Farm Management Newsletter FM 2000-3
March 13, 2000

Use and Perceptions of Precision Agriculture Technologies by Professional Chemical Services

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Use of precision agriculture (PA) technologies has increased with advances in technologies and increased farmer awareness of PA's usefulness and potential profitability. Many farmers and agribusinesses are still uncertain about the wisdom of adopting PA technologies. More information on use, costs and benefits of PA technologies is needed by producers, agribusinesses, consultants, and extension personnel making decisions about adoption of PA.

In December 1999 an attempt was made to gather some of this information by conducting a survey of persons attending the Ag Crop Management Conference sponsored by the University of Missouri. Attendees of this conference were professional chemical applicators, managers, consultants, and seed and chemical dealers. Seventy-five usable surveys were returned, representing 22% of conference attendees. Different offices of the same business were counted as separate respondents because they were expected to have different clients. Not all questions were answered by all respondents. The results in the summary tables are averages.

Table 1 summarizes respondents' perceptions of clientele usage of PA technologies. Respondents indicated that, on average, 13% of their clientele used yield monitors. Of those who had yield monitors, 55% developed and used yield maps. Twenty percent of their clients were estimated to use fertility, herbicide and/or soil maps.

Table 1. Use of Precision Agriculture by Clientele

Technology	Clientele currently using technology	Clientele expected to use technology in 5 years

Yield monitors	13%	33%
Yield maps[1]	55%	-
Fertility level maps, herbicide rate maps, or soil type maps	20%	39%

[1]Based on percentage of clientele already having yield monitors

A study by Norvell and Lattz at the University of Illinois found similar usage of PA technologies by Illinois producers. Within the next 5 years, respondents expect their clientele using yield monitors to increase to 33%; those using fertility, herbicide and/or soil maps are expected to reach 39%. They expect fertility, herbicide, and/or soils maps to be generated by service centers while yield monitors will be purchased and used by individual farmers. That a greater number are expected to use herbicide and/or soils maps indicates respondents believe the service sector will play a significant role in PA adoption.

Table 2 summarizes technologies the respondents currently offer or anticipate offering. Over 30% indicated that they offer global positioning system (GPS)-aided soil testing and yield monitor service and/or sales. Around 30% of respondents offer variable rate phosphorus (P), potassium (K) and lime application. Variable rate nitrogen application currently is being offered by 15% of respondents. No respondents indicated offering variable rate pesticide application. Of those respondents currently not offering a specific service, about half were undecided about offering that service in the future. This indicates that many service providers are contemplating their involvement or expansion of PA services. These are the persons who are most open to educational and marketing programs.

Table 2. Offering of Precision Agriculture Services by Respondents

Services	Currently offering service	If currently not offering service, then			
		Will start within 2 years	Plan to start in 3 or more years	Don't plan to use GPS technology	Undecided about GPS technology
GPS-aided soil testing	35%	6%	24%	21%	44%

Yield monitors	32%	31%	17%	17%	36%
Variable rate P or K application	28%	3%	17%	31%	44%
Variable rate lime application	27%	13%	>18%	21%	48%
Variable rate N application	15%	16%	19%	26%	40%
Variable rate pesticide application	0%	14%	24%	20%	41%

The service most likely to be adopted by the respondents in the next several years is yield monitor sales and service. Though reasons were not given for expansion into yield monitors, it can be assumed that the ability of the service providers to create and have access to producer yield maps will give their businesses crucial information for managing their other services. Of the variable rate fertilizer applications, nitrogen (N) application was the type respondents felt was most likely to be offered in the next few years. Variable rate N application is a natural outflow of having yield map information.

Since soil testing and variable rate P and K application are already the most offered services and respondents indicated the least interest in beginning to offer these services in the next few years, it can be surmised that the innovators and early adopters have already entered the field. Future entrants into these services will be followers. Experience has indicated that early adopters profit from a new technology, while followers adopt mostly to stay in business.

