2019 PRECISION AGRICULTURE DEALERSHIP SURVEY

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Departments of Agricultural Economics and Agronomy, Purdue University

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES, REFERENCE TO SURVEY QUESTION 2
ABOUT THE SURVEY, RESPONDENTS, AND RESPONDENT'S COMPANY/ORGANIZATION 3
CUSTOM APPLICATION 7
DEALER USE OF PRECISION TECHNOLOGIES 8
DEALER OFFERINGS OF SITE-SPECIFIC SERVICES 11
SOIL SAMPLING PROCEDURES 14
ANALYSIS OF DATA 16
PROFITABILITY OF PRECISION SERVICE OFFERINGS 18
PRODUCER'S USE OF PRECISION TECHNOLOGIES 20
FUTURE INVESTMENT PLANS 22
BARRIERS TO GROWTH AND EXPANSION 23
SUMMARY 25
SURVEY INSTRUMENT 26

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LIST OF FIGURES AND TABLES, REFERENCE TO SURVEY QUESTION

Figure 1, Q20: Respondent location by region. 3
Figure 2, Q1: Organizational type represented by respondents. 4
Figure 3, Q5: Number of retail outlets owned or managed by company. 4
Figure 4, Q3: Responsibility of survey respondent. 5
Figure 5, Q4: Annual retail sales of agronomy products and services for the respondent's location. 5
Figure 6, Q9: Acres custom applied at dealer's retail location. 7
Figure 7, Q13: Use of precision technology over time by retailers, automated technologies. 9
Figure 8, Q13: Use of precision technology over time by retailers, sensing technologies. 10
Figure 9, Q14: Dealer offerings of precision services. Due to rounding, rows may not total 100%. 11
Figure 10, Q14: Dealer offering of precision services over time, sensing technologies. 2022 are projections. 12
Figure 11, Q14: Dealer offerings of precision services over time, variable rate technologies. Starting at 2017 the survey stopped asking separately about single and multiple fertilizer applications. 2022 are projections. 13
Figure 12, Q12: Types of soil sampling services offered by retailers. Multiple responses were allowed. 14
Figure 13, Q12: Factors used by retailers to determine management zones for precision soil sampling. Due to rounding, percentage numbers each year may not total 100. 15
Figure 14, Q12: Grid sizes used by retailers for precision soil sampling. Due to rounding, percentage numbers each year may not total 100. 15
Figure 15, Q16: Ways dealers manage farm-level data to assist customers in decision-making. Multiple responses were allowed 16
Figure 17, Q18: Crop management decisions influenced by pooled data from customer's farms. Due to rounding, percentage numbers for a technology may not total 100. 17
Figure 16, Q16: Managing farm-level data to assist customers in decision making over time. 17
Figure 18, Q15: Profitability of precision service offerings for retailers. Due to rounding, percentages for each technology may not total 100. 18
Figure 19, Q15: Profitability of precision services over time for retailers. 19
Figure 20, Q21: Producer use of precision technologies, retailers estimate of their market area. Yield monitor, sprayer section controllers, and planter row/section shutoffs were inadvertently omitted in the 2017 survey. 21
Figure 21, Q21: Farmer use of variable rate technologies (VRT), market area estimated by retailers. Starting at 2017 the survey stopped asking separately about single and multiple fertilizer applications. 21
Figure 22, Q8: Expected investment in precision technology by retailers. 22
Figure 23, Q22: Customer issues that create barriers to expansion and growth in precision agriculture. 23
Figure 24, Q22: Dealer and technology issues that create a barrier to expansion and growth in precision agriculture. 24
Figure 25, Q22: Dealer and technology issues that create a barrier to expansion and growth in precision agriculture. 24

Table 1, Q20: Respondent location by state. 3
Table 2, Q6: Work roles at retailer location. 6
Table 3, Q13: Retailer use of precision technology for their business. 8
Table 4, Q21: Farmer use of precision technologies, market area estimated by retailers. 20

ABOUT THE SURVEY, RESPONDENTS, AND RESPONDENT'S COMPANY/ORGANIZATION

In February 2019 CropLife magazine and the Departments of Agricultural Economics and Agronomy at Purdue University conducted the 19th survey of crop input dealers about precision agriculture technologies. As with previous surveys, dealerships were asked questions about how they use precision agriculture within their business, what precision products and services they offer to their customers, customer adoption of precision farming, and questions aimed at understanding practices such as constraints to adoption and profitability. In addition, to better understand farmers and retailers use of data, additional questions were added about these practices. This survey is the most complete, longest-running, and continuous survey of precision farming practices in the United States.

The questionnaire was deployed using two modes of contact: A paper copy was mailed to a subset of CropLife magazine's subscription list, and a link to the identical set of questions was sent via email from a subset of CropLife's email list. The paper version survey instrument is at the end of this paper. There were 165 respondents. Most survey responses were from Midwest states (Figure 1). Response by state is shown in

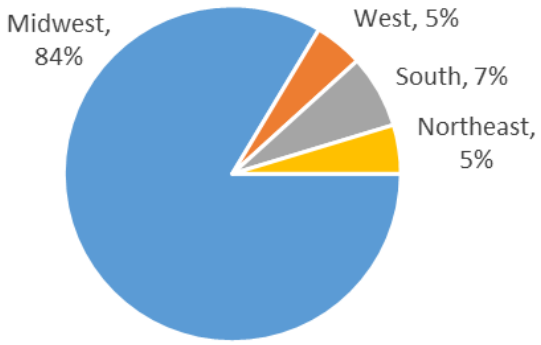

Figure 1, Q20: Respondent location by region.

Table 1, Q20: Respondent location by state.

State	% of Respondents	State	% of Respondents	State	% of Respondents
Illinois	13%	Ohio	4%	North Dakota	2%
Minnesota	10%	South Dakota	4%	Tennessee	2%
Indiana	9%	Pennsylvania	3%	Texas	2%
Iowa	9%	California	2%	Washington	2%
Wisconsin	9%	Michigan	2%	Alabama	1%
Nebraska	7%	Montana	2%	Kentucky	1%
Kansas	6%	New York	2%	Oklahoma	1%
Missouri	6%	North Carolina	2%		

Respondents were asked several questions about the organization they represent. Ninety percent of respondents were agricultural retail input suppliers, 5% consultants, none were farm equipment dealers, and 5% other. Of the ag retailers 16% indicated they represent a cooperative, 37% an independent dealership and 47% are part of a national or regional dealership (not a cooperative), Figure 2.

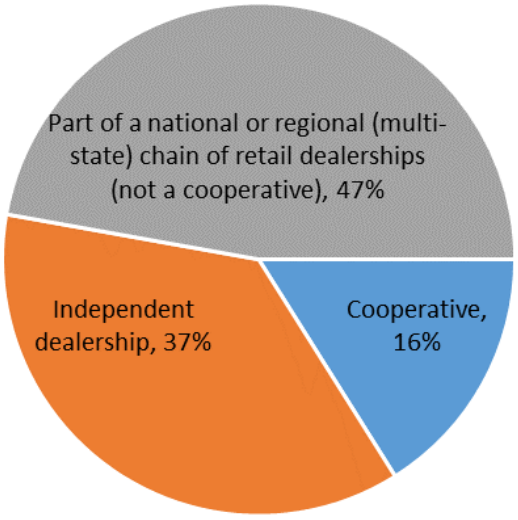

Figure 2, Q1: Organizational type represented by respondents.

The organizations the respondents represent are primarily multiple-retail locations, Figure 3. Three percent of the respondents did not own or manage a retail outlet. Thirty percent of respondents reported having only one retail outlet. The number of respondents that owned or managed five stores or less was 49%. The number of respondents that owned or managed six or more stores was 47%.

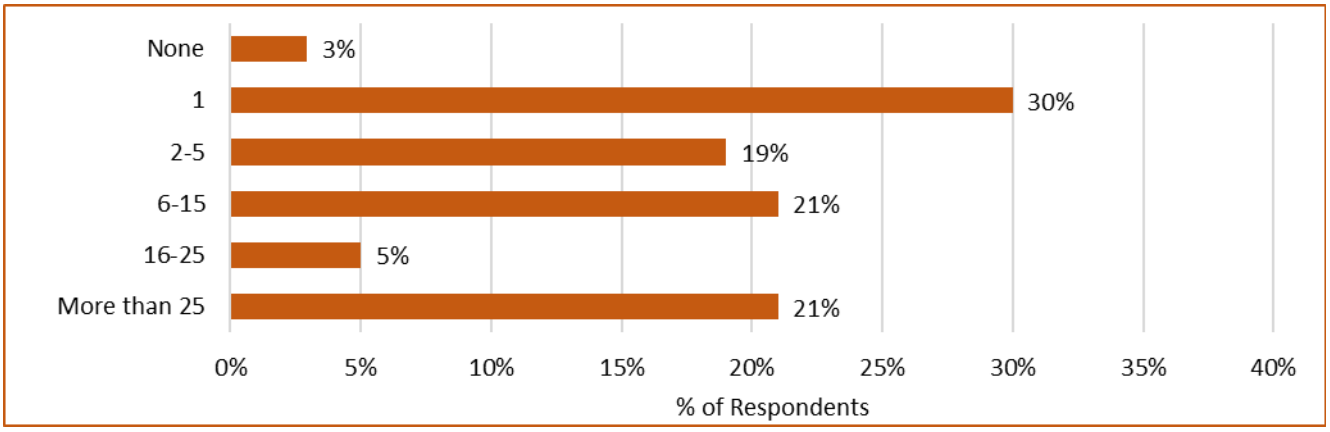

Figure 3, Q5: Number of retail outlets owned or managed by company.

The survey asked about the position the respondent held within their organization. Forty-four percent reported being the owner or location manager, and 21% were in sales or sales management. Other common job responsibilities for respondents were department manager (12%), precision manager (11%), and technical consultant/agronomist (9%). Overall the respondents of the survey are those that lead and manage the organization, or work directly with customers (Figure 5).

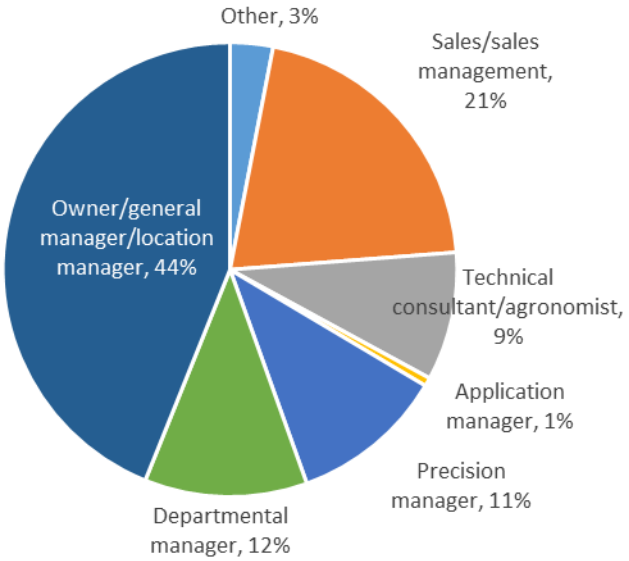

Figure 4, Q3: Responsibility of survey respondent.

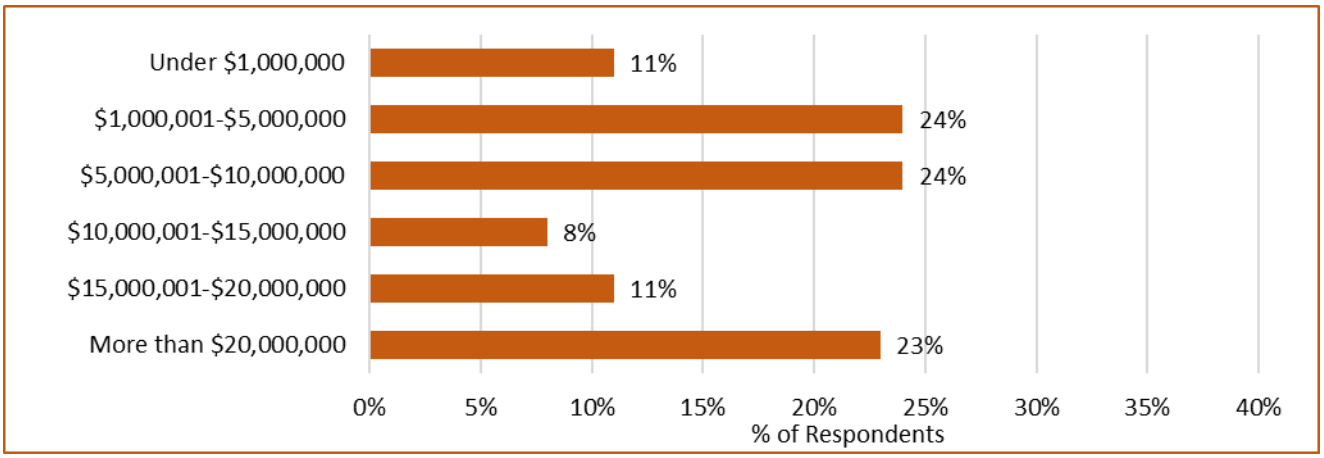

Figure 5, Q4: Annual retail sales of agronomy products and services for the respondent's location.

Table 2, Q6: Work roles at retailer location.

Work Role and Definition	Average number per respondent location
Applicator Runs the equipment that applies pesticides and fertilizers to farmer's fields.	10.2
Agronomist/Horticulturalist Provides recommendations on crop and soil management to farmers	5.2
Precision sales specialist Works specifically with precision equipment sales and support	1.5
Precision equipment technician Installs new precision equipment; troubleshoots and repairs ON SITE	1.0
Technical support Works with customers REMOTELY to troubleshoot precision equipment and software	0.8
Data manager/analyst Manages agronomic data from the dealership and customer's farms	1.3

Another metric for understanding the surveyed organizations is the total annual retail sales of agronomy products (fertilizer, chemicals, seed) and services at the respondent's location in 2018, Figure 4. The $1 million to $5 million group and the $1 million to $5 million group had the most respondents with 24% each, and the more than $20 million group came in next at 23%. The survey question dollar value categories changed in 2017 to help better define those respondents with large agronomy sales. In the 2013 and 2015 surveys, 50% of respondents had previous year annual agronomy sales equal to or greater than $7 million. In the 2017 survey 46% of respondents reported their agronomy sales exceeded $10 million, and in the 2019 survey 42% reported agronomy sales exceeded $10 million.

