2019 CropLife/Purdue Precision Agriculture Dealer Survey: More Moves Toward Decision Agriculture

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Precision Dealer Survey Specs

• Conducted yearly 1997 to 2009, then every other year.
• Topics:
  • Precision technologies used by the retailers in their business
  • Precision products and services offered to customers
  • Retailers’ estimation of farmer use of precision practices
  • Profitability, technology investment, constraints to adoption
  • Added more data questions in 2017
• Use U.S. CropLife magazine contact list
• Respondents include cooperatives, independents, multi-location regional companies
More Moves Toward Decision Agriculture

2019 RETAILER SURVEY

By Druce Johnson and James H. Lawing, Jr.

The 2019 Precision Agriculture Dealership Survey shows further steps toward a future in which crop management decisions will be increasingly guided by data collected from farmers' customers' fields. New technologies, such as precision soil sampling, satellite and unmanned aerial vehicles (UAV) mapping, and yield mapping, all showed signs of increased use compared to the 2017 results. Corresponding increases were seen in all variable-rate services — for fertilizer, lime, prescriptions for variable-rate seeding, and even for pesticides, although that remains relatively small.

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2019 Headlines:

• Automated technologies are in a maturing market in North America—this isn’t news;

• Knowledge intense technologies to sense, inform, and react are making gains but still lag—this isn’t news either!

• Dealers see big promise for UAVs in future.

• Dealers see big promise in precision pest management.

• Big uptick in using on-farm data for decision making.
Retailer Use of Precision Technology in 2019

- GPS Guidance and sprayer section control is standard practice
- Satellite and aerial imagery used by two thirds for internal purposes.

<table>
<thead>
<tr>
<th>Precision Ag Technology</th>
<th>2017</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS guidance systems with automatic control (autosteer) for fertilizer/chemical application</td>
<td>78%</td>
<td>86%</td>
</tr>
<tr>
<td>Auto sprayer boom section or nozzle control</td>
<td>73%</td>
<td>72%</td>
</tr>
<tr>
<td>GPS guidance systems with manual control (light bar) for fertilizer/chemical application</td>
<td>55%</td>
<td>56%</td>
</tr>
<tr>
<td>Satellite/aerial imagery for internal dealership purposes</td>
<td>52%</td>
<td>65%</td>
</tr>
<tr>
<td>Smart scouting using an app on a mobile device to record field situations and locations</td>
<td>44%</td>
<td>44%</td>
</tr>
<tr>
<td>Field mapping with GIS to document work for billing/insurance/legal purposes</td>
<td>43%</td>
<td>46%</td>
</tr>
<tr>
<td>UAV or drone for internal dealership purposes</td>
<td>34%</td>
<td>38%</td>
</tr>
<tr>
<td>GPS to manage vehicle logistics, tracking locations of vehicles, and guiding vehicles to the next site</td>
<td>34%</td>
<td>36%</td>
</tr>
<tr>
<td>Telematics to exchange information among applicators or to/from office locations</td>
<td>24%</td>
<td>30%</td>
</tr>
<tr>
<td>Sprayer turn compensation</td>
<td>22%</td>
<td>22%</td>
</tr>
<tr>
<td>Y drops on fertilizer applicators</td>
<td>19%</td>
<td>25%</td>
</tr>
<tr>
<td>Other soil sensors for mapping, mounted on a pickup, applicator or tractor (example: pH sensor)</td>
<td>9%</td>
<td>9%</td>
</tr>
<tr>
<td>Chlorophyll/greenness sensors mounted on a pickup, applicator or tractor (CropSpec, GreenSeeker, OptRx, etc.)</td>
<td>9%</td>
<td>7%</td>
</tr>
</tbody>
</table>
Retailers Adopted GPS Guidance Rapidly for Internal Business Use (% of Retailers)

- Lightbars rapidly adopted starting in late 1990s
- Autosteer rapidly adopted starting in about 2004
- Both are easy to use and have short run benefits
Ag Retailers Slower to Offer Data Gathering Technologies to Customers (% of Retailers)

• Data collection technologies are foundation of data-driven farming
• Intensive soil sampling services have become almost standard practice.
• After many years 70% offer satellite imagery
• Big future plans for UAV services
• 2022 numbers are their projections
Soil Sampling

More dealers sample in grids than zones

If zones, soil mapping units or yield maps most common method for delineation

If grids, 2.5 acres most common size
Dealer Offerings of Variable Rate Technologies

- % of Retailers
- VRT is the action side of data technologies for data-driven farming
- Big plans for VRT pesticides
- 2022 are projections
Farmer Adoption Estimated by Retailers in their Market

- % acres in the retailer’s market area, not % farmers
- GPS guidance becoming standard
- For yield monitor data always a question of use
Farmer VRT Adoption Estimated by Retailers

