycling sprinklers on and off. For example, to halve the application rate of a sprinkler at any given speed the sprinkler would be turned off for 30 seconds each minute. To double the rate the rotation speed of the pivot would be halved. It is possible for part of the pivot boom to be applying double the normal rate and another part applying half the normal rate (or less). It's simply a matter of the computer controller manipulating both pivot speed and sprinkler cycle time.

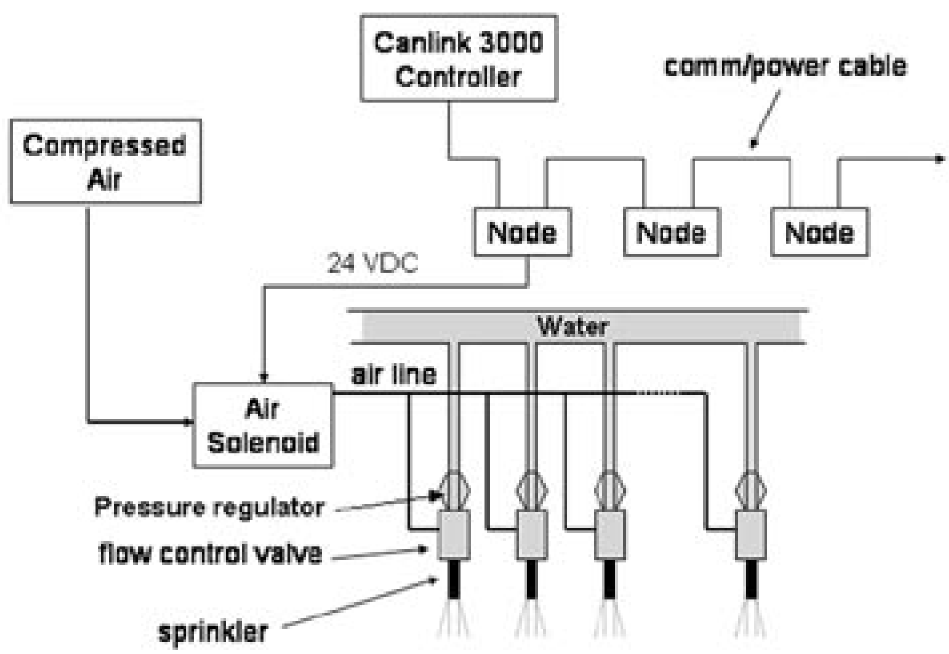

Figure 1. Layout of VRI control

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Site-Specific Irrigation Management (continued)

The NESPAL VRI system

NESPAL installed a standard 4 tower, 600 foot Reinke CP irrigation system and then retrofitted it with a VRI control system. The CP can be controlled either by the manufacturer's control panel or the new VRI system. The Farmscan group (http://www.farmscan.com) has been a partner on this project. Compressed air is used to control the sprinklers, reducing the likelihood of clogged valve orifices common with electrical solenoid valves.

The major components of the NESPAL VRI system (Figure 1) include:

- Farmscan Canlink3000™ controller with desktop software
- Farmscan proprietary control "nodes"
- air compressor and electrical air control valves
- air-actuated water control valves
- pressure regulators
- GPS receiver (for end-tower position/angle).

Desktop software allows management zones to be defined under the CP and then uploaded to the main controller. The pivot boom is segmented by grouping sprinklers in 15 banks (with either 2, 3, or 4 sprinklers each). The end gun is also VRI controlled. To ensure flow uniformity when some sprinklers are off, pressure regulators are present at each sprinkler.

Performance of the VRI system

To measure the performance of the NESPAL VRI system, a test was devised using catch cups along the entire length of the mainline. Three test patterns (uniform at 100%, uniform at 50%, and VRI) were each repeated three times. Plastic cups, placed every 5 ft, were held by rings about 1 ft above the soil surface (Figure 2). In Figure 3, the data shows the "100%" or normal rate had good uniformity. Similarly, the "50%" application rate also has good uniformity, showing that cycling sprinklers on/off to vary application rate did not alter the uniformity. In Figure 4, the "VRI" data points reflect the test results with sprinkler banks set to various target application rates. The graph shows good correlation between actual and target application.