Dealers were asked about the workers at their specific business location (Table 2). As an average each location has ten applicators, five agronomists or horticulturalists, one to two precision sales specialists, a precision equipment technician, a technical support person, and a data manager.

CUSTOM APPLICATION

Custom applications of pesticides, fertilizers, and seeds for their farmer customers is an important business aspect for many ag retailers. Figure 6 shows the acres of custom application the retailers apply at their location. Multiple applications made on the same field do not count as additional acres.

The largest segment, one quarter of the responses, were those applying more than 100,000 acres annually. Retailers applying more than 50,000 acres annually account for almost half of the respondents, down from 54% in 2017 and 60% in 2015, but up compared to 41% in 2013.

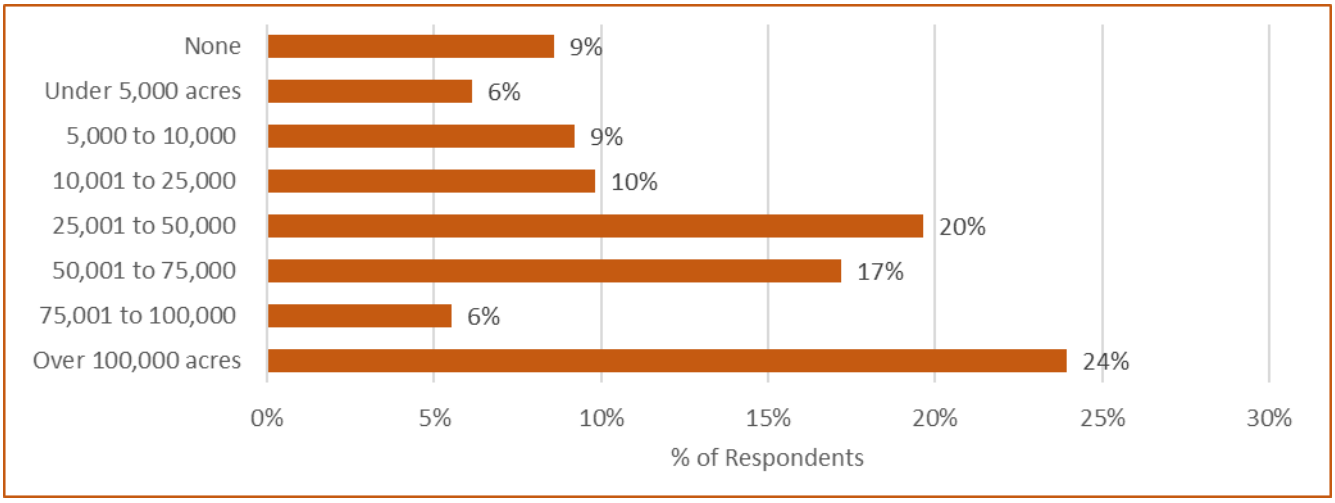

Figure 6, Q9: Acres custom applied at dealer's retail location.

Digging deeper into how custom application and input sales work hand-in-hand, respondents reported the share of fertilizer and pesticide sales that were custom applied as compared to selling to farmers for them to apply. On average, respondents reported custom applying 62% of fertilizer sales and 55% of pesticide/crop protection sales for customers. These numbers are nearly identical to those of a decade prior in 2009, at 63% and 56%, respectively, although they have varied a few percentage points over that time period.

Respondents also indicated what percentage of their custom application acres used certain technologies. Seventy-four percent of the respondent's applications used GPS auto guidance while 27% used GPS with manual control. WHAT % USED BOTH? The trend has been an increase in recent years of respondents using more auto guidance technologies and less manual guidance. Sixty-five percent of application acres used auto sprayer boom section or nozzle control and 32% of acres used variable prescription maps to control the application.

DEALER USE OF PRECISION TECHNOLOGIES

Dealers get utility from the precision technologies they use for their own business purposes, such as guidance on their applicators, as well as the precision products and services they offer to customers detailed in the next section. Eighty-three percent of dealers were offering some type of precision agronomic service for their customers.

The one technology that stands out as the most widely utilized by dealers is GPS guidance systems with automatic control (autosteer) for fertilizer/chemical application, at 90% adoption. Between autoguidance and manual guidance, 92% of dealers are using some type of guidance system on at least some of their equipment. Coming in next at 83% adoption is automatic sprayer boom section or nozzle controllers. And then satellite/aerial imagery at 68% for the dealers' own use in their business in providing products and services, not as a product sold to customers, which is reported in the next section. These numbers represent the percent of dealerships utilizing the technology in some form, which they may use on some or all of their equipment and on some or all of the acres they service. Forty-five percent of dealers are using an app on a mobile device to assist in field scouting, and 40% are using UAV's to assist with their delivery of products and services. Twenty-seven percent of dealers are using soil electrical conductivity mapping, but less than 10% of dealers are using other on-the-go sensors such as for soil pH or leaf greenness. About a quarter of dealers use Y-drops to apply fertilizers on some/all of their acres.

Table 3, Q13: Retailer use of precision technology for their business.

Precision Ag Technology	2017	2019
GPS guidance systems with automatic control (autosteer) for fertilizer/chemical application	78%	90%
Precision agronomic services for customers (such as soil sampling with GPS, GIS field mapping, etc.)	81%	83%
Auto sprayer boom section or nozzle control	73%	75%
Satellite/aerial imagery for internal dealership purposes	52%	68%
GPS guidance systems with manual control (light bar) for fertilizer/chemical application	55%	59%
Field mapping with GIS to document work for billing/insurance/legal purposes	43%	48%
Smart scouting using an app on a mobile device to record field situations and locations	44%	45%
UAV or drone for internal dealership purposes	34%	40%
GPS to manage vehicle logistics, tracking locations of vehicles, and guiding vehicles to the next site	34%	38%
Telematics to exchange information among applicators or to/from office locations	24%	31%
Soil electrical conductivity (EC) mapping	22%	27%
Y drops on fertilizer applicators	19%	26%
Sprayer turn compensation	22%	23%
Other soil sensors for mapping, mounted on a pickup, applicator or tractor (example: pH sensor)	9%	9%
Chlorophyll/greenness sensors mounted on a pickup, applicator or tractor	9%	7%
Do not use precision technology	5%	4%

Dealers were asked an open-ended question about what emerging precision technologies had the greatest potential to impact their business, Question 19. Respondents mentioned UAV's/drones, data analysis, and variable rate seeding the most. Other technologies mentioned by three or more dealers included variable hybrid/variety placement within fields and variable rate fertilization.

Retailer's use of precision ag technology over time is reported in Figure 7 with automated technologies and Figure 8 with sensing technologies. Note that the survey went from every year to every other year in 2011. For automated technologies, all were down in 2017 compared to 2015, but all rebounded for 2019. This has been the area of precision farming experiencing the most growth in recent years—a weak farm economy and other financial pressures on retailers could explain the recent dip. Note the overall downward trend for GPS guidance with manual control (lightbar), peaking at nearly 80% a decade ago but with current usage rates down below 60 percent. The decline is because it is being replaced with autoguidance technology. Note that the guidance numbers prior to 2004 do not distinguish manual and autoguidance, as the survey question then just asked about guidance in general because autoguidance was not widely available commercially then.

Telemetry showed the greatest decline from the 2015 survey to the 2017 survey, but strongly rebounded for 2019. The uncertainty in adoption of telematics may be related to poor signal strength, the amount of time needed to transfer the data, lack of connectivity with hardware and software packages, and/or the hardware or software ease of use. Data signal strength in some rural areas is poor and retailers are stretching further from their home bases which can lead to long data download times. Some programs have telemetry built in to their platform, others require data to be exported and migrated from platform to platform. The data migration can be problematic when dealing with converting data in to the proper file extensions for the various platforms that are available.

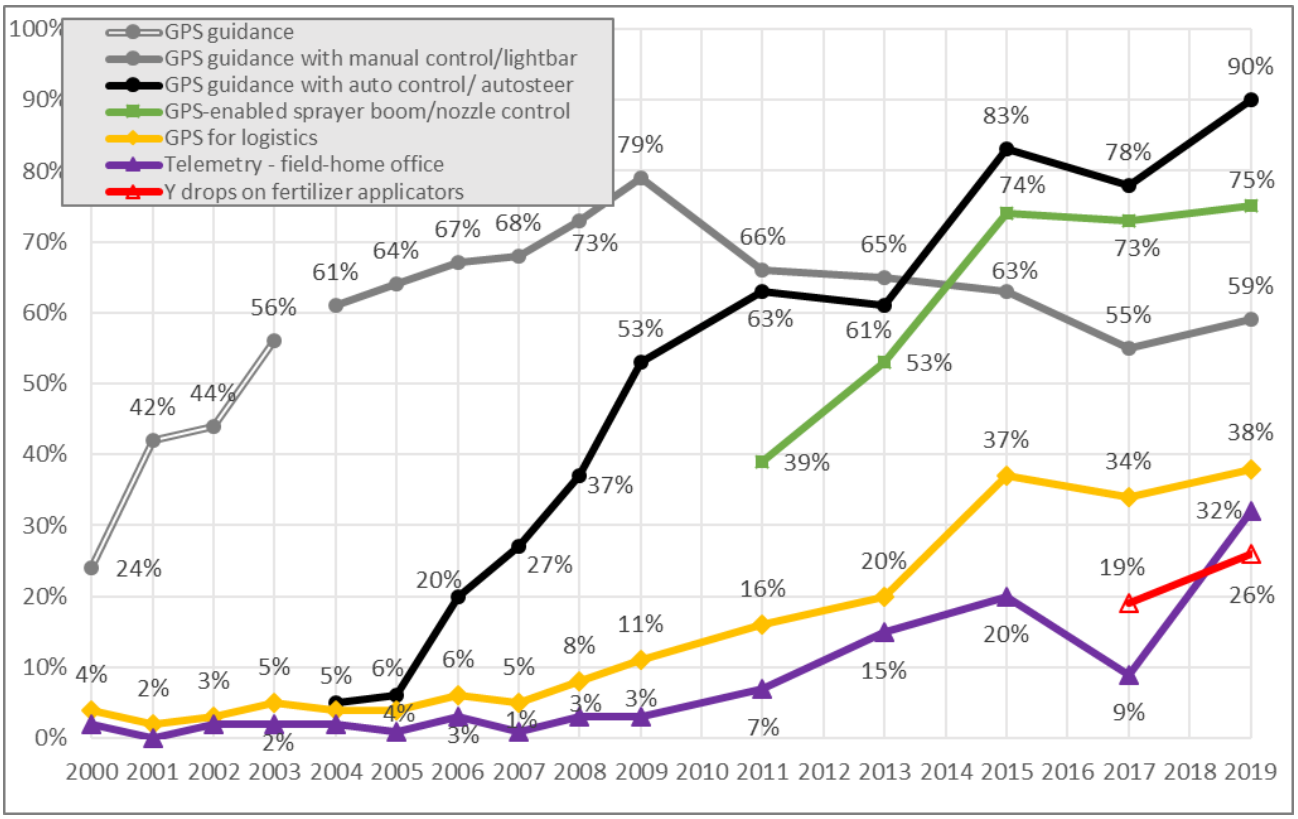

Figure 7, Q13: Use of precision technology over time by retailers, automated technologies.

For sensing technologies (Fig. 8), the trend for remote sensing using satellite/aerial imagery or UAV's is decidedly upward. More dealers are using soil EC mapping in recent years, but there is not an accompanying upward trend for other ground-based, vehicle-mounted sensors.

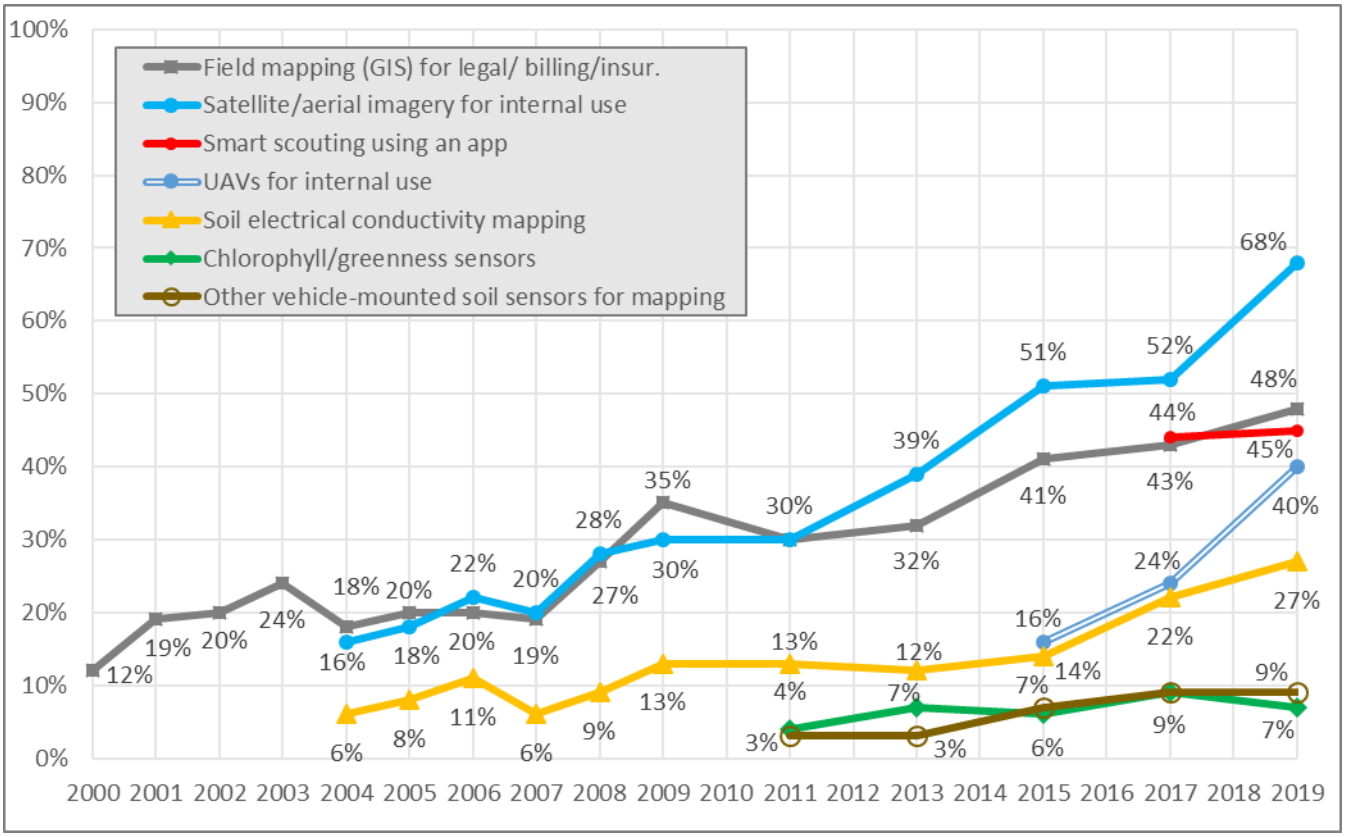

Figure 8, Q13: Use of precision technology over time by retailers, sensing technologies.