Some respondents may choose not to offer PA services because of the nature of their business. For instance, a yield monitor sales company is unlikely to offer variable rate fertilizer service. However, our survey did not ask respondents why they would not offer services.

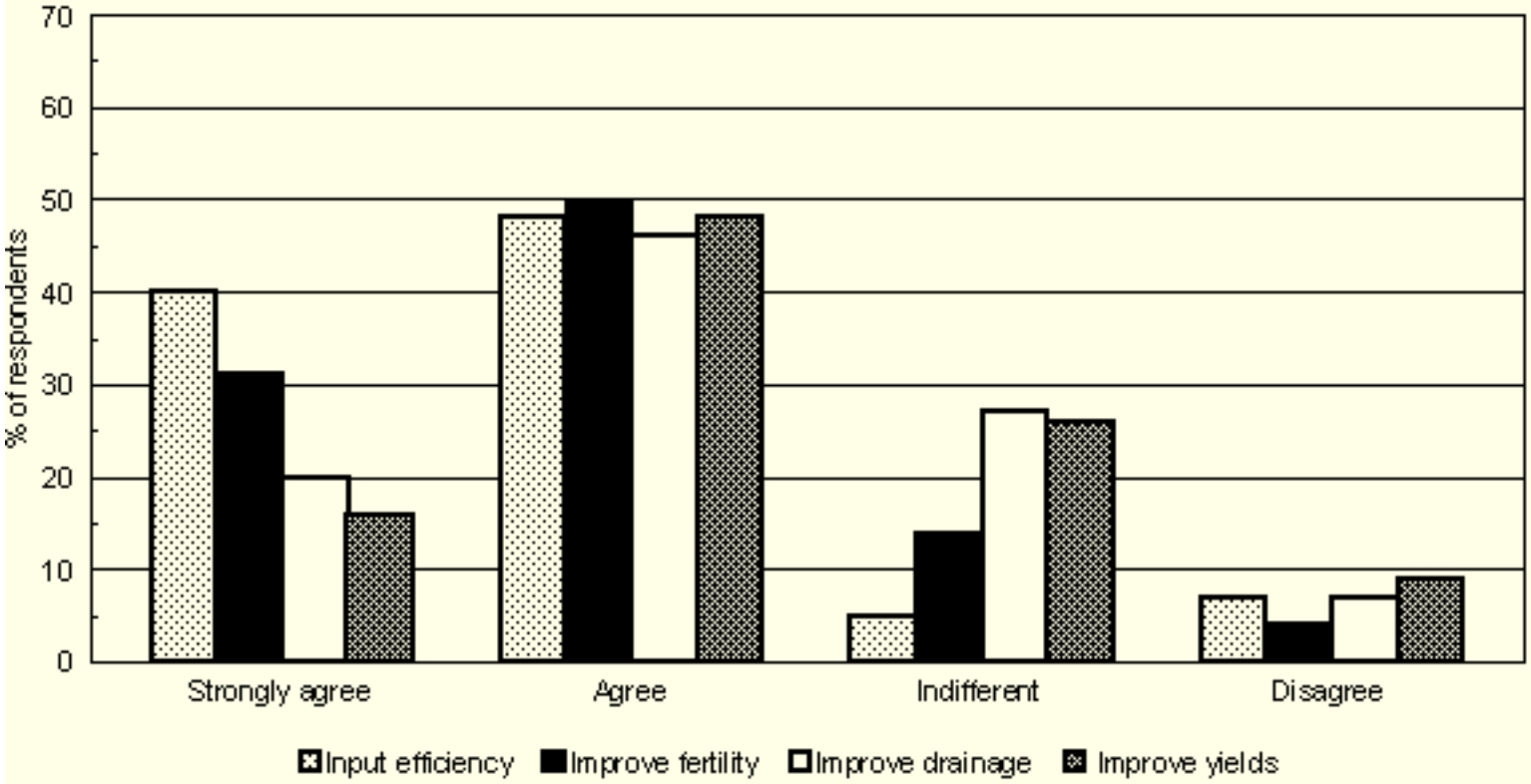
Table 3 summarizes survey respondents' perceptions of the use of PA technologies. Survey participants were asked to provide their perceptions regarding how various GPS technologies might increase clientele profits.

