IOWA STATE UNIVERSITY
Digital Repository

2002

Precision Agriculture Demonstration Project

Jerald R. DeWitt
Iowa State University, jdewitt@iastate.edu

William Lotz
Iowa State University

George Cummins
Iowa State University

Kenneth T. Pecinovsky
Iowa State University, kennethp@iastate.edu

Precision Agriculture Demonstration Project

Abstract

Global Positioning Systems (GPS), Geographical Information Systems (GIS), and Variable-Rate Technologies (VRT) have been promoted to producers and agri-businesses that serve producers. Improved accuracy, efficiency, profitability, decision making, and management have been suggested as potential benefits. This project was developed to provide producers and service providers with practical recommendations to realize the potential benefits of this new technology. Special emphasis was placed on making cropping decisions based on Integrated Crop Management principles and the information gathered using the GPS/GIS. The demonstration was conducted for 5 years (the 1997–2001 growing seasons).

Disciplines
Agricultural Science | Agriculture

Precision Agriculture Demonstration Project

Jerry DeWitt, Agriculture and Natural Resources, director
Bill Lotz and George Cummins, extension crops specialists
Ken Pecinovsky, farm superintendent

Introduction

Global Positioning Systems (GPS), Geographical Information Systems (GIS), and Variable-Rate Technologies (VRT) have been promoted to producers and agri-businesses that serve producers. Improved accuracy, efficiency, profitability, decision making, and management have been suggested as potential benefits. This project was developed to provide producers and service providers with practical recommendations to realize the potential benefits of this new technology. Special emphasis was placed on making cropping decisions based on Integrated Crop Management principles and the information gathered using the GPS/GIS. The demonstration was conducted for 5 years (the 1997–2001 growing seasons).

Materials and Methods

A 40-acre site adjacent to the Northeast Research and Demonstration Farm was divided into quadrants, then planted in a corn–soybean rotation (two quadrants in corn, two in soybeans each year). The only planned variables during the first three years were planting rates in the two corn quadrants (32K and 36K) and row spacing/seeding rates in the soybean quadrants (10" drill/200K planting rate and 30" row/182K planting rate). During the final two years, manure and commercial fertilizer nutrient sources were compared, and the row spacing/seeding rate variables in soybeans continued.

P, K, and pH data were collected. Several soil sampling methods were compared - center point, random point, and composite within various grid sizes (0.6 acres and 1.1 acres); by soil mapping unit (SMU) within a 10 acre quadrant; and as a composite sample within each 20 acre area. A balance sheet of estimated nutrient removal (drawdown) based on yield was developed and compared to soil test values. A digitized soil survey was imposed on the field site plan maps to localize differences in SMUs and yield potential.

For three years (1998–2000), rainfall was monitored at 9 points within the 40 acres. In 1999, planter accuracy was monitored by use of a computerized measuring wheel called a " Space Cadet," which measures plant population and spacing. The Late Spring Nitrate Test (LSNT) and the Fall Stalk Nitrate Test (FSNT) were used to monitor N utilization and losses. Field scouting was conducted throughout the growing season to document weed, insect, or disease problems. Yields were calculated by quadrant, by means of the combine yield monitor, three yield checks per 1.1 acre grid using the load cell scale on the research farm combine and quadrant scale weights from the elevator. The ISU Crop Management Database has been used to do an economic analysis of each 1.1 acre grid. Statisticians at Iowa State University and in Kansas have compared the various types of information acquired with yield data to discover correlations and identify factors limiting crop production.

Results and Discussion

GPS/GIS technology allows voluminous amounts of data to be generated; summaries of much of this data are included in the comprehensive project report, available upon request

1. Our experience with differences in soil test results from various sampling methods of an area reflects the findings of research conducted at Iowa State and elsewhere. Results from composite samples across an area seemed more consistent/predictable than point samples within a particular grid/area. More cores/samples (12 or more) increased predictability and repeatability. Results of this study support the recommendation to sample by "management areas."

2. A "representative sample" of the whole is difficult to obtain. When sampling soil (1# out of 2 million #/acre furrow-slice); plant population, lodging, or % barren (from $1/1000^{th}$ of an acre); grain moisture (a handful from a grain tank); or other characteristics, there is considerable opportunity for variation and

misrepresentation. There also is considerable variation between and within grids, partly explainable as "sampling error." In three years of this study, some areas (e.g., old farm/pasture sites, pH differences downwind from gravel road) have been identified that do not represent the whole and should be avoided when sampling.

3. Scouting data was available in a timely manner. Weed, insect, and N deficiency problems could be corrected before they caused economic yield reduction. Wireworm, hop vine borer, and ECB damage in corn and white mold (sclerotinia stem rot) in soybeans are examples of scouting data that provided "ground truthing" to help explain and interpret the data from the demonstration project. Scouting can be done by the producer with little investment in new technologies.

4. Anhydrous ammonia toolbars, dry fertilizer/lime, and manure spreaders currently in use may compound soil test variability because of non-uniform spread patterns. Calibration, maintenance, and adjustment of planting, spreading, and spraying equipment is critical to implementing precision agriculture systems.

5. Project results suggest that combine monitor data obtained from specific points within a field, from small plots, or from odd-shaped fields, may not be sufficiently accurate or reliable and should be considered suspect.

6. Dust, pollen, moisture, adverse temperatures, loose connections and/or discharged batteries may affect the accuracy and reliability of GPS/GIS crop scouting equipment. The equipment is accurate most of the time—the problem is recognizing when it isn't. Also, grain flow sensors from different companies are not equally accurate.

7. Project yields have been equal to or greater than county yield averages. Project yields exceeded yields expected from use of the soil survey. Use of information gathered by our crop scout and GPS/GIS can, in some cases, identify limiting factor(s) —e.g., white mold in soybeans, ECB and N losses in corn, uneven and reduced stands, etc. In other cases, limiting factor(s) are not readily apparent and, in fact, may be contradictory.

8. Human interpretation and decision-making are still required. Precision agricultural technology does not replace management. Scouting and "ground truthing" are invaluable in explaining the raw numbers; in many ways, this information is more timely and more useful than the voluminous amounts of data collected by GPS/GIS systems.

9. Producers and agri-business people using the new technologies have reported experiences that mirror this study. Most are convinced that GPS/GIS is a means to an end and not an end in itself—that technology is a useful tool in implementing Integrated Crop Management principles and making economically and environmentally sound decisions. Most justify their investment in scouting and ICM decision-making but struggle to justify their investment in GPS/GIS.

10. Information from this demonstration has been shared at research farm field days, precision agriculture conferences, various extension/agri-business crop production meetings, and in the precision agriculture edition of the ICM Newsletter. It also has been featured in two issues of the *Wallace's Farmer.*