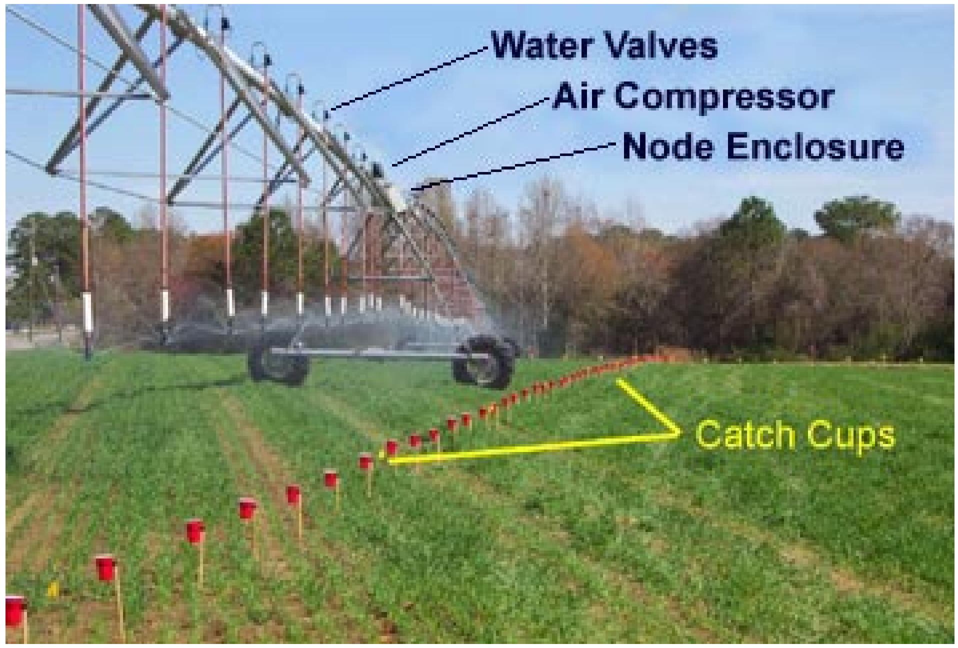

Figure 2. Catch cups used in NESPAL VRI system testing.

Future Directions

The NESPAL VRI control system has been installed on 4 additional CP systems on grower fields, and another has been installed at the University of Georgia Stripling Irrigation Research Park, near Camilla, Georgia.

One VRI installation was notable in that it was a partial installation. Only the last span, overhang, and end-gun have VRI controls. This type of installation was used because the primary aim was to reduce overlap irrigation with a neighboring CP.

The currently installed systems will be monitored over the coming seasons to judge their performance and reliability. We should soon know more about the economic and environmental impacts of VRI. These systems will be used as models for water conservation and Precision Agriculture extension activities. The knowledge gained from their operation should help farmers, waste applicators, and researchers decide whether or not VRI is a viable option in the context of their irrigation operations. For more information please see http://www.nespal.org/PrecAg/vri.asp.

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Site-Specific Irrigation Management (continued)