Table 3. Agriculture Chemical Service Providers' Attitudes about Precision Agriculture

	Strongly Agree	Agree	Indifferent	Disagree	Strongly disagree
GPS technology increases clientele profits by					
-- more efficiently using farm inputs	40%	48%	5%	5%	2%
-- improving farm fertility	31%	50%	14%	2%	2%
-- improving management of farm drainage	20%	46%	27%	7%	0%
-- increasing yields	16%	48%	26%	9%	0%
Clientele GPS maps are interpreted by					
-- fertilizer dealers: Yield	26%	54%	14%	6%	0%
Soil	26%	60%	11%	3%	0%
-- crop consultants: Yield	25%	56%	17%	3%	0%
Soil	23%	60%	14%	3%	0%
-- the clientele: Yield	17%	69%	11%	3%	0%
Soil	3%	60%	26%	11%	0%
-- equipment dealers: Yield	3%	33%	42%	14%	8%
Soil	6%	23%	23%	14%	9%

Forty percent of respondents strongly agreed that GPS technology would increase clientele profits by using inputs more efficiently and 31% felt strongly that it would improve farm fertility (see Figure 1).

Figure 1. Survey respondents' perceptions of effect of PA on clientele profits.



Only 16% strongly believed that GPS technology would increase yields. This indicates a belief among respondents that GPS provides optimal input allocation rather than opportunity to remedy deficiencies. One interpretation of this might be that current inputs are sufficient on a whole-field basis but input location and rate are issues. If redistribution of those inputs doesn't offer yield increases, one might expect to see input decreases. Another interpretation is that respondents have seen the benefits in efficient use of farm inputs and improved soil fertility but they are waiting to see evidence of increased yields due to GPS technologies. This would explain the high level of respondents who are indifferent to the idea that GPS increases clientele yields.

When asked who typically interprets GPS yield and soil maps, the responses that fertilizer dealers and crop consultants interpret maps are almost identical. This indicates that the respondents probably viewed these categories as the same. Because the respondents were mostly professional chemical applicators, managers, consultants, and seed and chemical dealers, they most likely viewed their jobs as encompassing both sales (fertilizer dealers) and consultation. The question was worded so that more than one person could be responsible for interpreting maps. Therefore, the strength of agreement or disagreement is used to determine whom the primary and secondary interpreters would be.

The survey respondents indicated that they viewed fertilizer dealers and crop consultants as the primary interpreters of both yield and soil maps (see Figures 2 and 3).

Figure 2. Survey respondents' perceptions of who interprets clientele yield maps.

