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Rather than carpet bomb their fields with pesticide and fertilizer, computer-savvy farmers can now target each square foot individually.

Cyberfarm

By Christine Lutton

FOR THE PAST 10,000 years farmers have had no way of judging the yield of a given acre of land. They would figure the average yield and just assume that one acre was much the same as another. They aren't: Agronomists have found that one plot can be twice as productive as a nearby one, even though there is no visible difference in the land. Why, they asked, can't we discover what the ailing acres are missing and supply it, thereby raising total productivity?

Such targeted treatment, called precision farming, is finally coming into its own, thanks to the declining cost of computers and the availability of such navigational aids as the satellite-borne Global Positioning System. In principle, you could comb your field for systematic variations in elevation, soil composition, moisture and wind exposure, then whip up an individual recipe of treatment for every bit of earth. Then you apply just the right amounts of fertilizer, herbicide, insecticide and water to each spot, in the process saving on chemicals and minimizing runoff into rivers and lakes.

Take the example of farmer Douglas Harford. Harford, 47, maneuvers a combine equipped with a yield monitor through 1,500 acres of corn and soybeans in Mazon, Ill. At the end of the day he removes a data card, takes it to his PC and makes maps showing how each field is doing. Along the way, his $3,500 GPS receiver shows him (and his computer) where in the field he is. Using information gleaned from three harvests, Harford is now doing test plots to see how changing one variable affects the crop.

In four years, Harford guesses, he has spent $20,000 on technology and saved as much on chemicals and other inputs. More important, Harford says, is what he's learned: "I am confident that this will give me a tremendous advantage."

The return on investment, always problematic for pioneering computer applications, is very much so in agriculture. Trial and error doesn't work as quickly as it would in a newly automated steel mill or office. Farmers can't control the weather and the changing price of chemicals and grain. Moreover, it takes a year of farming to get a set of data on a subplot of land. Daniel Ess, an assistant professor of agricultural and biological engineering at Purdue

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Douglas Harford
Data gleaning.

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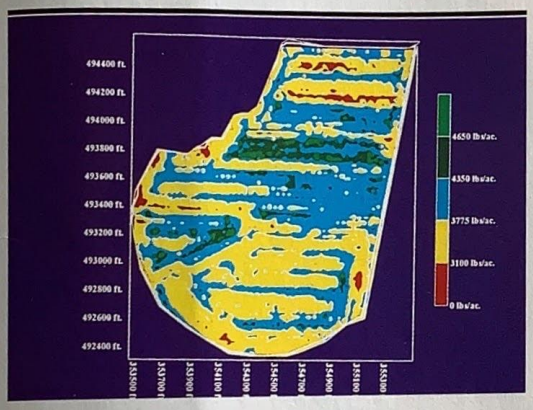
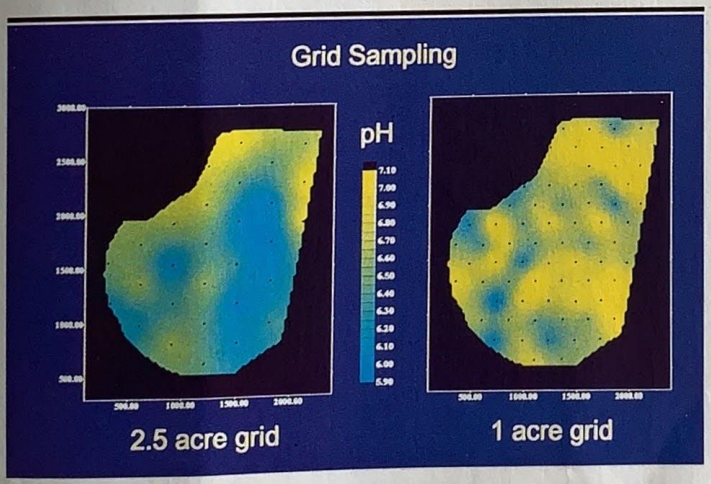
University, says it may take as many as five years to get a clear sense of a field's potential.

This slow payoff explains why only a handful of farms, mostly well-capitalized spreads in the upper Midwest, have bought into precision farming so far. When these beta testers have done their job, however, and when computer system costs come down further, the break-even point will come within the reach of far more farmers. When that day comes, whichever technology has grabbed a goodly share of the market will be worth a lot of money.

In 1986 that growth potential attracted Allen Myers, a farm-bred engineer who was working at Sundstrand Corp., a maker of air compressors and other equipment for aerospace and industrial applications. Myers, 47, started research in his dining room in Ames, Iowa, where he cobbled together a yield monitor—a device that weighs how many bushels of grain are spit through a combine at each point in a farmer's field. He tested early versions on his father's corn and soybean farm, a seven-hour drive away, in Watseka, Ill., and sold his first monitor in 1992—the same year he quit his job and went to work on monitors full time. "He's two steps ahead of everyone else," says Michael Cerny, who uses the yield monitor to farm his 2,500 acres in Sharon, Wis.



Nerd's eye view **Aerial photo of a field (top), computer map of its yield (middle) and maps of soil chemistry (bottom).**



This year Myers expects to sell 3,000 monitors through his Ag Leaders Technology. At an average $3,400 a sale, that translates to revenues of just $10 million—chicken feed by Silicon Valley standards. Still, it may suffice to attract the roving eye of a farm equipment giant, such as John Deere or Case Corp. Both companies are beginning to produce systems that combine yield monitors with graphical display software and GPS readers.

Another builder of precision farming systems (minus the yield monitor) is Rockwell Corp., which is a leader in GPS technology for aircraft. These integrated systems cost between $6,000 and $8,000. Until now, most farmers had connected the pieces themselves, often spending twice those sums to build their systems à la carte.

Maybe the suddenly lowered price will change some farmers' minds. But there will be resistance to overcome. Farmers will either have to learn a lot about computers or pass along the raw data to outside firms (like fertilizer companies) they may not trust.

In any case, the iron logic of ever cheaper computer power ensures that if precision farming doesn't make economic sense now, it will five or ten years from now. Farmers are technologically conservative, and with good reason: The first on his block to embrace a new method might not gain permanent advantage if it works, and he may lose his shirt if it fails. When the cost/benefit ratio shifts sharply into the black, 50,000 combines likely will have to be retrofitted with yield monitors.