DEALER OFFERINGS OF SITE-SPECIFIC SERVICES

Another element of precision technology for dealers is in the services they offer to their farmer customers. Respondents were asked to report their current offerings of precision services and what they plan to offer three years from now, in 2022 (Figure 9).

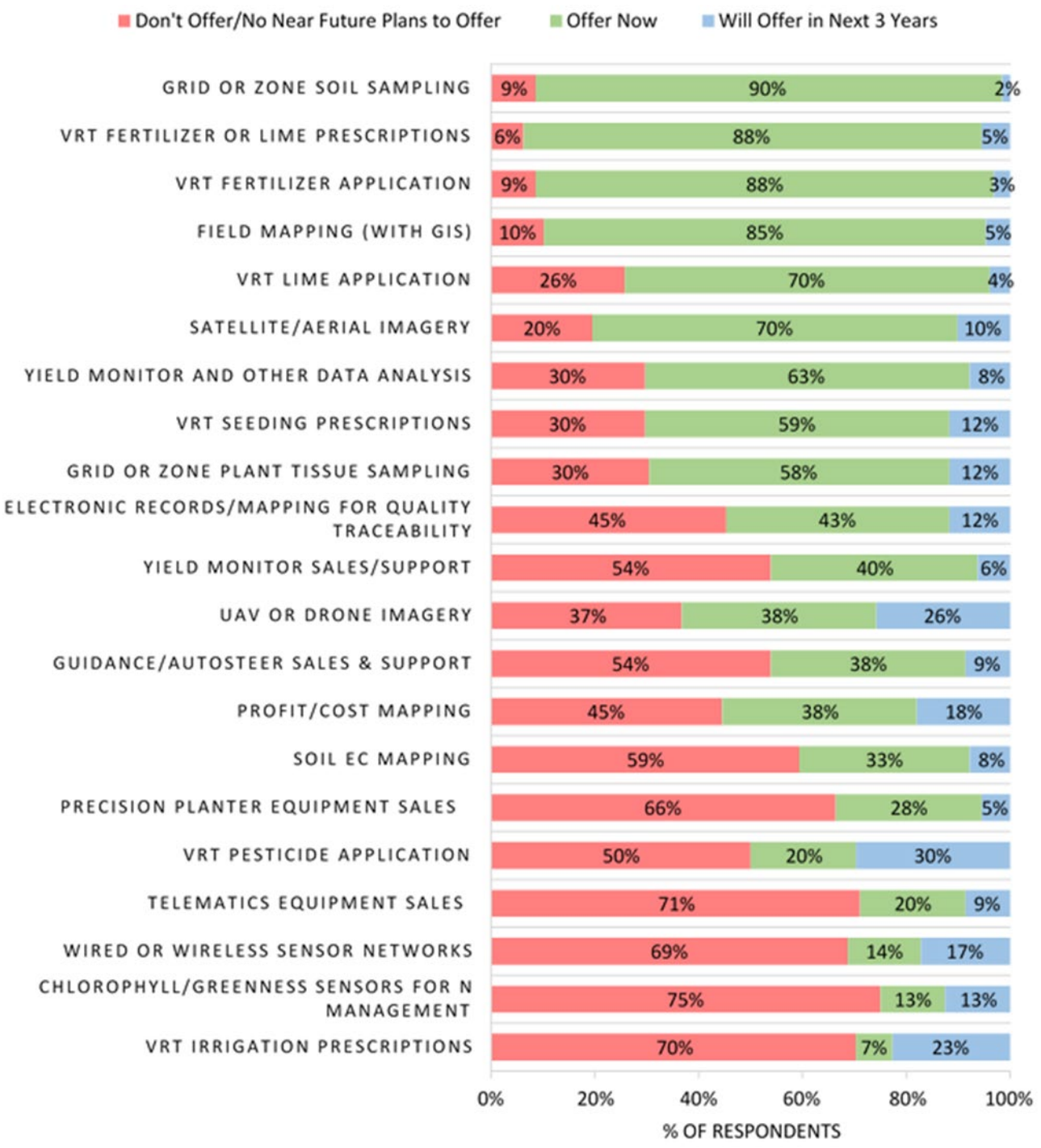

Figure 9, Q14: Dealer offerings of precision services. Due to rounding, rows may not total 100%.

Site-specific services that dealers now offer most include technologies related to precision fertilizers and soil amendments-- grid or zone soil sampling, VRT fertilizer or lime prescriptions, VRT fertilizer applications, and field mapping services. Over the next 3 years, the technologies respondents are planning the most growth are in VRT pesticide application (30% of respondents will add), UAV/drone imagery (26%), VRT irrigation prescriptions (23%), profit/cost mapping (18%), and sensor networks (17%). The areas of VRT seeding prescriptions (12%), electronic records/mapping for quality traceability (12%), and grid or zone plant tissue sampling (12%) are the next most popular areas for future growth. In many past surveys, dealers have optimistically overestimated their precision offerings plans compared to the actual numbers the survey showed in years following.

Figure 10 shows the adoption of service and sensor precision ag services over time, with dealers also projecting into the future (dotted lines). The 2022 projections are calculated as the sum of 2019 question 14 responses for each technology for "offer now" plus "will offer in next 3 years." The time-scale graphics in Figure 10 do not include technologies that were first asked about in 2019: grid or zone plant tissue sampling, electronic records/mapping for quality traceability, VRT irrigation prescriptions, and wired or wireless sensor networks.

All of these technologies except one showed growth from 2017 to 2019. Satellite/aerial imagery had the greatest increase in the percentage of dealers offering, going from 59% in 2017 to 70% in 2019. Ten percent of dealers will add satellite or aerial remote sensing services by 2022, up to 80%. UAV or drone imagery increased from 32% of dealers offering in 2017 to 38% in 2019, and 64% of dealers say they will offer by 2022.

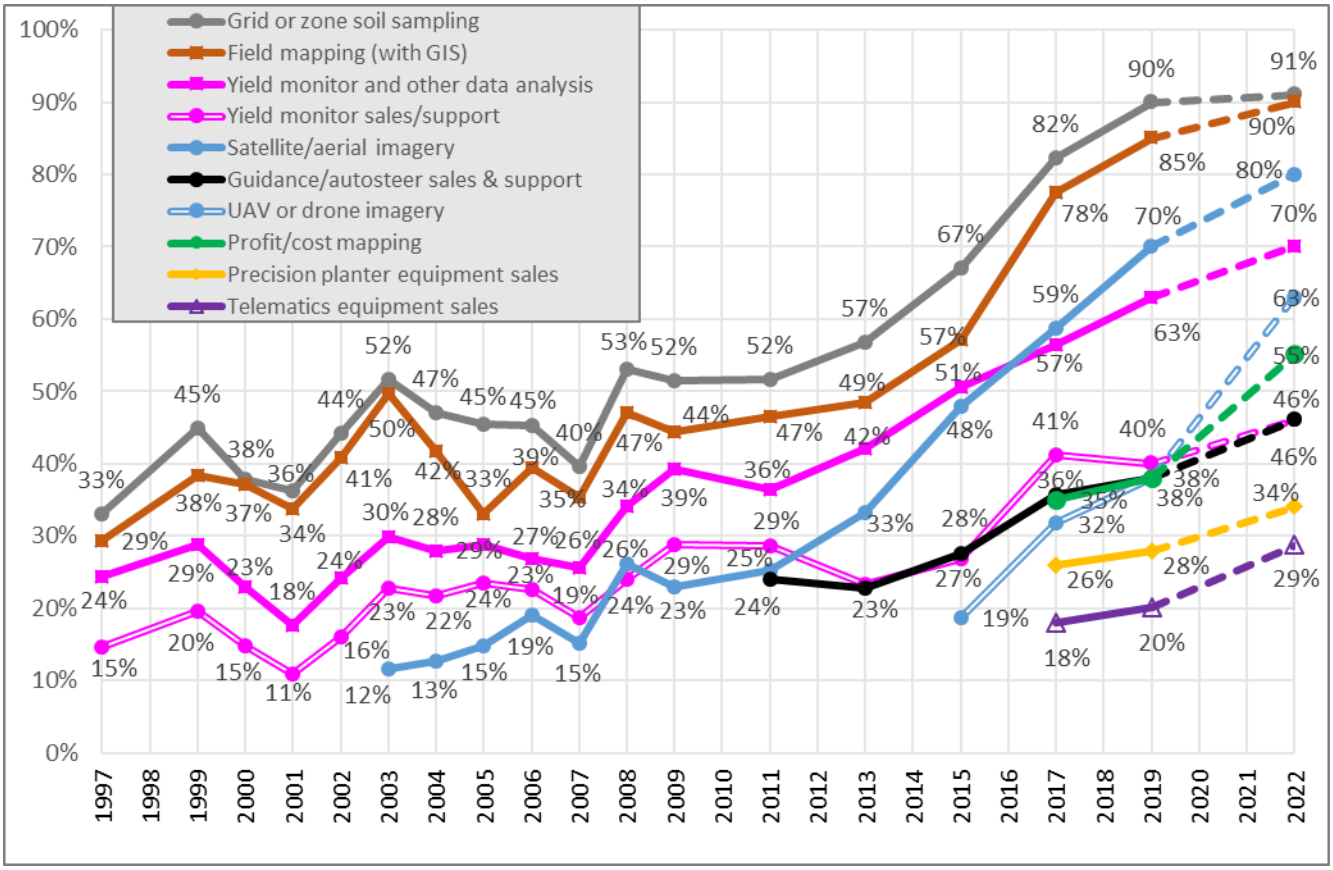

Figure 10, Q14: Dealer offering of precision services over time, sensing technologies. 2022 are projections.

Figure 11 shows the dealer offerings of variable rate technology (VRT) services over time, with dealers also projecting into the future (dotted lines). As with Figure 10, the 2022 projections are calculated as the sum of 2019 question 14 responses for each technology for "offer now" plus "will offer in next 3 years." All these site-specific services showed growth compared to 2017. VRT pesticide application had a 10% decrease from 2015 to 2017, but rebounded in 2019. It can be a challenge to quantify the changing mix of various insect, disease, or weed populations across fields needed to craft a variable rate prescription while staying within legally labeled rates. The growth leader in site-specific service offerings was VRT fertilizer applications with a 7% increase from 2017 to 2019. From 2003 to 2013, the growth in VRT fertilizer or lime offerings by dealers was little more than this most recent increase for the entire decade. Other technologies showed similar "flat lines" during that time period, which some might call precision agriculture's period of disillusionment after the initial excitement of the late 1990s and early 2000s.

Starting in 2017 the survey no longer separately asks about VRT single fertilizer applications from multiple product applications—thus the multiple red lines in Figure 11. For ease of reading we did not display VRT fertilizer or lime prescription numbers in these graphics--the prescriptions question has been asked the last two surveys, and the numbers mimic VRT fertilizer or lime applications. Also note that small changes in the adoption numbers reported may reflect the inherent variability and error present in any survey, and this survey is a different pool of respondents each time. In other words, a few percentage points difference may not signify a trend or a real difference from another technology.

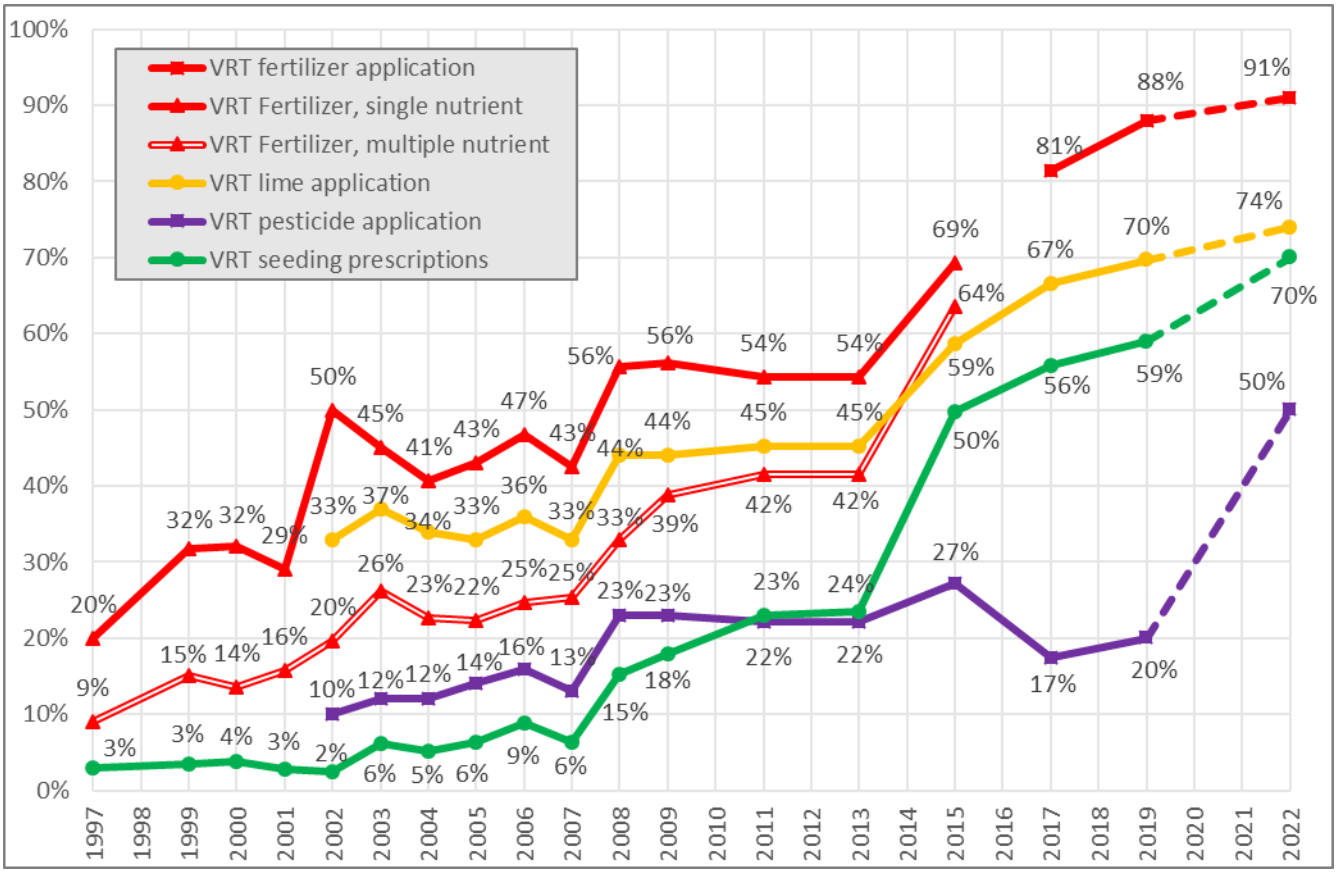

Figure 11, Q14: Dealer offerings of precision services over time, variable rate technologies. Starting at 2017 the survey stopped asking separately about single and multiple fertilizer applications. 2022 are projections.

