Farmer perspectives of precision agriculture in Western Australia: issues and the way forward

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Abstract

Many farmers in the Western Australian (WA) wheatbelt have successfully adopted guidance and yield mapping technologies. However they have so far not adopted in a wide scale the variable rate technology (VRT). While agronomists and farmers believe they can identify poor performing parts of a paddock, they have less confidence in managing the spatial variability. Although WA farmers understand the need to adopt these techniques they have encountered problems with a lack of compatibility between hardware and software, complexity of software packages, and poor technical support. A paper based questionnaire was circulated to growers in the WA. The survey, along with case studies, first hand incidence of farmers, consultants and hardware suppliers add to the understanding of the problems faced by farmers in establishing a PA system based around VRT. From this survey, the reasons behind slow or non-adoption of PA were a frustration with the technology and a lack of support for the technology. The cost of the technology was of minor importance and not the overriding factor, as some studies suggest. Despite these limitations, the farming community strongly endorse the adoption of precision agriculture technology to manage variability within paddocks. This implies they are comfortable making the appropriate agronomic decisions given the data and will move forward when they get the systems up and running. This paper reports on WA farmers' perception of precision agriculture, variable rate technology and the causes of slow or stalled adoption. We also propose of a way forward for farmers and the grains industry as a whole.

Key words

PA, variability, VRT, technology

Introduction

The concept of precision agriculture, where inputs to grow crops in fields may be varied in a spatially explicit manner has been around for at least 15 years. In that time, guidance technology has been widely adopted. In contrast, precision agriculture technologies that require a farmer or consultant to construct, recommend, and then implement the variable application of inputs across a field (variable rate technology or VRT) have not been taken up at the same rate. The economic merit of these technologies has been demonstrated (Robertson *et al*, 2008), thus the basis behind the apparent lack of adoption needed to be explored in more detail. PA is still an emerging technology. As such, early reports into its adoption (Watson 2004), are now likely to be out of date, in part becasue the technology has advanced and there may be an increase in awareness of the benefits by growers. This survey was conducted in WA because it has a higher than average rate of PA adoption based on a national survey (Robertson *et al*, in review) and farmer based growers group have previously investigated the rate of change in PA adoption. To that end we conducted a survey of growers in the WA wheatbelt to firstly identify the current rate of uptake of PA technology and secondly determine what, if any factors may be limiting the rate of uptake in the technology. This paper reports on WA farmers' perception of precision agriculture, variable rate technology and the causes of slow or stalled adoption. We also propose of a way forward for farmers and the grains industry to maximise benefits as a whole in the area of training and extension in PA.

Method

A paper based questionnaire was circulated to growers in the WA Northern agricultural region through the Liebe group (a large community-based farmer group in Buntine, www.liebe.asn.au), in the central wheatbelt and in the South with the South East Premium Wheat Growers Association (SEPWA based in Esperance). The 102 responses were voluntary, but were drawn from active participants in these regions or grower groups. Case studies of two farmers from each of the three regions were developed to document their progression in PA and their comments and feedback is included. The results of the responses to the questionnaire are summarized in the following tables. Values are averages of respondents answering “YES” to the questions.

Results and Discussion

Famers were aware that crop yields within their paddocks and across their farms varied. In general, farmers managed paddocks on the farm differently. Thus variability is already managed at the paddock level. The 1 t/ha was chosen to indicate to farmers the magnitude of variability necessary for an economic benefits from VRT. However the vast majority of farmers are interested in varying inputs within a paddock under the belief that this will increase their profitability (Table 1). More than 80% of farmers are varying inputs between paddocks and one-half to two-thirds say they vary inputs within paddocks. This is a higher rate of use than that for variable rate technology in the previous surveys (Robertson *et al*, in review) and suggests that many farmers are varying inputs within paddocks by spot spraying, or manually changing fertilizer rates based on their own knowledge of the variability but are not using the automated VRT controller systems. It does indicate a willingness of farmers to think in terms of in paddock variability and a desire for a usable VRT system.

Table 1. Does variability exist on your farm and what does it mean to you?

	South (45)	North (28)	Central (29)	Average
Does yield vary in ANY paddock by more than 1 t/ha?	84%	89%	88%	87%
Are low yielding parts of farm reducing profitability?	84%	96%	100%	92%
Do you vary inputs between paddocks for the same crop?	78%	100%	88%	87%
Do you vary inputs to different parts of a paddock?	44%	75%	63%	58%
Could varying inputs (within the paddock) make your cropping program more profitable?	100%	100%	100%	100%
If so how?				
by variation on general farm areas	20%	36%	25%	26%
by variation on individual paddocks	38%	29%	25%	32%
by variation of inputs within a paddock	64%	75%	100%	77%