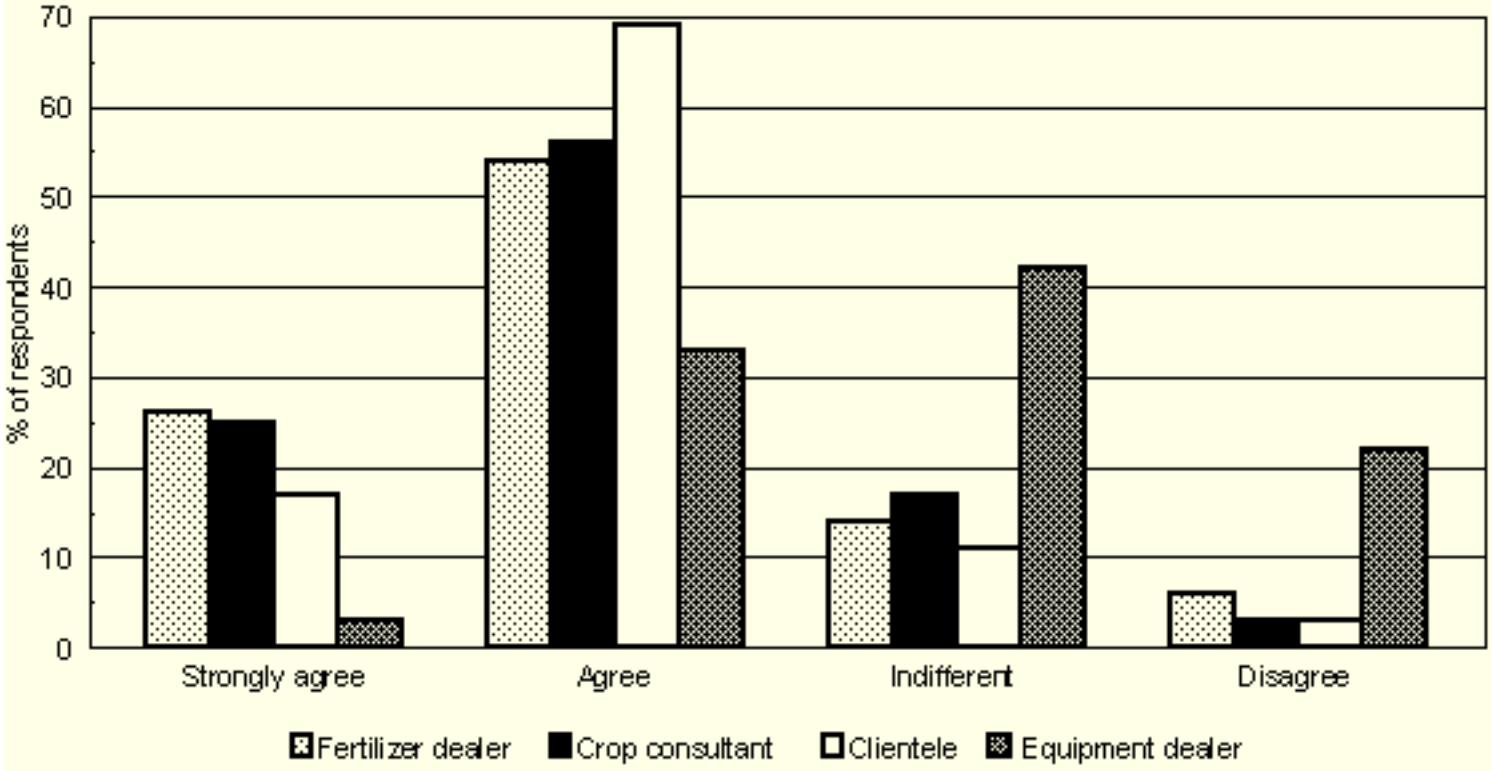
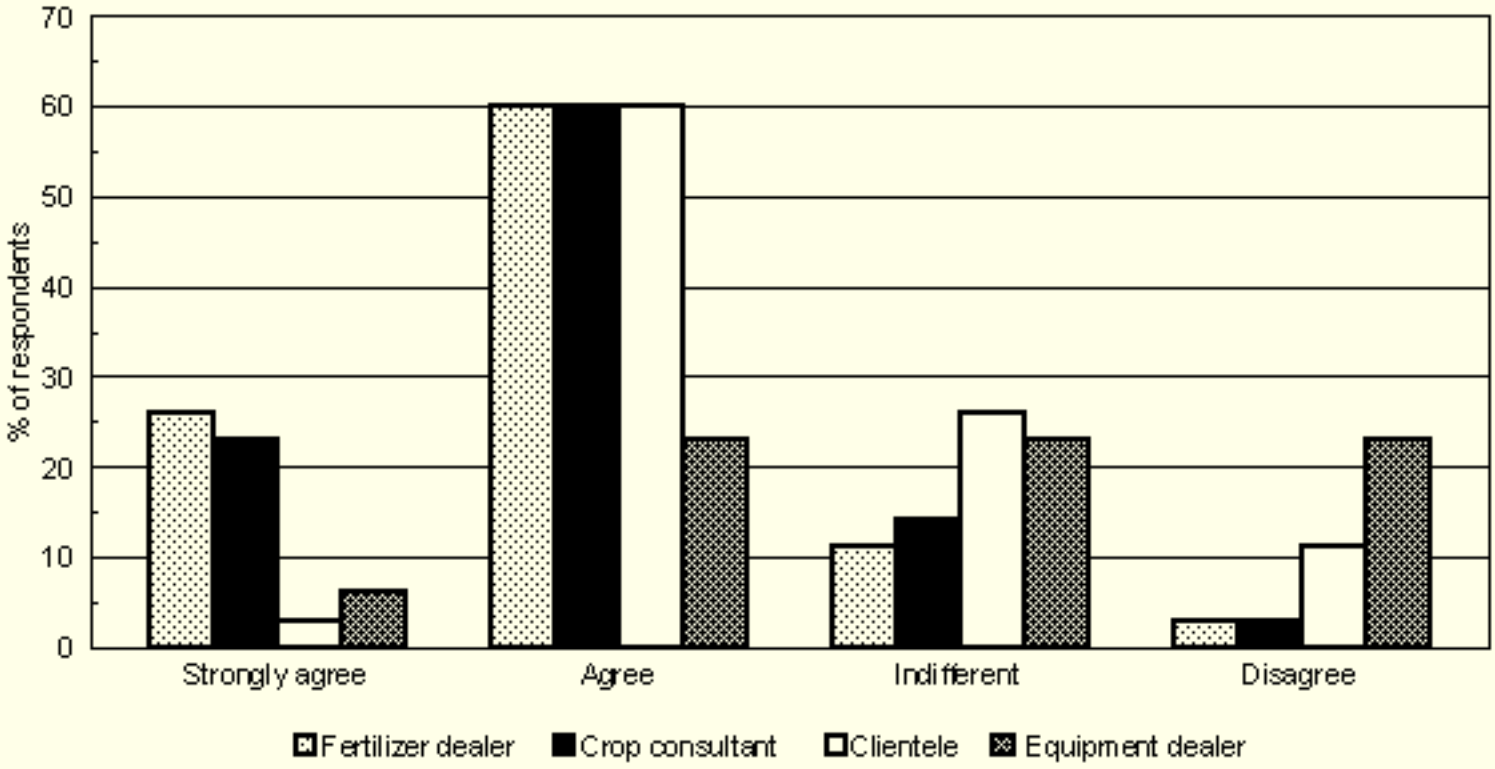