SOIL SAMPLING PROCEDURES

An important role of many agricultural dealers, especially of agronomic products and services, is helping producers manage soil nutrients. Most of the time this starts with grid or zone soil sampling, a service offered by 90% of dealers. The exact location of the soil sample (or subsamples) is easily determined using GPS. The location information combined with a fertilizer recommendation from a lab informs the rates used for variable rate application technology.

Respondents were asked about the soil sampling procedures they used—multiple responses were allowed for multiple procedures. In 2019 70% of dealers offered grid soil sampling, 59% offered traditional or whole field sampling, and 55% offered sampling using management zones (Figure 12). For dealers who offer management zones, more are using soil mapping units or yield maps to delineate the zones, and fewer are using soil electrical conductivity (Figure 13, respondents could only choose one). For dealers who grid sample, 2.5 acres (1 hectare) is the most common grid size, although many commonly sample in larger grids (Figure 14). Grids larger than 2.5 acres are more common than smaller grids. The appropriate grid size is a compromise of the labor/time and equipment needed for sampling and soil testing costs vs. the specificity desired to inform variable rates.

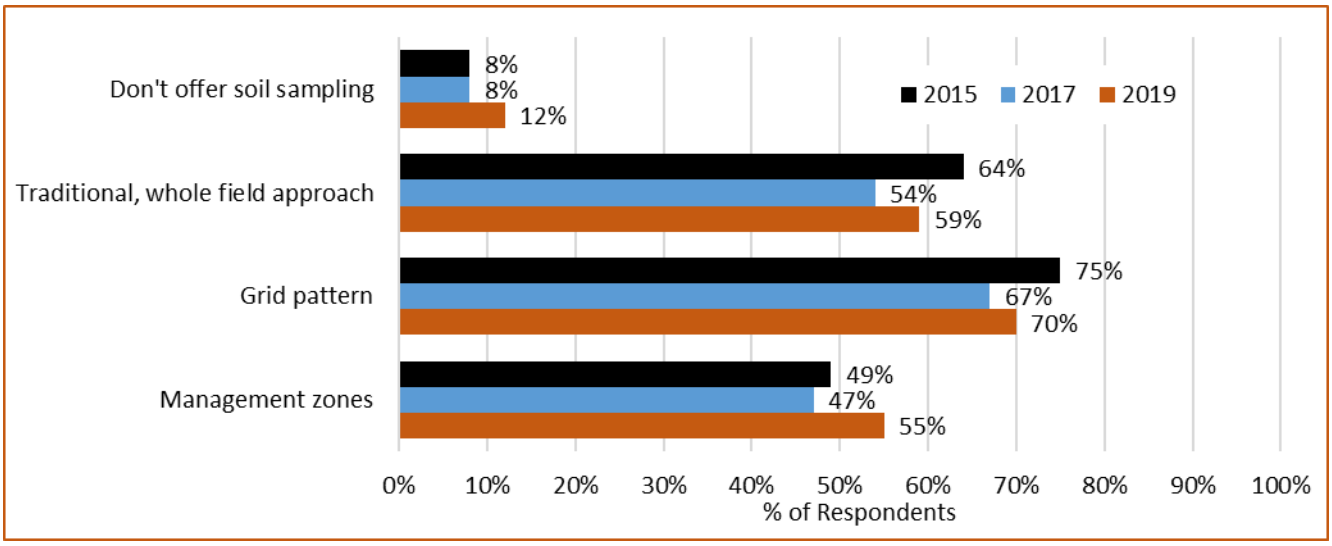

Figure 12, Q12: Types of soil sampling services offered by retailers. Multiple responses were allowed.

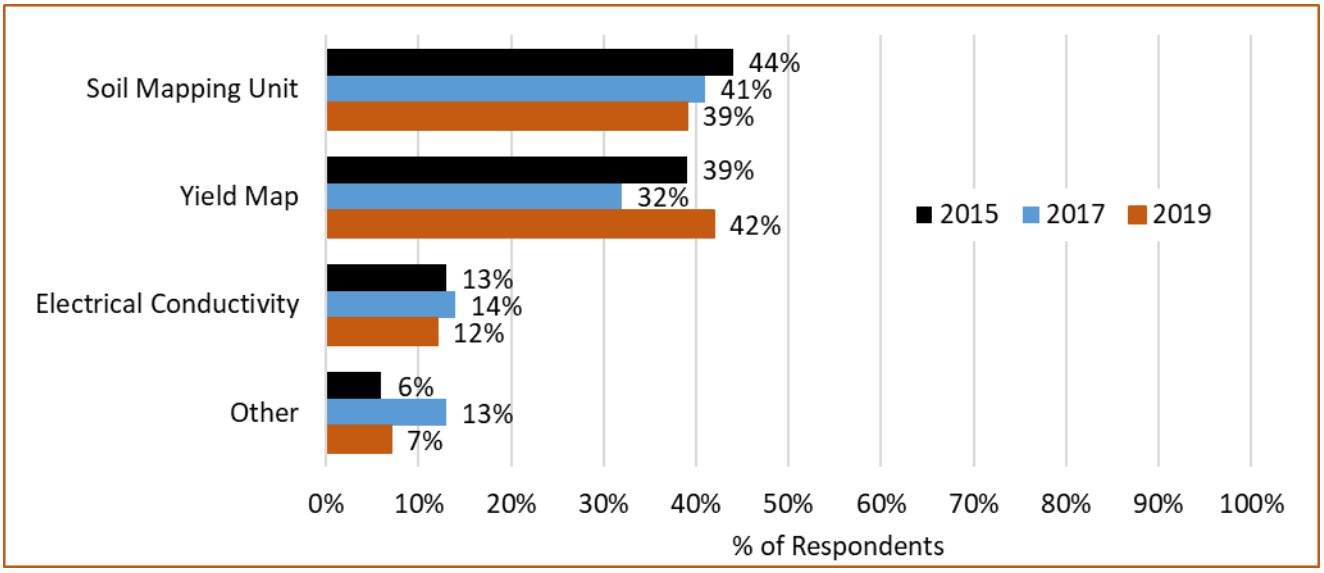

Figure 13, Q12: Factors used by retailers to determine management zones for precision soil sampling. Due to rounding, percentage numbers each year may not total 100.

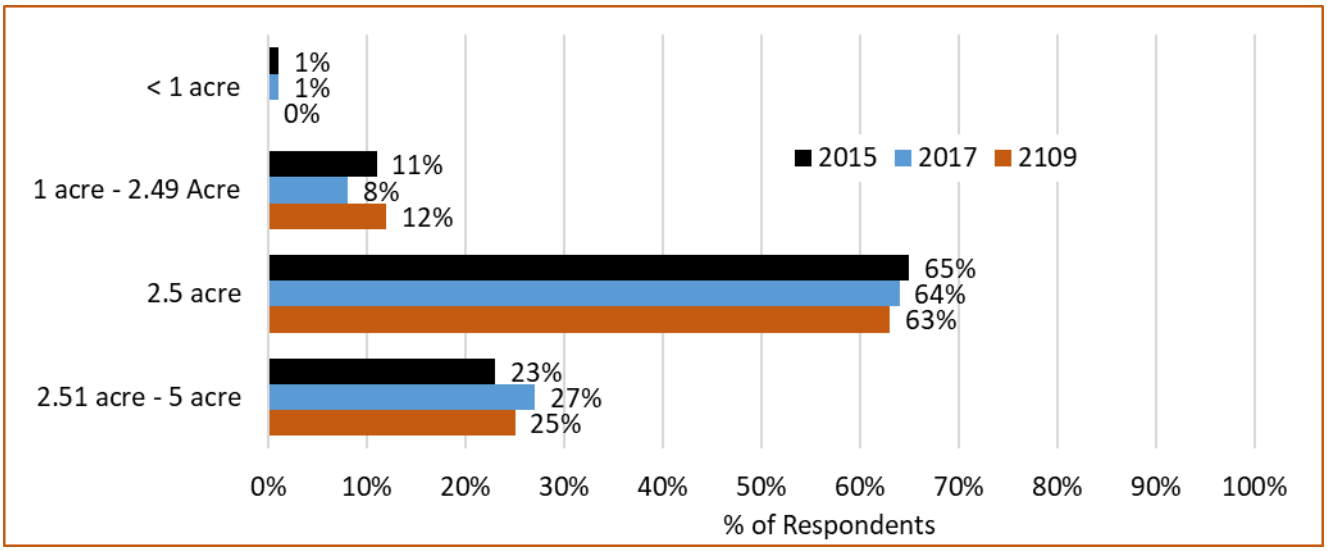

Figure 14, Q12: Grid sizes used by retailers for precision soil sampling. Due to rounding, percentage numbers each year may not total 100.

ANALYSIS OF DATA

Precision agriculture can provide an overwhelming amount of data from yield monitors, soil sampling, machine operations across fields, as-applied amounts, and remote sensors, to name a few. Often producers need assistance in analyzing these data in the hopes they can be turned into meaningful insights.

Figure 15 reports how dealers help customers manage farm-level data in decision-making. The most common way dealers are helping customers was printing maps, such as yield, soil electrical conductivity, and soil maps. Beyond printing maps, 61% of dealers are archiving and managing yield, soil test, and other data for future use. Half of respondents work with farmers individually. Respondents could mark any or all that apply.

In addition to the farmer's individual data, 22% of the respondents reported working with farmers by using data aggregated among farmers within the dealership. Eight percent reported using data aggregated among farmers including those outside the dealership. Eleven percent of the respondents do not help farmers with their farm-level data. Forty-seven percent of dealers have a customer data privacy statement and/or data terms & conditions agreement, up from 45% in 2017 (Question 17).

Figure 16 shows how dealers are assisting customers with their data and decisions over time. Helping customers with their own yield data is up the most since the last survey, as is printing maps for customers.

Figure 17 shows the types of decisions where pooled customer data is used for decision-making, reported by dealers as a major influence, some, or no influence. Dealers report fertilizer and liming decisions are most influenced. Following close behind are overall decisions about hybrid and variety selection and overall planting rates.

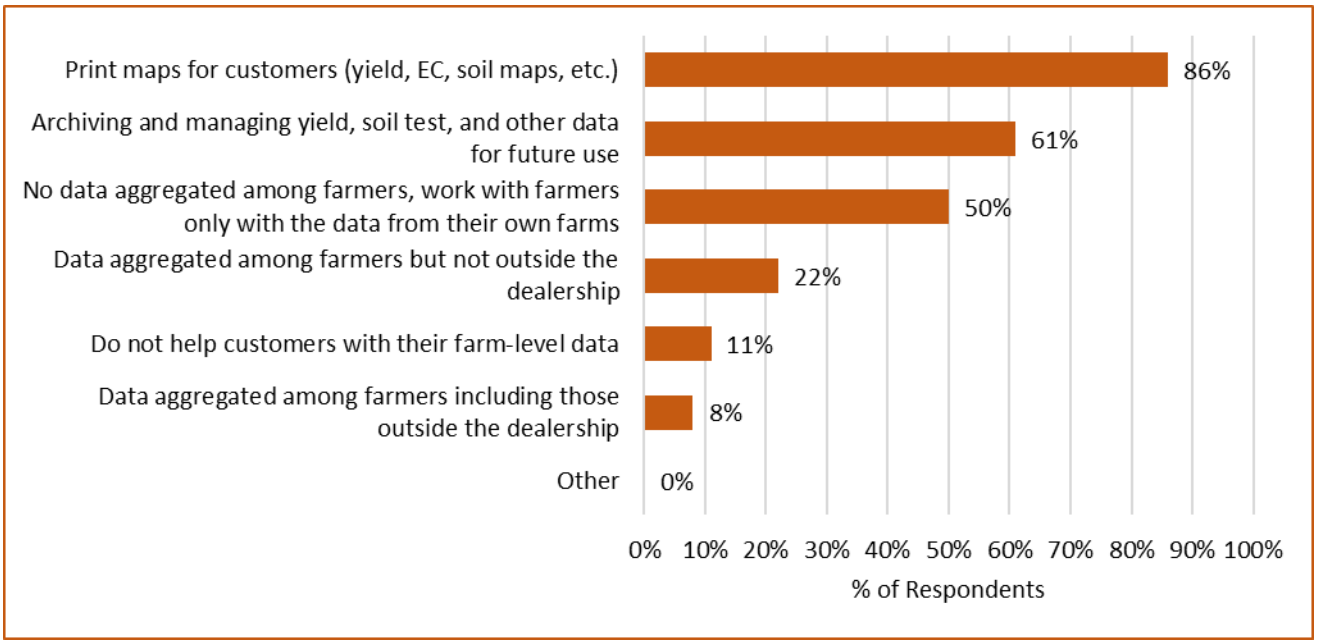

Figure 15, Q16: Ways dealers manage farm-level data to assist customers in decision-making. Multiple responses were allowed.