Most farmers believe they know if and where they have a yield limiting problem simply by observation (Table 2). One grower indicated that he could see this variability most when spraying and that he felt confident in drawing “mud maps” of yield variation in his paddocks. Soil testing is a widely accepted technique to assist in understanding yield limiting problems. With VRT, soil sampling must be on a zone bases as opposed to the averages a series of cores within a paddock. Yield monitoring is being carried out by many farmers, but most are not converting these to yield maps. Although it is possible that some value from yield monitoring is being extracted through ‘live’ observation of the monitor at harvest time, the result is most likely to reflect that many yield monitors are acquired by farmers independent of any motivation to adopt PA (e.g. via new harvester purchase). Farmer observations and yield maps should be used together to develop a soil sampling protocol to test the zones within paddocks. The combination of years of observation, yield maps and strategic soil sampling with or without agronomist input are all part of developing a targeted VRT program. Agronomists and remote data layers (NDVI and EM) were not seen as helpful in determining where yield limitation occurred but were brought into play in determining why their yield varied.

Table 2. How did you know you had a yield limiting problem?

	South (45)	North (28)		Central (29)	Average
Farmers observation	64%	57%	88%	69%	
Soil test	31%	93%	62%	57%	
Yield maps	29%	36%	25%	30%	
Agronomists	11%	14%	13%	12%	
NDVI images	11%	11%	0%	8%	

Developing VRT zones within a paddock depends on the knowledge of the level and cause of the variability. Differences in the ability of soils to hold water (Plant Available Water Capacity - PAWC) account for much of the yield variability in WA agriculture (Lawes *et al,* 2009). Changes in soil types within a paddock can be observed by farmers, backed up by yield maps, soil testing and surveys. All of these data are used to develop zones within a paddock and can be used to produce prescription maps. There is no one “right data layer”, but farmer’s knowledge, yield maps and soil data was the key data used to determine the input rates and boundaries between zones (Table 3).

Table 3. How did you work out where to put the different rates? (Between paddocks or within a paddock)

	South (45)	North (28)	Central (29)	Average
Farmers knowledge	33%	33%	58%	40%
Yield maps	27%	27%	20%	25%

Soil surveys	13%	13%	33%	19%
EM surveys	18%	18%	-	13%
Agronomists	4%	4%	20%	9%
NDVI imagery	4%	4%	-	3%

Table 4 summarizes the problems growers identified as to what is holding them back in further adoption of PA. The major impediments to the adoption of precision agriculture are the problems of hardware interactions and complexity of the software. In our case studies we have numerous stories of lack of support for new equipment, lack of understanding from machine dealerships on the capabilities of systems and a general attitude of “we sell the machines, it is up to you to make them work”. There are always exceptions to this. In regions with high PA competency and support from dealership there is increased adoption. Software is poorly designed for the computer literacy of the average user. Lack of ongoing use of the software results in “relearning” the process each year and constant updates and changes result in farmer frustration. Hardware incompatibility was to be addressed by the implementation of the ISO 11783 Canbus (a system of standardized hardware connections and data transfer protocols) but it has fallen short in practice.

Data interpretation and complexity problems are in part a lack of confidence on the farmer’s part and poorly presented data. If yield data is presented in complex blended patterns at very high resolution, it is difficult to deal with the amount of “variability noise”. The scale at which data is collected should be extended to the image resolution i.e. header width or seeder bar width should be a standard. When data is presented in an appropriate scale it is often easy to interpret.

Earlier surveys have reported cost as a major impediment to uptake. Early systems required retrofitting and were expensive, but current systems have become standard features on new equipment. The used equipment market will in time benefit from the inclusion of standard PA gear. Lack of time to process and develop VRT maps were also seen as minor impediments to uptake of VRT systems. Only 4% of those surveyed were not convinced that the system would not be beneficial and make their farm more profitable. This is promising in that there is a belief in the process. That either a simplification of the systems (unlikely) or an education of farmers and agronomists of how to work with and understand the systems will result in accelerated uptake of VRT systems.

Table 4. Problems for Growers (What is holding them back in adopting PA?)

	South (45)	North (28)	Central (29)	Average
Software & machine interaction	38%	27%	50%	38%
Data interpretation & complexity	33%	39%	26%	33%
Cost	13%	7%	13%	11%
Time	4%	9%	13%	8%

Not yet convinced	4%	9%	-	4%
Inexperienced seasonal workers	-	4%	-	1%
Reliability	-	4%	-	1%

Conclusion

The farming community strongly endorse the adoption of precision agriculture technology to manage variability within paddocks. Nevertheless they have become frustrated with the technology and the support for that technology and this has impeded uptake more than any other factor. This implies they are comfortable making the appropriate agronomic decisions given the data and will move forward when they get the systems up and running. Education at all levels in the industry is required to move PA adoption forward. Consultants and agronomists need to be up-skilled so they can help farmers. At a practical level farmers need to gain the confidence in how to deal with variability & work in partnership with PA specialists. Machinery companies require a greater understanding of their role in PA technologies and how PA is being used will also be an important component of the approach. Unless all levels are up-skilled adoption of VRT will remain low and the industry will not benefit from the potential gains.

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