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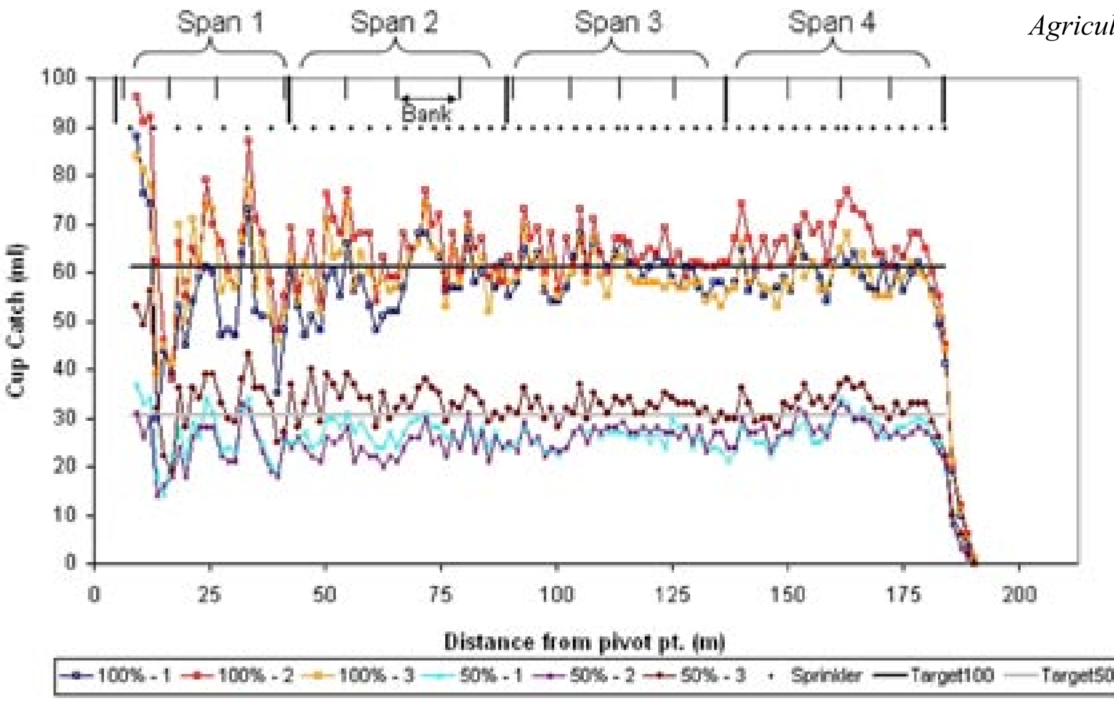

Figure 3. Results of 100% and 50% testing of NESPAL pivot.

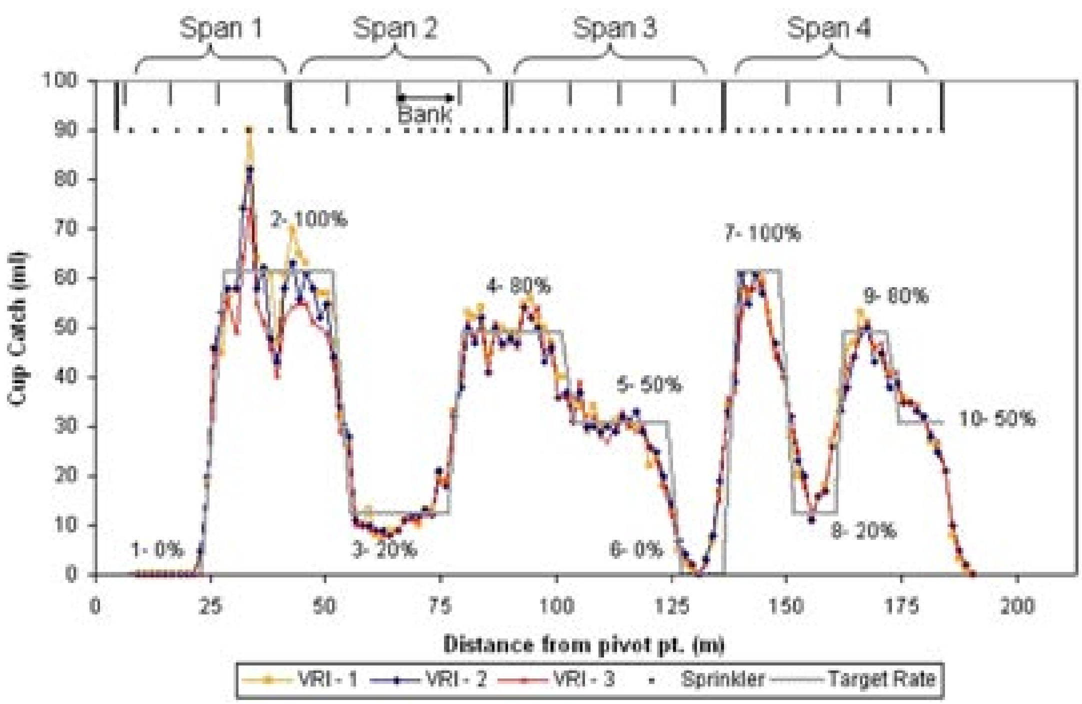

Figure 4. Results of variable-rate testing of NESPAL pivot.