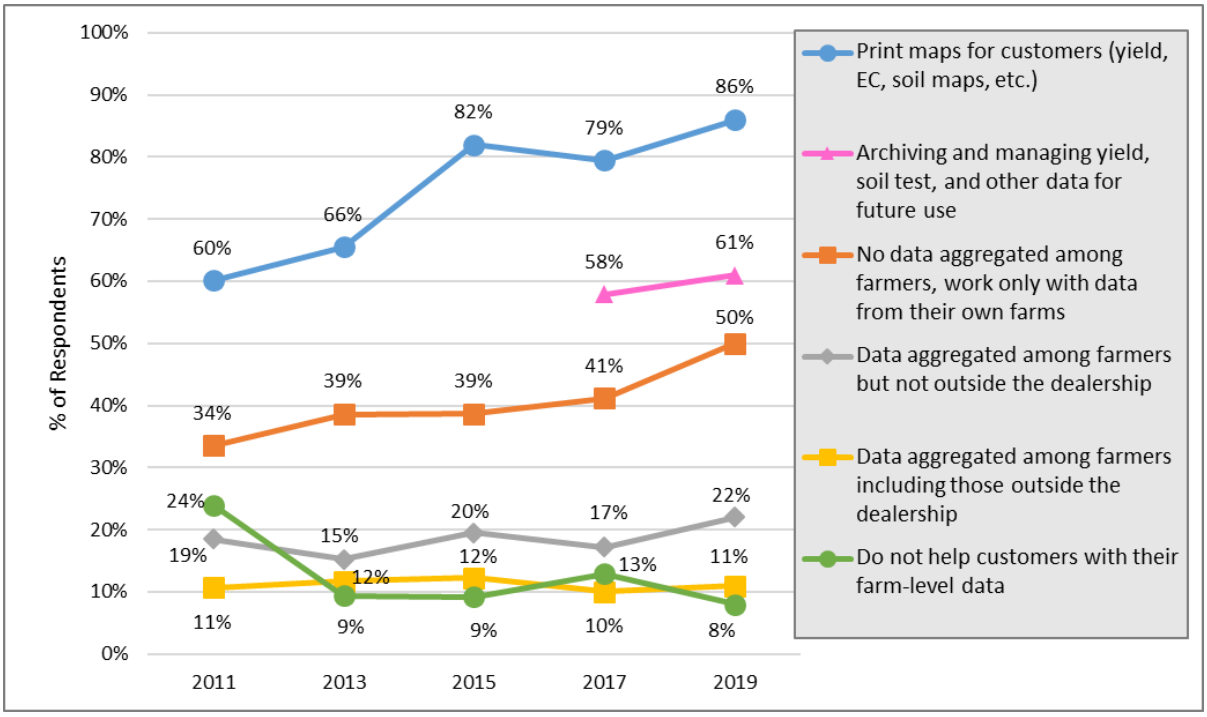

Figure 17, Q16: Managing farm-level data to assist customers in decision making over time.

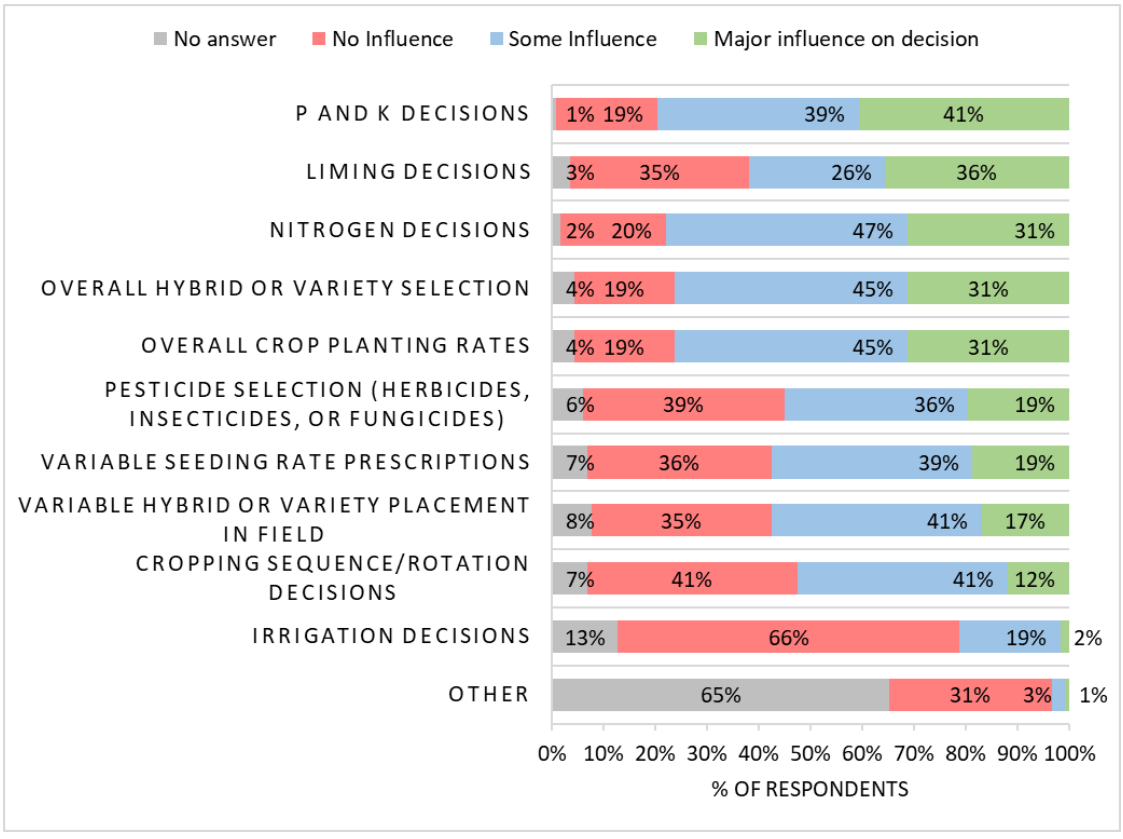

Figure 16, Q18: Crop management decisions influenced by pooled data from customer's farms. Due to rounding, percentage numbers for a technology may not total 100.

PROFITABILITY OF PRECISION SERVICE OFFERINGS

Dealerships were asked to report on the profitability of the precision technology services they offer: either making a profit, breaking even, not breaking even, or don't know, Figure 18. Overall, the categories with the greatest percent of respondents making a profit are VRT fertilizer applications (69%), grid or zone soil sampling (63%), VRT fertilizer or lime prescriptions (63%), precision planter equipment sales (62%), VRT lime applications (58%), and telematics equipment sales (56%). UAV or drone imagery is a service area where dealers struggle the most to generate a profit where almost three-fourths of respondents are losing money or just breaking even. The profit situation is somewhat better for satellite or aerial imagery, where over half of dealers are in the black.

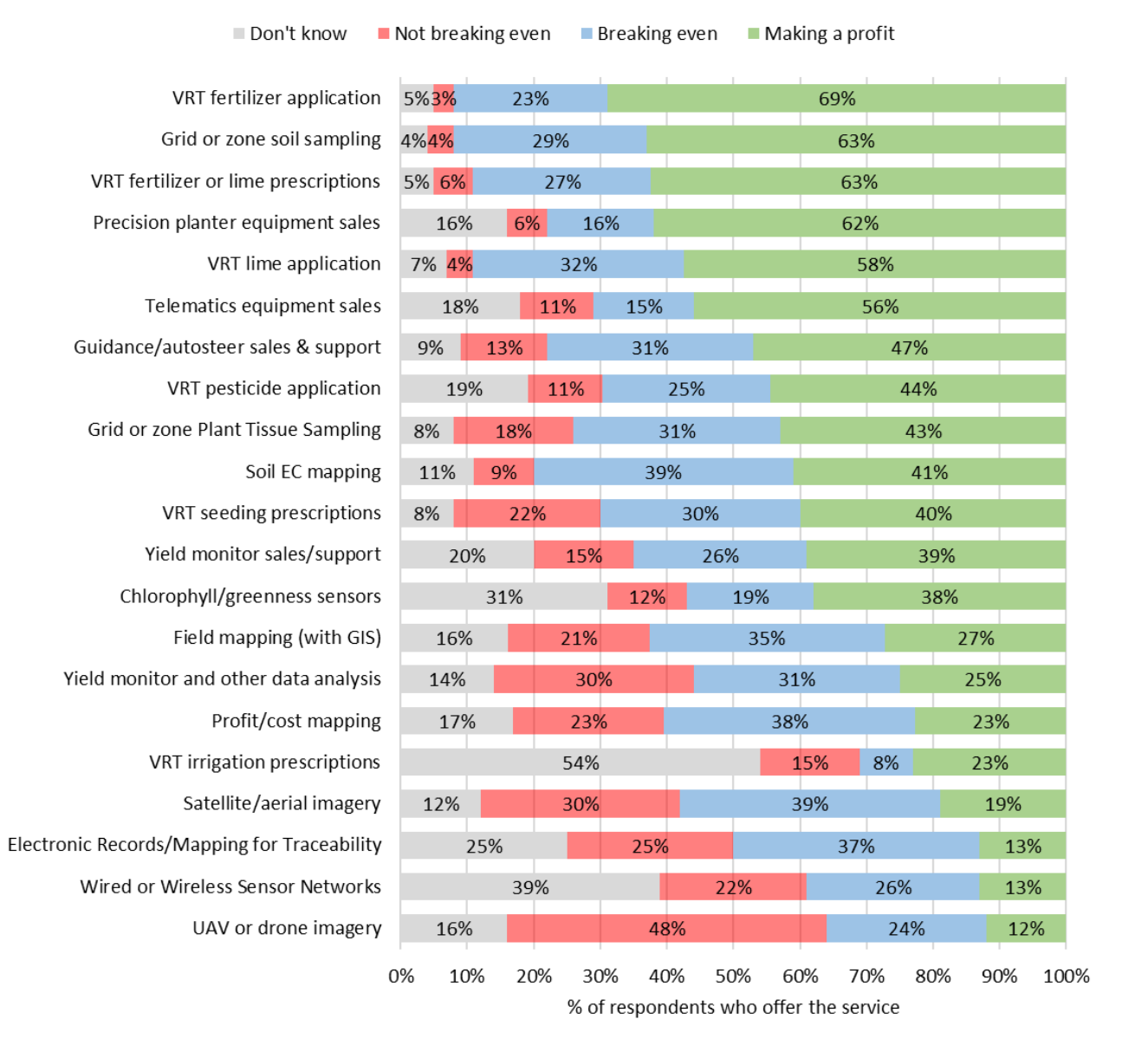

Figure 18, Q15: Profitability of precision service offerings for retailers. Due to rounding, percentages for each technology may not total 100.

Figure 19 shows the percent of respondents making a profit in certain precision ag services over time. More dealers report making a profit with VRT fertilizer applications and grid soil sampling as compared to a decade past. Dealers reporting profits in satellite and aerial imagery and yield monitor and other data analysis have not had similar increases in that same time.

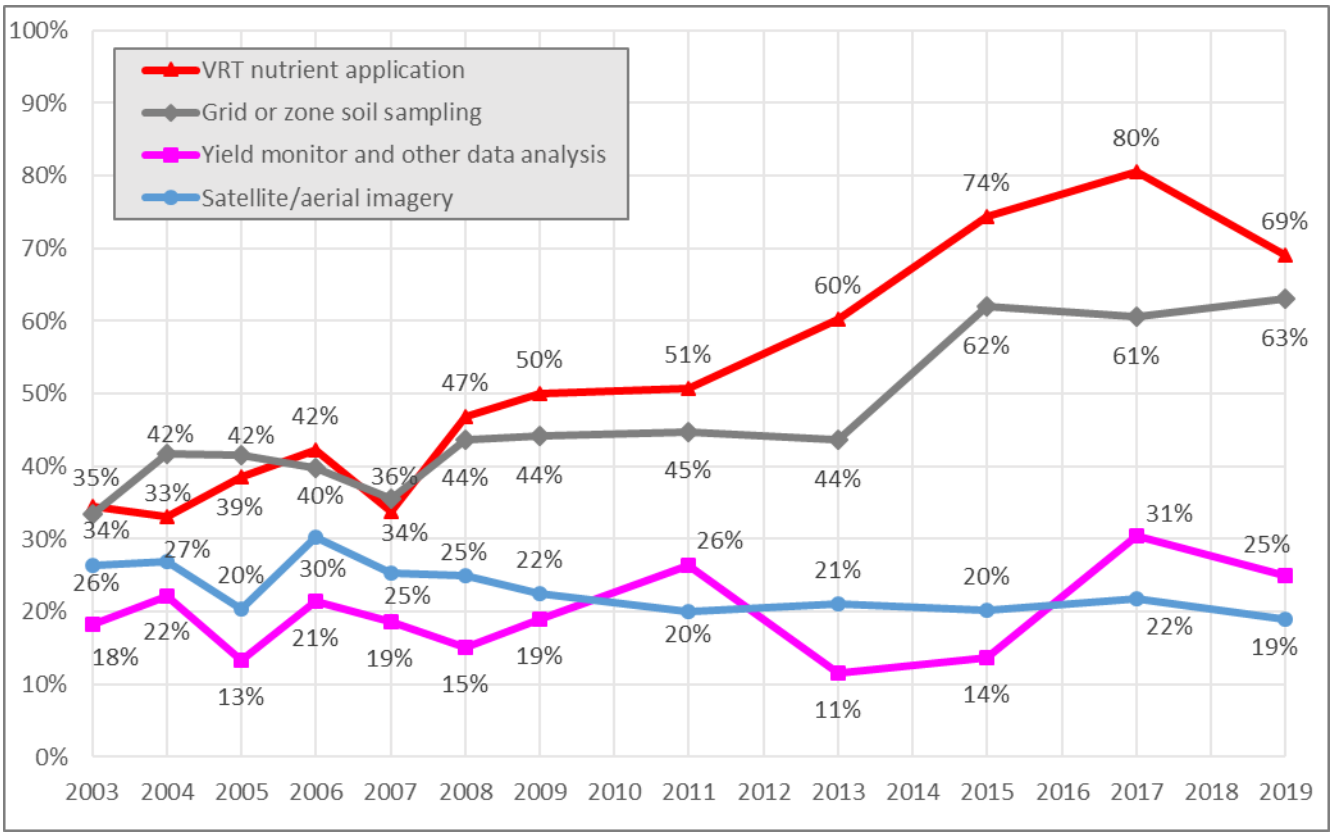

Figure 19, Q15: Profitability of precision services over time for retailers.