- % acres, not % farmers, in the retailer’s market area
- Substantially higher estimates than USDA and other sources
- VRT seeding and pesticides lag
Setting the Record Straight on Precision Agriculture Adoption

James Lowenberg-DeBoer and Bruce Erickson*

ABSTRACT
BECAUSE PRECISION AGRICULTURE (PA) is considered an "easy" approach to increase agricultural productivity, PA is often promoted as a management strategy that uses electronic information and other technologies to gather, process, and analyze spatial and temporal data for the purpose of guiding targeted actions that improve efficiency, while increasing the sustainability of agricultural operations. In this definition, "agriculture" should be broadly defined to include all types of biological production systems (e.g., raising crops or livestock, farming of wild species, aquaculture, livestock husbandry, and apiculture). Unfortunately, ambiguity remains in the field of agricultural production due to differences in understanding PA technologies and their applications.

Some argue that PA is no longer a practice because there is no longer such a thing as "PA." Others argue that PA has been replaced by "smart farming." However, very different practices exist: some that are more "factual" and others that are more "strategy." The ongoing confusion is due to the lack of a common definition of PA. There is a need to establish a more comprehensive and consistent definition of PA to avoid confusion and improve the adoption of PA technologies.

In this article, we discuss the current state of PA definitions and the challenges that arise from the lack of a common definition. We also propose a new definition of PA that includes both factual and strategic elements. This definition emphasizes the role of PA in improving the efficiency and sustainability of agricultural production.

Keywords: PA, PA adoption, PA technology, PA definition, PA implementation

Figures

- Figure 1: A historical timeline of PA technology development.
- Figure 2: A comparison of PA and non-PA farming practices.
- Figure 3: A map showing the extent of PA adoption in different regions.

References


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REVIEW

Published in AgBioForum, 12(2), 113-119 (2009)
http://dx.doi.org/10.5772/12879

Body of knowledge thoroughly reviewed in the author's article on open access option

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Precision Agriculture Timeline

Table 1. Key precision agriculture milestones.

<table>
<thead>
<tr>
<th>Year</th>
<th>Technology or activity†</th>
<th>Company/organization, product name</th>
<th>Reference</th>
</tr>
</thead>
</table>
| 1983 | Executive order that allowed civilian use of GPS | US government | Brustein, 2014
|      |                         |                                    | Rip and Hasik, 2002 |
| 1988 | Handheld GNSS           | Magellan                           | Smithsonian, 2018 |
| 1992 | First conference dedicated to precision agriculture research | International Conference on Precision Agriculture | Khosla, 2010 |

- First InfoAg?
- Impact plate grain yield monitor?
- Autoguidance?
## Table 1. Key precision agriculture milestones.

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<td>Khosla, 2010</td>
</tr>
<tr>
<td>1992</td>
<td>Impact plate grain yield monitor</td>
<td>Ag Leader, Yield Monitor 2000</td>
<td>Ag Leader, 2018</td>
</tr>
<tr>
<td>1995</td>
<td>First conference dedicated to precision agriculture industry</td>
<td>InfoAg</td>
<td>IPNI, 2010</td>
</tr>
<tr>
<td>1997</td>
<td>Auto guidance</td>
<td>Beeline</td>
<td>Rural Retailer, 2002</td>
</tr>
<tr>
<td>1997</td>
<td>On-the-go soil EC sensor</td>
<td>Veris</td>
<td>(Lund, E. personal communication, 13 Nov, 2018)</td>
</tr>
<tr>
<td>1997</td>
<td>Cotton yield monitor</td>
<td>Micro-Trak, Zycom</td>
<td>Vellidis et al., 2003</td>
</tr>
<tr>
<td>2000</td>
<td>End of GNSS selective availability</td>
<td>US government</td>
<td>Coalition to Save Our GPS, 2012</td>
</tr>
<tr>
<td>2002</td>
<td>Integrated optical sensor and variable rate nitrogen applicator</td>
<td>N-Tech Industries, Greenseeker</td>
<td>Rutto and Arnall, 2017</td>
</tr>
<tr>
<td>2006</td>
<td>Automated sprayer boom section controllers</td>
<td>Trimble, AgGPS EZ-Boom 2010</td>
<td>Trimble, 2006</td>
</tr>
<tr>
<td>2009</td>
<td>Planter row shut-offs</td>
<td>Ag Leader, Sure Stop</td>
<td>Ag Leader, 2018</td>
</tr>
<tr>
<td>2017</td>
<td>First fully autonomous field crop production</td>
<td>Harper Adams University</td>
<td>Hands Free Hectare, 2018</td>
</tr>
</tbody>
</table>