Figure 3. Survey respondents' perceptions of who interprets clientele soil maps.



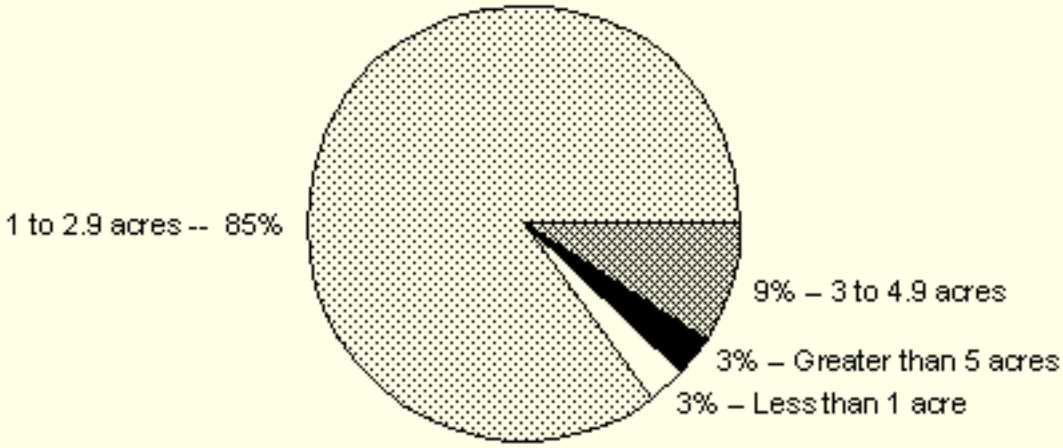
A University of Illinois survey found that 91% of producers interpreted GPS maps. It appears that service providers believe that farmers rely heavily on dealers and consultants to understand and use the maps generated with GPS technology. Alternatively, farmers believe