PRODUCER'S USE OF PRECISION TECHNOLOGIES

While the survey focuses primarily on the technologies used and precision services offered, dealers' insights into their customers' practices offer a different look into the adoption of these practices. As a part of the survey, respondents reported on the share of acres in their local market area that are utilizing various precision technologies.

Table 4, Q21: Farmer use of precision technologies, market area estimated by retailers.

Yield Monitor	69%
Guidance/Autosteer	66%
Field Mapping (with GIS)	58%
Sprayer Section Controllers	56%
Grid or Zone Soil Sampling	52%
Planter Row or Section Shutoffs	45%
VRT Lime Application	41%
VRT Fertilizer Application	39%
Variable Down Pressure on Planter	29%
Satellite or Aerial Imagery	26%
Any Data Analysis Service	26%
Cloud Storage of Farm Data	21%
Electronic Records/Mapping for Quality Traceability	20%
VRT Seeding	19%
Variable Hybrid Placement Within Fields	11%
Soil EC Mapping	10%
Y Drops on Fertilizer Applicator	10%
Telematics	10%
UAV or Drone Imagery	8%
VRT Pesticide Application	8%
Chlorophyll/Greenness Sensors for N Management	5%
VRT Irrigation	4%
Selective Harvest for Quality Improvement	4%
Robotics/Automation for Weeding	0%
Robotics/Automation for Harvesting	0%

Table 4 shows the estimated market area of an array of precision technologies in 2019. Yield monitors and GPS guidance with automatic control have the highest farmer adoption, with dealers reporting around two thirds of the acres in their market areas using these. Yield monitors are standard equipment on most combines now, and there are many benefits to autosteer including less operator fatigue, more time focused on operating equipment and less waste of applied inputs. Coming in next are field mapping, sprayer boom section controllers and grid/zone soil sampling, at over 50% adoption each. Dealers report that not quite half of the farmland in their areas was planted with row shutoffs, and even less utilize VRT liming or VRT fertilizer technology. On the opposite end, the much-discussed coming technologies of robotics automation have not yet materialized to any extent on U.S. farms. This was the first year the survey asked about VRT irrigation, where dealers indicated just 4% of their market area was using this. This number comes with some consideration, as most responders were from the Midwest where in most areas irrigation is the exception. This was also the first year to ask about selective harvest, where dealers report it occurs on 4% of the acres in their trade areas.

In Figures 20 and 21, you can see the changes over time in the percent of the market area of various precision ag technologies used by farmers. The time-scale graphics do not include technologies that were first asked about in 2019: VRT irrigation, selective harvest for quality improvement, robotics/automation for weeding, and robotics/automation for harvesting--the numbers for those can be seen in Table 4. In addition, two technologies that were asked first in 2017 and also in 2019 were not included in the graphics, for lack of room and clarity—telematics and Y-drops. Both of these were estimated by retailers as 10% of market area in 2019 (Table 4), but were half of that in 2017 at 6% and 5% respectively. As with the dealer information, starting in 2017 the survey did not ask separately about single and multi-nutrient VRT fertilizer applications on farms. All precision ag practices show growth in recent years, with the exception of VRT pesticide applications which fell back in 2017 but rebounded slightly in 2019 to the levels of a decade ago. Some variation in survey results from year to year is to be expected, as survey respondents are not the same each year.

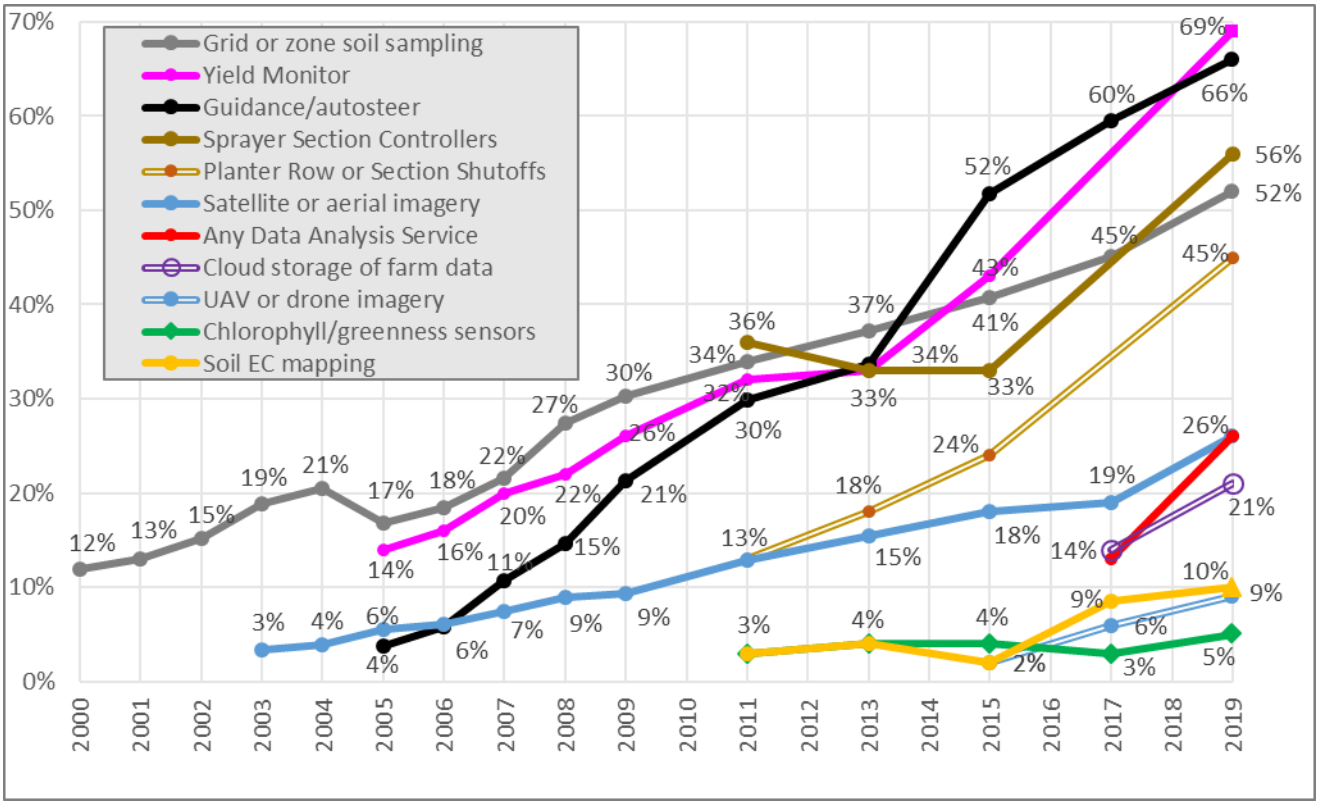

Figure 20, Q21: Producer use of precision technologies, retailers estimate of their market area. Yield monitor, sprayer section controllers, and planter row/section shutoffs were inadvertently omitted in the 2017 survey.

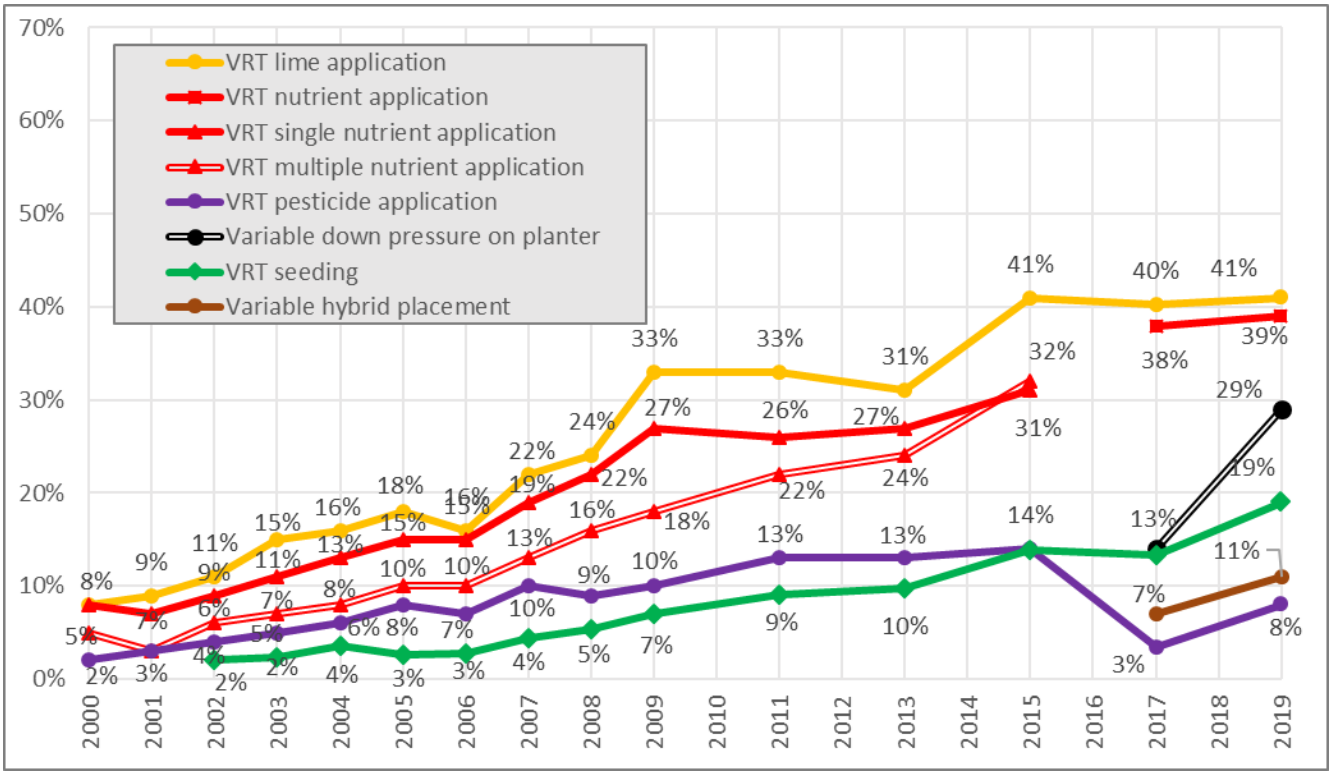

Figure 21, Q21: Farmer use of variable rate technologies (VRT), market area estimated by retailers. Starting at 2017 the survey stopped asking separately about single and multiple fertilizer applications.

FUTURE INVESTMENT PLANS

Dealers were asked about their investment plans in 2019 for precision technologies and equipment, selecting a range in dollars. Ten percent of retailers were not planning on investing in precision technologies in 2019, down from previous surveys this decade, Figure 22. Those retailers investing $10,000 or less is relatively steady across time. Retailers investing from $10,000 to $25,000 are up sharply. An important consideration no specifically asked in the question are associated costs such as human capital and supporting assets. For instance, dealers may be investing in UAV technologies, but tangential investments in additional employees, office space, computers, storage facilities, or employee vehicles required were not reported.

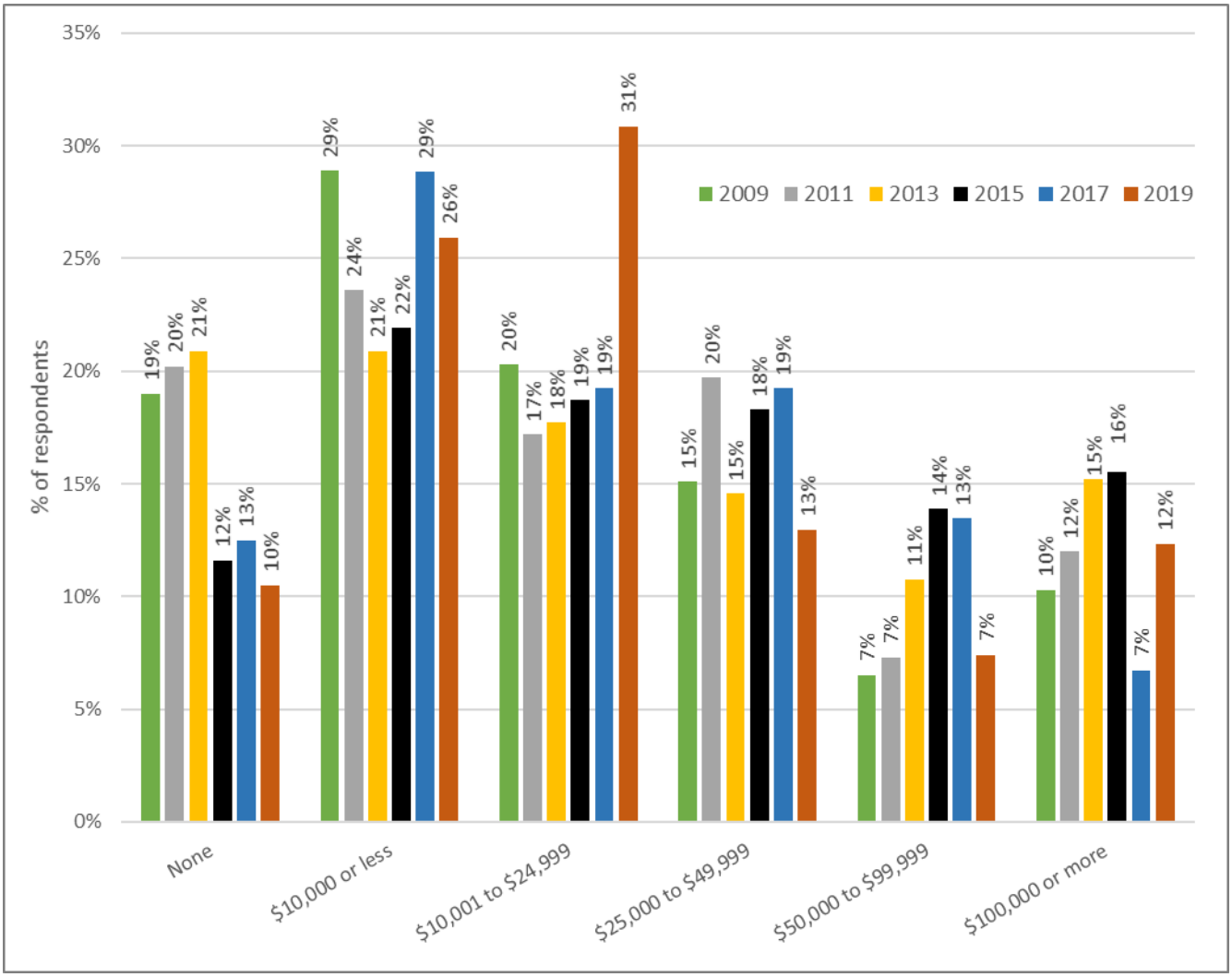

Figure 22, Q8: Expected investment in precision technology by retailers.