† EC, electrical conductivity; GNSS, Global Navigation Satellite Systems; GPS, global positioning system; VRT, variable rate technology.
USDA Data: Acres with Autoguidance in U.S.
USDA Data: Acres Using Any VRT in U.S.
## Big Uptick in Data for Decisions

### 2017

<table>
<thead>
<tr>
<th>Decision</th>
<th>% of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>P and K decisions</td>
<td>18% 39% 32% 11%</td>
</tr>
<tr>
<td>Nitrogen decisions</td>
<td>17% 44% 29% 10%</td>
</tr>
<tr>
<td>Liming decisions</td>
<td>29% 34% 28% 9%</td>
</tr>
<tr>
<td>Variable hybrid or variety selection</td>
<td>31% 39% 22% 8%</td>
</tr>
<tr>
<td>Overall hybrid or variety selection</td>
<td>20% 40% 32% 7%</td>
</tr>
<tr>
<td>Irrigation decisions</td>
<td>55% 30% 11% 6%</td>
</tr>
<tr>
<td>Pesticide selection (herbicides, fungicides)</td>
<td>23% 42% 30% 4%</td>
</tr>
<tr>
<td>Overall crop planting rates</td>
<td>25% 45% 27% 3%</td>
</tr>
<tr>
<td>Variable seeding rate prescriptions</td>
<td>33% 38% 27% 3%</td>
</tr>
<tr>
<td>Cropping sequence/rotation</td>
<td>37% 37% 25% 2%</td>
</tr>
</tbody>
</table>

### 2019

<table>
<thead>
<tr>
<th>Decision</th>
<th>% of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>P and K decisions</td>
<td>1% 19% 39% 41%</td>
</tr>
<tr>
<td>Overall hybrid or variety selection</td>
<td>4% 19% 45% 36%</td>
</tr>
<tr>
<td>Liming decisions</td>
<td>3% 35% 26% 36%</td>
</tr>
<tr>
<td>Nitrogen decisions</td>
<td>2% 20% 47% 32%</td>
</tr>
<tr>
<td>Overall crop planting rates</td>
<td>4% 19% 45% 31%</td>
</tr>
<tr>
<td>Variable hybrid or variety selection</td>
<td>8% 35% 41% 31%</td>
</tr>
<tr>
<td>Variable seeding rate</td>
<td>7% 36% 39% 19%</td>
</tr>
<tr>
<td>Pesticide selection</td>
<td>6% 39% 36% 19%</td>
</tr>
<tr>
<td>Cropping sequence/rotation</td>
<td>7% 41% 41% 12%</td>
</tr>
<tr>
<td>Irrigation decisions</td>
<td>13% 66% 19% 2%</td>
</tr>
</tbody>
</table>

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### Years Compared

- **2017**
- **2019**
Nutrient Mgmt. and Hybrid/Variety Selection Dominate Decisions Based on Farm Data

- 61% of retailers manage and/or archive yield, soil test and other data for farmers.
- 22% pool that data within their customer base.
- 11% pool that data beyond their customers.
- Only 8% of retailers do not help customers with farm data.
Profitability of Offerings

- % of Retailers
- VRT fertilizer related services usually profitable
- Sensing services (e.g. UAV, satellite/aerial imagery, soil EC, chlorophyll sensors) less profitable
Dealer Barriers to Adoption

- It is difficult to find employees who can deliver precision agricultural services
- Lack of manufacturer support for precision services limits our ability to provide such services
- Creating a precision program that adds significantly more value for the grower than a traditional one
- The equipment needed to provide precision services changes quickly, increasing my costs
- The equipment required to deliver precision services is too complex for many of my employees to use
- Incompatibilities across types of precision equipment and technology (different data formats, inability to share)
CropLife-Purdue Survey Summary:

• GPS guidance technologies have been adopted rapidly by retailers
• Information-intensive technologies more complicated, adoption is slower but increasing
• Most ag retailers offering farm data management & archiving
• Big increase in use of data to make decisions
• Creating a profitable data driven ag input supply business remains a challenge for retailers
E-Learning Academy

**PRECISION AGRICULTURE**

**ONLINE COURSE**

**2016 Session Starting Dates for this 12-Week Course: January 10, June 13 and September 19**

**PRECISION AGRICULTURE EDUCATION**

**OFFERED IN A CONVENIENT FORMAT**

Applying technology to crop production through mechanization, fertilizers, crop protection chemistry, genetics, and other innovations has resulted in multiple-fold gains in productivity and efficiency. Now, the application of information technology to crop production, known as precision agriculture, has transformed many aspects of crop production and promises even more.

While the capabilities of precision agriculture have progressed dramatically in recent years, the inability to understand and apply these to benefit crop production can greatly limit utility. Change has come so fast that many involved in crop production are unfamiliar with, or uncomfortable working around an often intimidating array of sensors, wires, controllers, monitors, and computer programs.

