Managing variability of landformed fields

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- Two thirds of rice farmers surveyed in the 2009–10 rice season were using precision agriculture techniques to manage variability within their fields.
- Precision agriculture techniques used include cut and fill maps, GPS, variable rate technology, yield mapping, EM maps and aerial NDVI images for NIR sampling.
- The most popular treatments used to restore cut areas in rice fields were extra nitrogen, extra phosphorus and stubble retention.

Precision agriculture techniques such as cut and fill maps, variable rate technology and aerial NDVI images for NIR sampling, are being used by 67% of rice growers. The techniques are seen as very important for managing field variability, especially that due to landforming.

Survey data collected in the 2009–10 rice season demonstrated adoption by rice farmers of precision agriculture and the techniques they use to manage variability in their fields. Precision agriculture is an important management tool that can decrease yield variability within individual fields and therefore improve overall crop performance.

A survey was conducted to ascertain:

- how many farmers use precision agriculture techniques
- what techniques they use
- when they last landformed and the classes of cuts and fills they used
- whether or not they chose to topsoil and whether or not it would be an option in the future
- what treatments they used to restore cut areas in rice fields
- whether or not the relative condition of the treated soil improved.

To determine farmer responses to precision agriculture the district agronomists of the Murray and Murrumbidgee valleys conducted a survey at Rice Discussion Group meetings.

Specific questions were asked to determine how widespread precision agriculture adoption was and the techniques used by farmers. One hundred farmers across both valleys responded to the survey and the data obtained is presented here.

This survey complements the RIRDC research project *Understanding, Quantifying and Managing Spatial Variability of Rice Growth and Yield* being conducted by Yanco researchers Geoff Beecher, Brian Dunn and Tina Dunn.

Use of precision agriculture

The purpose of precision agriculture is to improve crop performance and quality through the application of technologies and agronomic principles using localised management within a field. With this in mind farmers from the Murray and Murrumbidgee valleys were asked if they use precision agriculture. Of the 100 farmers surveyed 67% used some form of precision agriculture, whilst 33% did not.

How is precision ag used?

Farmers who answered 'yes' they do use precision agriculture, were then asked what form of precision agriculture was used (Table 1).

Cut and fill maps are one of the most important resources for farmers to determine field variability and the high adoption rate of this information was very encouraging.

Cut and fill maps, variable rate technology (VRT) and aerial NDVI images for NIR sampling are used in conjunction with one another to determine the zones for panicle initiation (PI) sampling and targeted PI nitrogen applications. The use of aerial NDVI images for NIR sampling should increase in the future with more timely access to images before tissue testing.

Table 1. Precision agriculture technologies used by rice growers

Precision agriculture technology	Usage (%)
Cut and fill maps	73
Global positioning system (GPS)	64
Variable rate technology (VRT)	46
Yield mapping	39
EM maps	30
Aerial NDVI images for NIR sampling	28

Note: The total of percentages equal more than 100 because some farmers used more than one technology

Table 2. Main reasons for rice growers not adopting precision agriculture techniques

Reason for non adoption	Percentage of farmers (%)
Cost	30
Small enterprise	12
Lack of water/drought	9
Time constraints	9
Unsuitable equipment	6
Use contractors/no access	6
Good soil/no perceived problem	6

Table 3. Classes of cut and fills when landforming

Class of cut and fill	Percentage of farmers (%)
> 30 cm cut	21
10–30 cm cut	39
10 cm cut to 10 cm fill	51
10–30 cm fill	25
> 30 cm fill	13
Other	6

Note: The percentages equal more than 100 because some farmers had different cut and fills on different fields

Table 4. The treatments for cuts in rice fields used to try and restore the soil health to normal topsoil condition

Treatment	Percentage of farmers using treatment (%)
Extra nitrogen/pasture/forage crop	69
Stubble retention	56
Extra phosphorus	55
1–3 tonnes of gypsum	33
Minimum tillage	31
Chook litter	22
Same treatment as rest of field	21
Extra seed	18
Feedlot/cow manure	15

Note: The percentages equal more than 100 because some farmers used more than one treatment

Table 5. The relative condition of treated soil in comparison to normal topsoil

Relative condition of treated soil	Percentage of farmers (%)
100%	5
80-99%	29
60-79%	42
40-59%	10
20-39%	1
<20%	0

Note: The percentage does not equal 100% because 7% of farmers gave several answers and 6% gave no answer

Why some don't use precision ag

Farmers who answered 'no' they don't use precision agriculture, were asked why they didn't (Table 2).

Cost remains the biggest barrier to adoption which is understandable given the recent long-term drought and the lack of cash flow experienced by many farmers.