BARRIERS TO GROWTH AND EXPANSION

In an attempt to understand what prevents growth and expanded use of precision technologies the survey asked respondents to report on producer and dealer barriers. These barriers were evaluated at the aggregated precision agricultural level; specific technologies were not assessed.

Producer Barriers

Figure 23 shows the perceived barriers as reported by dealers over time for issues that would influence customer decisions on technology. All barriers were up in 2019. Reported is the percentage who agree or strongly agree the stated barrier is preventing more farmers from adopting or expanding their use of precision agriculture. For 2019 farm income pressure greatly exceeds the other factors, followed by the cost of services being greater than the benefit from the services, then the lack of confidence in recommendations. For all barriers, these were also the three where dealers agreed (scores of 4 or 5, see survey instrument) more than disagreed (scores of 1 or 2) with the statement being a barrier. For the other four barriers, dealers disagreed more than agreed that they were a barrier in 2019. Looking across years the biggest changes from year to year have been related to farm income pressure and cost of services. Topography limiting use, soil types limiting profitability, interpreting and making decisions are barriers that dealers rate more consistently from year to year. Note the survey question was not included in all past surveys.

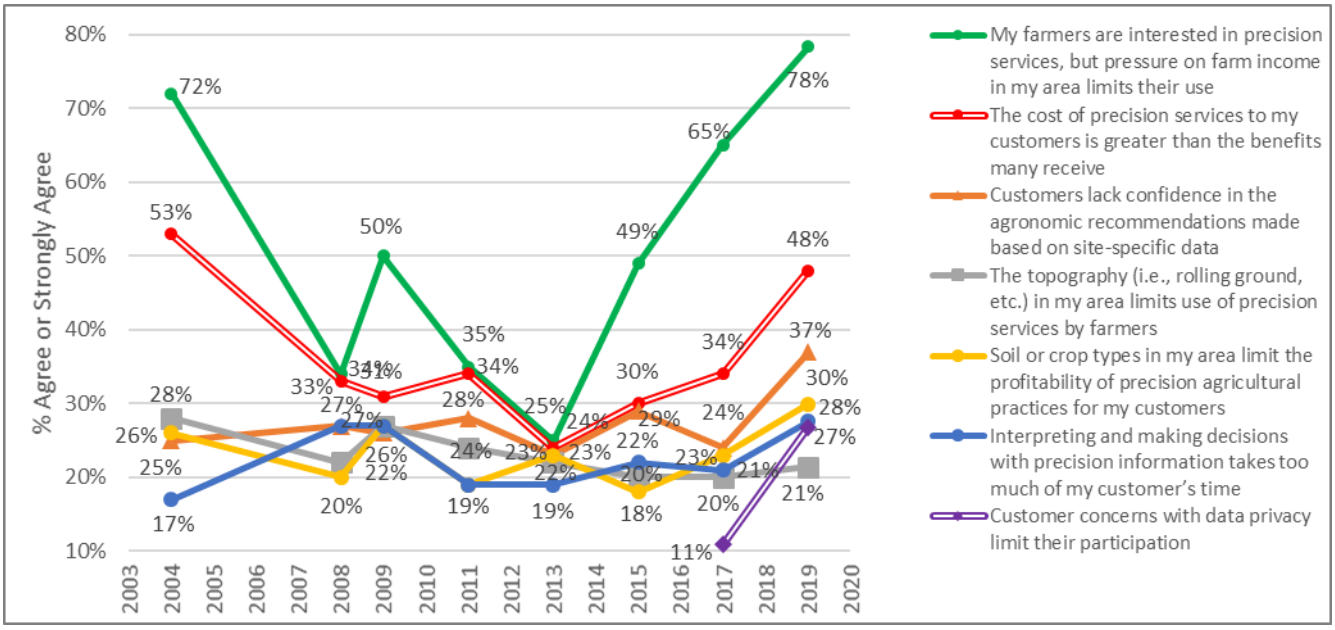

Figure 23, Q22: Customer issues that create barriers to expansion and growth in precision agriculture.

Dealer Barriers

Figures 24 and 25 show factors related to dealers and technology. All were up in 2019 compared to 2017. The barriers noted most by the dealers were the quickly changing equipment, the fees they can charge are not high enough to enable a profit, followed by the difficulty in finding employees who can deliver on precision products and services. In general the dealer barriers were on a downward trend during the 2000's decade and into the early 2010's, but have been creeping up on the last three surveys.

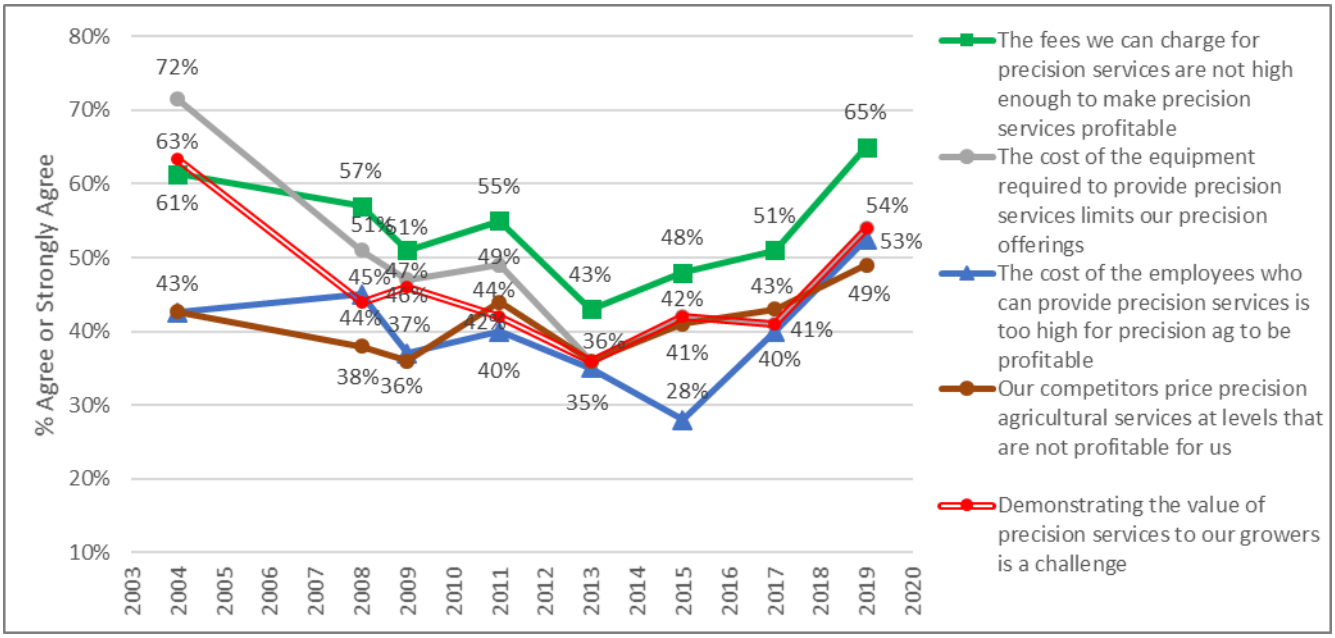

Figure 24, Q22: Dealer and technology issues that create a barrier to expansion and growth in precision agriculture.

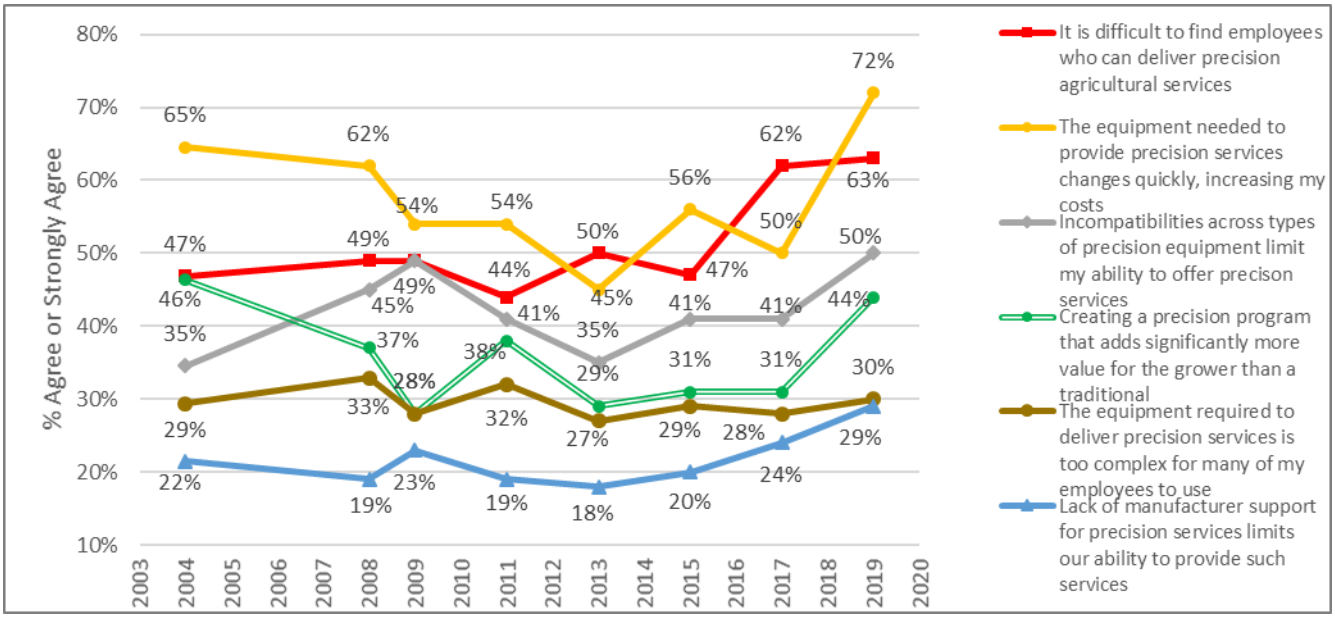

Figure 25, Q22: Dealer and technology issues that create a barrier to expansion and growth in precision agriculture.

SUMMARY

Precision agriculture utilizes information technology through a set of related tools, aiming to manage crops more accurately and meticulously. Using embedded and remote sensors that measure soil and crop parameters spatially and temporally, software analyzes variability to detect correlations and trends for informing inputs--with the payoff hoped in more exact and tailored applications of seeds, fertilizers, pesticides, and other inputs. The overall goal is to increase the efficiency of the production process through better-utilized inputs and/or enhanced productivity. This survey spans the more than two decades since agricultural retailers and farmers began using GPS to guide soil sampling and apply fertilizers and soil amendments variably across fields, and farmers used GPS-linked yield monitors to create maps that helped illuminate differences across fields and over years.

Since the mid-1990's there have been watershed changes to the technologies as well as new types introduced. The most significant of these in changing how crops are produced has been GPS guidance—first manual, and now supplanted by autoguidance systems that are becoming ubiquitous among farms and dealerships in the U.S. Sprayer boom section and planter row controllers are offshoots of guidance that are achieving widespread use.

Autoguidance and autocontrols on inputs are now mostly standard equipment across dealerships, partially because they are relatively simple to use and the benefits are relatively obvious. Guidance and section controllers don't depend on site-specific information to extract value, only location and previous applications. They help reduce input costs by reducing skips, overlaps and duplicate applications. In contrast, the information-intensive side of precision farming continues to lag in demonstrating value. Using site-specific information from fields, such as remote sensing imagery, soil test results, soil or yield maps, to characterize and understand field variability and its impact on crop performance, and then to act upon that by variably managing fields—has been a greater challenge than many would have predicted two decades ago.

The 2019 survey shows another increase in dealer use of most data collection technology such as greenness sensors, UAV's and EC mapping by dealers. Correspondingly more dealers are offering precision sensing services to customers such as satellite imagery, yield monitor analysis, and precision soil sampling, and more are offering VRT liming, fertilizing, and seedling prescriptions. Respondents continue to struggle with generating a profit with the higher end precision ag tools and services. Farmers in the market areas of the dealers continue to adopt more precision ag practices. Practices growing fastest include precision soil sampling, yield monitor use, guidance, and sprayer section boom controllers, all in use from over half to nearly three quarters of the acres in dealer trade areas. Use on less of the acres but sharply up since 2017 is variable planter down pressure and farmer use of a data service. More dealers are helping their customers with data overall. Some of these increases may be from improved hardware and software compatibly, greater ability to move, store, and analyze data, and increasing familiarity with some of these new technologies.

The 2019 survey shows farmer income and the value perceived by the growers continues to be a barrier for growth, with these barriers up sharply since 2017. Respondents struggle with hardware and software incompatibilities, hiring the people to manage precision ag services, competitive pricing and difficulty in showing the customer value. As seen in the past, as farm incomes go down, there can be a reduction in precision ag services purchased. As dealerships began to struggle with profit margins, smaller investments were made in precision technologies. One of the emerging dealership issues is the need for employees with the skills and experience to utilize precision agriculture tools and grow the precision service business. This is a job opportunity for those willing to acquire those skills and for the educational institutions who rise to the challenge of providing precision agriculture education.