Site-Specific Soil Sampling

Improving the way you soil sample for maximum variability.

Issue

Soil sampling is generally not practiced often enough by Texas producers, and the tradition of sampling strategy has not been evaluated in many years. Improper soil sampling can result in incorrect fertilizer applications, loss of production and profits, as well as nitrate contamination of groundwater. Animal waste applications to cropland is another important soil nutrient issue. Excessive manuring without proper soil sampling can result in nitrogen and phosphorus imbalances and contamination of surface waters. Nutrient contamination of ground- and surface waters is a pressing environmental concern in Texas and other parts of the country. Finally, global positioning system (GPS)-referenced variable-rate fertilizer equipment is becoming more available, and economical soil sampling approaches for this technology are needed.

What We Have Learned

Depth to soil sampling is the first concern. Historically in Texas, soil sampling for nitrate and nitrogen fertilizer recommendations has been done to 6 inches. Our project has shown that this practice can greatly over-estimate fertilizer recommendations by ignoring the often high levels of residual nitrate-nitrogen in clayey subsoils of the 6 to 24 inch layer. By thorough soil sampling of five farmers' fields between 2000 and 2002 in Yoakum, Hockley, Lamb, and Hale counties, we have found that there can be nearly four times the amount of nitrate-nitrogen in the 6 to 24 inch soil layer (average of 70 lb nitrate-nitrogen/ac) as in the 0 to 6 inch top layer (just 18 lb nitrate-nitrogen/ac). Soil sampling to 6 inches is sufficient for phosphorus, potassium, micronutrient, and pH analysis. However, since phosphorus fertilizer is often band-applied, it is important that all positions in the field, i.e. bottom of furrow, side of bed, and top of bed, be sampled and composited.

Where to take soil samples in the field is the second major issue. Grid soil sampling from 0.5 acre to 2.5 acre-grid has been used by researchers and 2.5 acre-grid is used by commercial fertilizer applicators to produce soil test maps. Variable-rate fertilizer application is a service that is now being offered by commercial applicators in the Southern High Plains of Texas. However, grid-soil sampling has received criticism as a practice that a producer could not be able to do profitably. Therefore, there has been interest in "management zone"– based soil sampling. Results from our research show that "directed" soil sampling from management zones based on soil type, landscape position, and/or zones in yield maps can be as effective as grid soil sampling. Specifically, four to six soil samples can be taken from each zone and composited, so that one soil sample from each zone can be sent to a state or private soil testing laboratory for analysis. With this approach, producers can apply different rates of fertilizer to a small number of zones.

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Fertilizing by zone is "doable", even without variable-rate equipment, if soil tests in certain zones recommend no fertilizer application. For producers with variable-rate fertilizer equipment, less or no fertilizer can be applied to zones testing high in soil nutrients. Similarly, higher fertilizer rates should be applied to zones with low soil test values.

The Benefit

The management zone approach to soil sampling and deep soil sampling are easy to understand and to implement. These improved strategies can result in substantial reductions in farmers' fertilizer application rates and associated costs. Seventy lb nitrate-nitrogen/ac is probably a typical nitrate-nitrogen

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Site-Specific Soil Sampling (continued)

level in the 6 to 24 inch layer of High Plains soils, nitrogen that can only be realized by soil sampling to 24 inches. This represents a savings of $17/ac that is needlessly applied as fertilizer nitrogen.

Site-specific soil nutrient management approaches are especially beneficial in identifying "hot spots" of nutrients, such as areas where animal wastes have been applied. These approaches will also mitigate excessive nitrate buildup in the subsoils of the High Plains, and minimize leaching to the groundwater. Avoiding excessive phosphorus fertilizer applications by "site-specific" soil sampling and fertilization can help minimize movement of phosphorus in runoff to surface waters. As of the 2002 growing season, we know of at least two prominent area crop/soil consultants who are presently doing deep soil sampling and zone soil sampling in Castro, Hale, and Lamb counties. The Texas Agricultural Experiment Station is promoting these improved soil sampling strategies so that their adoption widens.

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Site-Specific Farming Enhances Farm Resilience

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Times of crisis are times of change. In the history of human endeavor, those who survive and effectively take challenges and adapt them into their advantage are the first to profit from the new prosperity that always follows a period of strife. An Elite set of American farmers will profit from the current agricultural crisis including those tinkering with site specific farming using precision-Ag technology.