There are many on-farm examples of benefits to overall crop production and increased returns from precision agriculture techniques. It may be useful to showcase some of these examples to educate all farmers about the benefits of precision agriculture.

Landforming

Landforming is carried out to create a uniform soil surface for ease of irrigation, and in conjunction with site-specific management can lead to increases in crop uniformity and yield. However, it can leave subsoil exposed in cut areas, unless the field is topsoiled.

Farmers were asked how long it was since they had landformed and if they had landformed, whether or not they topsoiled. An enquiry about future landforming and topsoiling was also made.

Of the farmers surveyed:

- 81% landformed individual fields within the last 10 years
- 34% landformed individual fields more than 11 years ago.

Of those that had landformed:

- 40% chose to topsoil
- 53% chose not to topsoil
- 7% topsoiled some landformed fields and not others.

With any future landforming, 77% of farmers would consider topsoiling as an option to help manage the soils in individual fields. This intent is substantially higher than the actual level of topsoiling recorded in the survey (40%).

Farmers are well aware of the effect of landforming without topsoiling, where 'cut' areas often are still evident after 20 years, resulting in variable crop performance. Having observed this, farmers are very keen to maximise the performance of individual fields by adopting topsoiling. However, the additional cost of topsoiling may still hinder adoption even though productivity returns to normal levels more quickly.

Extent of cut & fill

'Within field' variability is increased due to soil differences between the landformed cut and fill areas. Therefore cut and fill maps are an important resource to help farmers to deal with this source of variability. The survey identified the classes of cut and fills that had resulted from landforming operations (Table 3).

The majority of fields had less severe cuts and fills to 10 cm but there were a significant number of fields with heavy cuts and fills.

It is recommended that fields should be separated into zones according to the cut and fill maps and managed based on these zones.

Different cut and fill classes can also be present within the one field and these classes need to be managed selectively to improve overall crop production.

Expensive machinery is not needed for basic precision agriculture, often applying twice to the cut area with what you applied to the rest of the field is a good start.

Restoring soil health

Farmers were asked to identify the treatments used to try and restore the soil health to normal topsoil condition (Table 4).

There was good adoption of extra nitrogen/pasture/forage crops to cut areas to improve crop biomass and grain yield. However, a third of farmers still did not use this treatment.

Applying extra phosphorus to cut areas is a recommended strategy to improve biomass and grain yield but only 55% of farmers are adopting this approach.

Applying nitrogen and phosphorus in combination to cut areas improves soil nutrient levels and decreases crop variability. The Yanco spatial variability research project has found both nitrogen and phosphorus need to be applied together to cut areas, and at significant rates, to match the yield of non-cut areas. The information in the survey was unable to determine if farmers were using this combination, so that will be an issue for future surveys.

Just over half of the farmers surveyed used stubble retention as a way to restore soil health to their cut areas. Stubble retention is known to improve soil structure and add organic matter to the soil profile.

It is interesting to note that 21% of farmers treated their cut areas the same as the rest of the field and had not considered the different soil properties of cut and fill areas. These farmers would find improvements in crop uniformity by applying precision agriculture techniques to individual fields to improve soil health.

Condition of treated soil

Finally, farmers were asked if the relative condition of treated soil was comparable to the normal topsoil (Table 5).

Three quarters of farmers had considerable improvement in the condition of their treated soil. This indicates that the treatments applied to cut areas were successful in restoring those areas for crop performance.

There are still some farmers who need to improve the health of their soil which could be accomplished by implementing other treatments to their soil.

Wide adoption of precision ag

Precision agriculture techniques are being widely adopted by many farmers in the Murrumbidgee and Murray valleys. However, one third of farmers still do not manage their fields using precision agriculture. The biggest limiting factor is cost, which is understandable due to the recent long-term drought.

Cut and fill maps is the most popular technique used by farmers to manage their fields. This is very promising because these maps can be used to separate fields into zones for specific management purposes based on the cut and fill areas and can complement EM zones.

Over half of the farmers apply either nitrogen or phosphorus to cut areas to improve soil conditions and increase overall crop performance and reduce variability within their fields, however some farmers are still treating their cuts and fills the same as uncut parts of the field.

Follow-up surveys will be conducted throughout the Murrumbidgee and Murray valleys in the future to gauge the progress by farmers of adoption of precision agriculture and management techniques used to manage variability within their fields.

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'Within field' variability is increased due to soil differences between cut and fill areas in the years following landforming. Cut and fill maps are an important resource in helping farmers to deal with this source of variability, as are other precision agriculture techniques such as variable rate technology, and aerial NDVI images for NIR sampling. Photo: Brian Dunn.