In 2017, Precision Agriculture earned Purdue’s highest award for professional online courses. Precision Agriculture is a full online course that provides knowledge from which those working in agriculture can better understand the science of site-specific agriculture to help their customers and benefit their companies. Designed for working professionals who must now continue education with other responsibilities, participants in the course can access content at their convenience by computer, tablet, or mobile device.

The foundation of the lessons in this course are dozens of high-definition videos featuring leaders in precision agriculture, along with supplemental reading, graphics, glossaries, and tests. Through visual and audio presentations, this course connects with all learning styles and was specifically designed to meet the needs of off-campus learners.

**Successful Completion**

Earns a Certificate of Completion & 18 Cert. Ed. Crop Adviser CEUs

Agricultural professionals in this course will gain current knowledge of precision agriculture that will help them understand management challenges of crop production. The course will equip them to better communicate with and advise customers, building customer confidence and trust.

**COURSE MODULE OUTLINE**

- **Introduction to Precision Agriculture**
  - Scope and overview of the technologies and their applications
- **Global Positioning Systems**
  - Global navigation systems used around the world, how they work, equipment factors affecting accuracy
- **Differential Correction**
  - Ground-based and aerial-based correction systems, levels of accuracy, cost, and guidance and autoguidance
- **Sensors**
  - Lasers, video, GPS, and precision farming platforms; online vs. passive sensing; spectral, spatial, and temporal resolution; soil, crop, and weather sensors
- **Soil & Water Spatial Variability**
  - Soil formation and change across landscapes, soil mapping systems, utility, precision land management, irrigation and drainage
- **Nutrient Spatial Variability**
  - Geostatistical and zone sampling approaches, developing management zones, nutrient-specific sensors, equipment for nutrient VRT
- **Crop Spatial Variability**
  - Yield monitors for grain and non-grain crops, calibration of monitors, data cleaning, yield map interpretation, yield stability, crop quality sensors
- **Geographic Information Systems**
  - GIS coordinates systems, map scales and standards, capture, storage, editing, analysis, display, image classification
- **Automation**
  - Implement steering, VRT steering, planter unit controllers, variable hybrid row-by-row spray, boom and nozzle controllers, boom leveling
- **Data Analysis**
  - Experimental design, data quality, compatibility, privacy, interpretation and collation, product comparisons
- **Telematics**
  - Understanding telematics technology, wireless network applications, product comparisons
- **Precision Farming Economics and Adoption**
  - Cost-effectiveness of guidance systems, section controllers, site-specific management in various crops, regions, situations

**CONTACT US**

For more information about this or other online agronomy courses designed for the needs of sales staff, farmers and other agricultural professionals:

Email: elearn@purdue.edu
Website: http://eag.purdue.edu/ag/EDE/pages/default.aspx
OR http://myout.com/purdueagry

**Purdue AGRICULTURE**
Crop Water Use

Water Balance Equation

\[ WC_t = WC_{t-1} + IRR + RAIN - AET - DP \]

- **WC\(_t\)**: Soil water content today (inches).
- **WC\(_{t-1}\)**: Soil water content yesterday (inches).
- **IRR**: Irrigation depth since yesterday (inches).
- **RAIN**: Rain since yesterday (inches).
- **AET**: Actual ET (inches).
- **DP**: Deep percolation (inches).

Evapotranspiration and the Water Cycle

Evapotranspiration is the sum of the water lost to the atmosphere from evaporation from the earth's surface and the transpiration of plants. Warm conditions, dry air, and the thickness of the plant canopy are some of the factors that can increase evapotranspiration, which is a major part of the water cycle. Openings in the leaves of plants called stomates open to allow the diffusion of CO\(_2\) for photosynthesis, but also regulate transpiration, or the loss of water from plant leaves.

Plant Available Water

During part of a plant's lifecycle, precipitation may not meet its demand for water, so it will rely on irrigation or water stored in the soil. When a field is saturated, the pore space available for water and air is filled with water. Gravitational force will force the water to drain, leaving a layer of capillary water surrounding the solids in soil, a level called field capacity. The wilting point is reached when the remaining capillary water is so tightly held by the soil that it is unavailable to plants. A soil's plant available water is the volume of water between field capacity and the wilting point.

Water Availability in Different Soils

Plant available water in different soil textures is related to soil particle shape and size. Water drains most quickly from sandy soils, whereas clay soils hold more water, but the tight pores between clay's small particles make it more difficult for plants to access the water. Soils that have the most plant available water are loams and silt loams.

Farmers can track the water available in soils using sensors connected to irrigation systems or a formula that calculates the soil's water balance by using the previous day's water content, adding any rain or irrigation water, and subtracting evapotranspiration and water lost to ground storage.

Presentation Slides: Crop Water Use