Federal Census and US Economic studies show that agriculture in the United States is in an economic crisis not seen since the 1930's Depression and Dust Bowl era. The evidence is seen in the fact that farmers' and ranchers' personal income is less than two third of workers in all other sectors of the economy. Inflation in agricultural inputs and land values, the trend toward topping out of crop yields, and flat commodity prices have wrung out profits from nearly all farm operations. The agricultural producers who can survive and thrive in these extremely tough times have unique personal and management qualities that are key to their survival.

One critical characteristic of these individuals is that they keep personally involved in applying new practices and field level research on their farms. These are individuals that invest personally in testing new crop varieties, different fertilizer blends and levels, new cropping rotations or livestock/crop integrations, different tillage and production practices, and other types of modifications to find the ones that have the most profitable and practical fit to their operational style and constraints. They have maintained the "can do" spirit that built America and served us so well through troubled times throughout our country's history. They are forward thinkers but more importantly they are committed to and active in making farm management decisions that adjust their practices to cope with external economic and social changes.

Another characteristic is being future oriented. These are the individuals who invest a portion of their time, management and, resources in trying out new technology in their operations. It is this author's belief that a good percentage of these pioneering farmers are currently applying site specific farm management using precision ag technology on their fields and are profiting from their use. These are the individuals who can best take a research based idea and put it to profitable and practical use on their farm. They are the most skilled in adapting and adopting to fit good ideas into workable practices because they have a lifetime experience of making the mis-aligned and mis-matched work on the farm.

Finally, the producers who will succeed and grow during times of crisis are those who have written down goals and a strategic plan to achieve their goal and then follow up with applying management and effort to accomplish the goal. Strategic planning is simply a series of steps and procedures that today's business manager uses to effectively plan the course of action he would like to follow including changes when potential new situations arise. Strategic planning is about looking into the future -- determining what products/services should be promoted, maintained, or abandoned depending on future conditions. This involves deciding what the market for products/services will be 5, 10, or more years into the future. Strategic planning begins with taking a business and personal assessment focusing on Strengths, Weaknesses, Opportunities and Threats.

Creating your place in the future is a matter of taking steps today that insure that you will get there. Having the confidence and optimism to take the first step is to use the will to do so. Confidence and optimism come from succeeding with that step and each following step. Your challenge is to take informed risks so that you learn better how to manage risks. Make site specific farming a reality on your farm by using today's technology.

Mr. D. Bruce Bosley
Extension Agent/Cropping Systems
Lower South Platte

Some Websites for Your Information

Precision Agriculture / Yield Monitoring
http://www.agleader.com (GPS receivers, yield monitors, and controllers)

http://www.omnistar.com (DGPS differential correction subscription service)

http://www.trimble.com (DGPS receivers)

http://www.precisionag.com (Precision agriculture equipment buyers guide)

http://www.starlinkdgps.com (DGPS receivers)

http://www.redhorsetech.com (Yield monitors for specialty crops)

http://www.harvestmaster.com (Field data collection tools)

http://www.deere.com/greenstar (Combine yield monitors)

E.C.
http://www.veristech.com (Soil mapping equipment based on E.C. sensors)

http://www.ppi-far.org/ppiweb/ppibase.nsf/$webindex/article=BD1CF45C852569D700636EDAC9ADC4DE (Site specific management guidelines)

http://www.pioneer.com/usa/technology/soil_conductivity_mapping_99.htm
(Soil E.C. mapping introduction and summary)

Remote Sensing
http://www.digitalglobe.com (Satellite imagery)

http://www.earthscan.com (Satellite imagery)

Precision Agriculture
http://www.precisionfarming.com/ (Site-specific farm management, such as GPS)

http://www.pioneer.com/usa/technology/precision.htm (Mapping soil properties or grid-sampling, yield monitoring, remote sensing, electrical conductivity measurements, and farm profits as related to precision agriculture)

http://terraserver.com/ (High resolution topographic images)

http://www.deere.com/deerecom/Farmers+and+Ranchers/harvestlink.htm (Custom harvesting information)