4R Framework Implementation: Precision Ag Adoption by Farmers and Dealers

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Introduction

Implementing the 4R framework in the field often results in the question *"What specific 4R practices I should do?"* Precision ag practices like GPS mapping, grid or zone soil sampling, yield monitors, variable rate nutrient applications, and split nutrient applications, are all recognized as 4R practices (Snyder, 2016 and Bruulsema, 2017). Selecting the right suite of 4R practices for site specific characteristics can result in increased crop uptake of nutrients for greater productivity and return on investment and decreased loss of nutrients to air and water.

Understanding trends in practice adoption by farmers and agricultural dealers helps CCAs know where there are opportunities to increase implementation and what information is key when interacting with producers. Recently, surveys were conducted to evaluate the adoption rate and the economics linked to precision ag practice adoption. Two surveys focused on famer adoption and two on agricultural dealers.

Farmer Adoption

In 2016, the United States Department of Agriculture (USDA) Economic Research Service (ERS) published a report using data from the USDA Agricultural Resource Management Survey of field crop producers evaluating adoption trends and farm profitability for specific precision ag technologies (Schminelpfennig, 2016). The report focused on the use of GPS mapping systems (including yield monitors and soil or yield mapping), guidance or auto-steer systems, and variable rate technology (VRT).

Yield monitors had the highest rate of adoption on corn and soybean farms, though the creation of yield maps was only half of that value (Table 1). Pointing to a gap in the use of data collection and analysis tools on the farm. Use of GPS soil maps and VRT had the lowest reported rate of adoption per farm (Table 1). This level of implementation by individual farms represents 70 percent of corn acres and 69 percent of soybean acres with yield monitor recording versus only 28 percent of corn and 34 percent of soybean acres implementing VRT (Schminelpfennig, 2016)

Table 1. Rate of adoption of precision ag technologies on Corn (2010) and Soybean (2012) for all reporting farms (Schminelpfennig, 2016).

Farm Type	Yield Monitor	Yield Map	GPS Soil Maps	VRT
Corn	48%	25%	19%	19%
Soybean	51%	21%	16%	26%

When results were assessed based on acres farmed, implementation level increased with farm size. On corn farms over 3,800 acres, GPS mapping systems had an 84 percent adoption rate, followed by guidance systems (80 percent), and VRT (40 percent) (Schminelpfennig, 2016). However, the rate of adoption of each practice as farm size increased was different. The use of GPS mapping increased the most between the farm sizes of under 600 acres to between 600 and 1,000 acres, 22 percent

(Schminelpfennig, 2016). Guidance system adoption increased the most between the acreage range of 1,300 to 1,700 acres and 1,700 to 2,200 acres, 20 percent (Schminelpfennig, 2016). While the use of VRT did not see the largest increase in adoption until the highest acreage ranges, 2,900 to 3,800 acres to over 3,800-acre farms, when it increased to 40 percent (Schminelpfennig, 2016). These adoption trends reflect the impact of expense and availability of precision ag technologies to smaller farms. For example, the adoption VRT for nutrient application requires the purchase of specialized equipment by the producer or an extra charge from an applicator and the time to compile and interpret the data collected.

The USDA survey information was also used to calculate precision ag technology impacts on the farms' total net return. Overall, implementing a precision technology increased net returns on U.S. corn farms participating in the 2010 USDA survey (Schminelpfennig, 2016). The highest increase was for GPS mapping (1.8 percent), followed by guidance systems (1.5 percent), then VRT (1.1 percent). Additionally, the 4R practice of using soil testing to determine nutrient deficiencies had a positive effect on adoption across the three precision ag technologies (Schminelpfennig, 2016). Adopting 4R practices can be profitable for a farm. Encouraging farms to use simple practices like soil testing at a field level, can increase the likelihood of that farm continuing to adopt advanced practices.

Similar levels of practice adoption were reported in a Kansas Farm Management Association member survey, with only 26 percent adopting VRT, and 40 percent adopting GPS yield monitors (Griffin et al., 2016). The survey also assesses use of grid soil sampling and found 42 percent of farms had adopted the practice. Less than 4 percent of the farms reported abandoning these precision ag technologies after adopting them (Griffin et al., 2016). By collecting data from the same farms in multiple years, this survey could also evaluate the probability of additional practice adoption based on those previously adopted by the farm. Farms that reported using VRT had a 92 percent likelihood of adopting precision soil sampling (Griffin et al., 2016). Precision soil sampling is a major component of a VRT program. And, farms reporting use of variable rate seeding and GPS yield monitors had a 75 and 69 percent likelihood of also adopting precision soil sampling (Griffin et al., 2016). Indicating again that as a farm increases management precision in one area they are more likely to continue to improve precision in others.

Service Availability

In some cases, the ability of farms to adopt precision 4R practices is dependent on the rate of service and equipment adoption by agricultural retailers. Purdue University administers a survey every other year on the precision consulting and application services offered by agricultural dealers. From 2011 to 2017 the rate of adoption of soil sampling with GPS, field mapping with GPS, yield monitor data analysis, and soil electrical conductivity mapping has increased (Erickson and Lowenber-Deboer, 2017). Soil sampling with GPS consistently has the highest adoption rate relative to other dealer precision services. In 2017, 78 percent of dealers reported offering soil sampling with GPS, followed by field mapping with GPS at 75 percent (Erickson and Lowenber-Deboer, 2017).

As determined in the two farmer surveys, increased adoption of VRT and GPS based soil sampling are linked. Between 2011 and 2017 retailer provided VRT fertilizer services increased from 54 to 78 percent (Erickson and Lowenber-Deboer, 2017).

To gain understanding of 4R practice use, TFI surveyed retail consultants previously recognized as a 4R Advocate (http://www.nutrientstewardship.com/advocates/). Grid or zone soil sampling and analysis was the most used practice when making a recommendation to a producer. Post-harvest yield

monitoring and end of season nutrient use efficiency assessment were also recognized as key tools for making nutrient recommendations.

Return on Investment

Dealers and farmers are both concerned with practice profitability when selecting and implementing the discussed technologies and services. As reported in the ERS research, there is a positive effect of adopting precision ag technologies on the net return to the farm for GPS mapping systems, guidance systems, and VRT. Similarly, the dealers surveyed by Purdue University reported VRT fertilizer application, VRT fertilizer and lime prescriptions, and grid or zone soil sampling services as being profitable for the dealer (Erickson and Lowenber-Deboer, 2017). The 4R Advocates surveyed also reported these practices as being profitable for their firms.

Conclusions

Precision ag practices like GPS mapping, grid or zone soil sampling, yield monitors, and VRT applications are recognized as 4R practices that can improve nutrient use and reduce environmental risk. These recent producer and agricultural dealer surveys also indicate these practices have a positive impact on farm and dealer profitability. There is significant room to expand the use and availability of these practices on farms and by dealers, with less than 30 percent of farms using VRT and 78 percent of dealers offering VRT fertilizer services and application.

References

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