SURVEY INSTRUMENT

CropLife

19th Precision Agriculture Services Dealership Survey

PURDUE AGRICULTURE

IRB APPROVAL 1702018754

Dear agricultural retailer,

The CropLife/Purdue survey is the longest-running, most widely used survey that chronicles the development and adoption of precision agriculture! We depend on your continued input. Please complete by March 22, 2019. Two ways to participate:
Send this paper back to: **CropLife, 37733 Euclid Ave., Willoughby, OH 44094; Fax: 440-942-0662.**
Or complete the survey online at https://2019precisionsurvey.questionpro.com Thank you for your participation!

Bruce Erickson & Jess Lowenberg-DeBoer *Purdue University* **Paul Schrimpf** *CropLife/Meister Media*

1. Which best describes your business? *[please mark only one]*
   - [ ] Agricultural retail input supplier
   - [ ] Farm equipment dealer
   - [ ] Agricultural consultant
   - [ ] Other: *[please specify]* _____

2. If you answered agricultural retail input supplier above-- Are you a: *[please mark only one]*
   - [ ] Independent dealership
   - [ ] Cooperative
   - [ ] Part of a national or regional chain (not a cooperative)
   - [ ] Other: *[please specify]* _____

3. Your primary responsibility: *[please mark only one]*
   - [ ] Owner/general manager/location manager
   - [ ] Departmental manager
   - [ ] Precision manager
   - [ ] Application manager
   - [ ] Technical consultant/agronomist
   - [ ] Sales/sales management
   - [ ] Other: *[please specify]* _____

4. What were the total annual retail sales (in dollars) of agronomic products and services (fertilizer, chemicals, seed, precision agronomy and other services) at this individual location in 2018? *[please mark only one]*
   - [ ] Under $1,000,000
   - [ ] $1,000,001 - $5,000,000
   - [ ] $5,000,001 - $10,000,000
   - [ ] $10,000,001 - $15,000,000
   - [ ] $15,000,001 - 20,000,000
   - [ ] More than $20,000,000

5. How many total retail outlets does your company own or manage? *[please mark only one]*
   [ ] None [ ] 1 [ ] 2-5 [ ] 6-15 [ ] 16-25 [ ] More than 25

6. How many of each of the work roles does your specific location employ? *[please answer each, include full and part time]*
   - _____ Applicator—Runs the equipment that applies pesticides and fertilizers to farmer's fields.
   - _____ Agronomist/Horticulturalist—Provides recommendations on crop and soil management to farmers.
   - _____ Precision sales specialist—Works specifically with precision equipment sales and support.
   - _____ Precision equipment technician—Installs new precision equipment; troubleshoots and repairs ON SITE.
   - _____ Technical support—Works with customers REMOTELY to troubleshoot precision equipment and software.
   - _____ Data manager/analyst—Manages agronomic data from the dealership and customer's farms.

7. Rank the following crop types according to the value of products and services you provide to each *[1=highest, 2 next highest, etc. Leave blank if less than 2% of your business.]*
   - [ ] field crops (corn, soy, wheat, rice, cotton, milo, sugar beets, dry beans, etc.)
   - [ ] hay and forages
   - [ ] nursery or greenhouse
   - [ ] vegetables (incl. potatoes, melons, lettuce, tomatoes)
   - [ ] tree fruits & nuts
   - [ ] berries (strawberries, blueberries, raspberries, etc.)
   - [ ] grapes
   - [ ] Other: *[please specify]* _____

8. How much will your location invest in precision/site-specific technology and equipment during 2019?
   [ ] None [ ] $1 – $10,000 [ ] $10,001 - $25,000 [ ] $25,001 - $50,000 [ ] $50,001 - $100,000 [ ] More than $100,000

9. In a typical year how many total acres do you custom apply at your specific location (fertilizer, chemicals, seeding – total acres including multiple applications)? *[please mark only one. If none, go to Question 12]*
   [ ] None [ ] Under 5,000 acres [ ] 5,001 to 10,000 acres [ ] 10,001 to 25,000 acres [ ] 25,001 to 50,000 acres [ ] 50,001 to 75,000 acres [ ] 75,001 to 100,000 acres [ ] Over 100,000 acres

10a. In 2018, approximately what percentage of your total fertilizer sales were custom applied? _____%

10b. In 2018, approximately what percentage of your total crop protection sales were custom applied? _____%

11. In 2018, approximately what percentage of your total custom application (total acres, all products) used:

Manual GPS guidance (light bar) _____%
Automated GPS guidance (autosteer) _____%
Auto sprayer boom section or nozzle control _____%
Variable rate prescription map _____%

12. Do you offer soil sampling — traditional, following a grid pattern and/or by management zone? *[mark all that apply]*

[ ] Don't offer soil sampling
[ ] Grid pattern
[ ] Traditional, whole field approach
[ ] Management zones

If grid, what grid size most common? *[mark only one]*
[ ] < 1 acre
[ ] 1 acre - 2.49 acre
[ ] 2.5 acre
[ ] 2.51 acre - 5 acre

If zone, determined by what factor? *[mark only one]*
[ ] Soil mapping unit
[ ] Electrical conductivity
[ ] Yield map
[ ] Other *[please specify]*:_____.

13. In which of the following ways does your dealership use precision technology? *[mark all that apply]*

[ ] Any precision agronomic services for customers (such as soil sampling with GPS, GIS field mapping, etc.)
[ ] GPS guidance systems with manual control (light bar) for fertilizer/chemical application
[ ] GPS guidance systems with automatic control (autosteer) for fertilizer/chemical application
[ ] Auto sprayer boom section or nozzle control
[ ] Sprayer turn compensation
[ ] Y drops on fertilizer applicators
[ ] Satellite/aerial imagery for internal dealership purposes
[ ] UAV or drone for internal dealership purposes
[ ] Soil electrical conductivity (EC) mapping
[ ] Other soil sensors for mapping, mounted on a pickup, applicator or tractor (example: pH sensor)
[ ] Chlorophyll/greenness sensors mounted on a pickup, applicator or tractor (CropSpec, GreenSeeker, OptRx, etc.)
[ ] Field mapping with GIS to document work for billing/insurance/legal purposes
[ ] Telematics to exchange information among applicators or to/from office locations
[ ] GPS fleet management for vehicle logistics, tracking locations of vehicles, and guiding vehicles to the next site
[ ] Smart scouting using an app on a mobile device to record field situations and locations
[ ] Do not use precision technology

14. Which "site-specific" (precision) services/products do you offer now? If you don't offer now, will you in three years? If you don't offer now and have no plans for the near future, leave the row blank.

	Offer now	Will offer by 2022
Field mapping (with GIS)	[ ]	[ ]
VRT (variable rate) fertilizer or lime prescriptions	[ ]	[ ]
VRT fertilizer application	[ ]	[ ]
VRT lime application	[ ]	[ ]
VRT pesticide application	[ ]	[ ]
VRT seeding prescriptions	[ ]	[ ]
VRT irrigation prescriptions	[ ]	[ ]
Yield monitor sales/support	[ ]	[ ]
Yield monitor and other data analysis	[ ]	[ ]
Satellite/aerial imagery	[ ]	[ ]
UAV or drone imagery	[ ]	[ ]
Guidance/autosteer sales & support	[ ]	[ ]
Grid or zone soil sampling	[ ]	[ ]
Grid or zone plant tissue sampling	[ ]	[ ]
Soil EC mapping	[ ]	[ ]
Chlorophyll/greenness sensors for N management	[ ]	[ ]
Precision planter equipment sales	[ ]	[ ]
Telematics equipment sales (Farmobile, Trimble DCM-300, etc.)	[ ]	[ ]
Profit/cost mapping	[ ]	[ ]
Electronic records/mapping for quality traceability	[ ]	[ ]
Wired or wireless sensor networks	[ ]	[ ]

15. For the following services that you offer, currently how profitable is each specific service for your dealership?

	Not breaking even	Breaking even	Making a profit	Don't know	Don't offer this
	please mark only one column per row				
Field mapping (with GIS)	[ ]	[ ]	[ ]	[ ]	[ ]
VRT (variable rate) fertilizer or lime prescriptions	[ ]	[ ]	[ ]	[ ]	[ ]
VRT fertilizer application	[ ]	[ ]	[ ]	[ ]	[ ]
VRT lime application	[ ]	[ ]	[ ]	[ ]	[ ]
VRT pesticide application	[ ]	[ ]	[ ]	[ ]	[ ]
VRT seeding prescriptions	[ ]	[ ]	[ ]	[ ]	[ ]
VRT irrigation prescriptions	[ ]	[ ]	[ ]	[ ]	[ ]
Yield monitor sales/support	[ ]	[ ]	[ ]	[ ]	[ ]
Yield monitor and other data analysis	[ ]	[ ]	[ ]	[ ]	[ ]
Satellite/aerial imagery	[ ]	[ ]	[ ]	[ ]	[ ]
UAV or drone imagery	[ ]	[ ]	[ ]	[ ]	[ ]
Guidance/autosteer sales & support	[ ]	[ ]	[ ]	[ ]	[ ]
Grid or zone soil sampling	[ ]	[ ]	[ ]	[ ]	[ ]
Grid or zone plant tissue sampling	[ ]	[ ]	[ ]	[ ]	[ ]
Soil EC mapping	[ ]	[ ]	[ ]	[ ]	[ ]
Chlorophyll/greenness sensors for N management	[ ]	[ ]	[ ]	[ ]	[ ]
Precision planter equipment sales	[ ]	[ ]	[ ]	[ ]	[ ]
Telematics equipment sales	[ ]	[ ]	[ ]	[ ]	[ ]
Profit/cost mapping	[ ]	[ ]	[ ]	[ ]	[ ]
Electronic records/mapping for quality traceability	[ ]	[ ]	[ ]	[ ]	[ ]
Wired or wireless sensor networks	[ ]	[ ]	[ ]	[ ]	[ ]

16. How do you help manage the farm-level data (i.e., yield maps, soil tests, EC, satellite imagery) of your farmer- customers to assist in their decision-making? *[mark all that apply]*

[ ] Print maps for customers (yield, EC, soil maps, etc.)
[ ] No data aggregated among farmers, work with farmers only with the data from their own farms
[ ] Data aggregated among farmers but not outside the dealership
[ ] Data aggregated among farmers including those outside the dealership
[ ] Archiving and managing yield, soil test, and other data for future use
[ ] Other *[please specify]* _____
[ ] Do not help customers with their farm-level data

17. Does your company have a customer data privacy statement and/or data terms & conditions agreement? Yes [ ] No [ ]

18. What crop management decisions are being influenced by pooled data from your customer's farms?

	No influence	Some influence	Major influence on decision
	[please mark only one column per row]		
Nitrogen decisions	[ ]	[ ]	[ ]
P and K decisions	[ ]	[ ]	[ ]
Liming decisions	[ ]	[ ]	[ ]
Overall hybrid or variety selection	[ ]	[ ]	[ ]
Variable hybrid or variety placement in field	[ ]	[ ]	[ ]
Overall crop planting rates	[ ]	[ ]	[ ]
Variable seeding rate prescriptions	[ ]	[ ]	[ ]
Pesticide selection (herbicides, insecticides, or fungicides)	[ ]	[ ]	[ ]
Cropping sequence/rotation decisions	[ ]	[ ]	[ ]
Irrigation decisions	[ ]	[ ]	[ ]
Other *[please specify]* _____	[ ]	[ ]	[ ]

19. As you look at the current and future precision situation in your local market, what emerging precision technologies have the greatest potential to impact your business?

_____

20. For your retail location, what state are you located in? _____. What is your ZIP code? _____.

21. Approximately what percentage of the total acreage in your market area (all growers, not just your current customers) is currently using the following agricultural practices?

Field mapping (with GIS)	_____%
VRT fertilizer application	_____%
VRT lime application	_____%
VRT pesticide application	_____%
VRT seeding	_____%
Variable hybrid/variety placement within fields	_____%
Variable rate irrigation	_____%
Satellite or aerial imagery	_____%
UAV or drone imagery	_____%
Guidance/autosteer	_____%
Sprayer section controllers	_____%
Planter row or section shutoffs	_____%
Variable down pressure on planter	_____%
Grid or zone soil sampling	_____%
Soil EC mapping	_____%
Chlorophyll/greenness sensors for N management	_____%
Yield monitor	_____%
Telematics	_____%
Cloud storage of farm data	_____%
Y drops on fertilizer applicator	_____%
Any data analysis service (Encirca, FieldView, FBN, FarmServer, etc.)	_____%
Robotics/automation for weeding	_____%
Robotics/automation for harvesting	_____%
Electronic records/mapping for quality traceability	_____%
Selective harvest for quality improvement	_____%

22. What are the primary barriers preventing more farmers from adopting or expanding their use of precision agricultural services and/or preventing you from offering more precision services?
Please rate the following statements on a scale from 1 (strongly disagree) to 5 (strongly agree).

Customer Issues	Disagree Agree
The cost of precision services to my customers is greater than the benefits many receive	1 2 3 4 5
My farmers are interested in precision services, but pressure on farm income in my area limits their use	1 2 3 4 5
The topography (i.e., rolling ground, etc.) in my area limits use of precision services by farmers	1 2 3 4 5
Soil or crop types in my area limit the profitability of precision agricultural practices for my customers	1 2 3 4 5
Interpreting and making decisions with precision information takes too much of my customer's time	1 2 3 4 5
Customers lack confidence in the agronomic recommendations made based on site-specific data	1 2 3 4 5
Customer concerns with data privacy limit their participation	1 2 3 4 5
Dealer Issues	
The cost of the equipment required to provide precision services limits our precision offerings	1 2 3 4 5
The cost of the employees who can provide precision services is too high for precision ag to be profitable	1 2 3 4 5
It is difficult to find employees who can deliver precision agricultural services	1 2 3 4 5
The fees we can charge for precision services are not high enough to make precision services profitable	1 2 3 4 5
Lack of manufacturer support for precision services limits our ability to provide such services	1 2 3 4 5
Creating a precision program that adds significantly more value for the grower than a traditional agronomic program is difficult for us	1 2 3 4 5
Demonstrating the value of precision services to our growers is a challenge	1 2 3 4 5
Our competitors price precision agricultural services at levels that are not profitable for us	1 2 3 4 5
The equipment needed to provide precision services changes quickly, increasing my costs	1 2 3 4 5
The equipment required to deliver precision services is too complex for many of my employees to use	1 2 3 4 5
Incompatibilities across types of precision equipment and technology (different data formats, inability to share information) limit my ability to offer precision services	1 2 3 4 5

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