that they do the interpretation. A possible explanation is that farmers value fertilizer dealer and consultant interpretation but believe that they are the final interpreter of the maps. Farmers are viewed by fertilizer dealers and consultants as reserving the right to add their own interpretations and constraints on whatever decisions might result from a particular map interpretation by the fertilizer dealer or consultant.

As might be expected, equipment dealers are more involved in interpreting yield maps than soil maps. Equipment dealers who sell yield monitoring equipment would be more involved in yield maps than soil maps for which they had little or no involvement in making.

Survey participants who sampled and mapped soil on a grid basis reported that 84% use an average grid size of 1 to 2.9 acres (see Figure 4). Three to 5 acre grids were a distant second as the most used grid size.

Figure 4. Percent of respondents using various grid sizes for soil sampling.



Survey participants were asked to rank 6 items for the importance of information to disseminate to clientele about PA technologies (Table 4). A ranking of 1 indicated the most important information and a 6 represented the least important information.

Table 4. Importance of Various Precision Agriculture Information To Be Communicated to Farmers

Information	Average Ranking
How to interpret GPS results	1.85
The average cost of using GPS	2.85

The latest GPS technologies	3.38
The optimal soil test grid size for GPS	3.89
Current shortcomings of GPS technology	3.86
The number of farmers using GPS	5.05

Respondents believed that the most important aspect to communicate is how to interpret GPS results. This indicates that service providers believe interpretation may require special training and experience. Since input and service providers have a vested interest in the interpretation of yield and soil maps (affects quantity of fertilizer sold), education of farmers on how to make decisions from yield and soil maps might best be done by University Extension personnel. The University of Illinois survey found that producers ranked "how to interpret GPS results" first in importance of GPS technology information. Of second perceived importance was the cost of using GPS. Communication of cost is critical if the adoption of PA technologies is going to be an economic decision.

Communicating the latest GPS technology, the optimal soil test grid size, and current shortcomings of the GPS technology were deemed to be moderately important by respondents. These results might imply that service providers are interested in communicating what their programs are rather than what others are offering or what they might be offering in the future. Communicating a level of surety in a rapidly changing environment is an important factor in marketing products and services. Communicating the number of farmers using GPS was deemed unimportant. For a new technology, the critical selling point is the reputation of adopters rather than the number of adopters.

Table 5 provides the average cost of PA services offered. The average cost per acre of soil sampling is $3.10. Field mapping and yield monitor analysis had a reported average cost of $1.30 per acre. The average cost of controller driven single- and multi-product application were $4.44 per acre and $10.10 per acre, respectively. The average cost of a packaged service, typically including soil sampling, field mapping, and soil maps, was $9.70 per acre.

Table 5. Pricing of Precision Agriculture Services

Service	Average price/acre
Soil sampling	$3.10

Field mapping	$1.30
Yield monitor analysis	$1.33
Controller driven application (single product)	$4.44
Controller driven application (multi product)	$10.10
Package service (typically included soil sampling, field mapping and oil maps)	$9.70

References

Norvell, J.M., and D.H. Lattz. "Value Added Crop, GPS Technology and Consultant Survey: Summary of a 1998 Survey of Illinois Farmers." Department of Agriculture and Consumer Economics, University of Illinois, departmental paper, July, 1999.

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