ZONING

FACT SHEET

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

SOUTHERN REGION
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Using production zones to develop a soil testing strategy

All paddocks have varying areas of production which can change between years depending on season and crop type.

KEY POINTS

- All paddocks have varying areas of production. By understanding the variability, different zones can be treated to maximise yields and profit
- Soil testing in different production zones can help identify the causes of variable crop performance within a paddock and whether variable management may be required
- Zoning occurs when paddocks or farming land are split into sections depending on soil type, EM38 readings, biomass, grain yield or other performance measures such as grain quality
- If detailed data is not available, the grower's knowledge of soil types and historical production can be used to develop rough zones
- Using a combination of data sets to generate a zone map can identify areas of consistent high yield potential, and other areas of a paddock which are suffering from soil or other constraints
- The number of zones developed within each paddock depends on the grower's goals
- Management practices can be adjusted depending on the soil test results from the various zones to help improve crop performance
- A simple fertiliser replacement program based on nutrients removed in the crop yield within each zone may not be the best strategy

Photo: AgCommunicators

Zoning is completed by collecting raw data which is then processed to create zone maps depending on variables of interest.

Understanding variation and identifying production zones within paddocks will help inform and develop an effective soil testing strategy. A targeted soil testing program will help understand the causes of the crop variability and management options.

What is zoning?

Traditionally, paddocks were treated as an average unit of land, typically using uniform practices and blanket rates of inputs. However, soil types, elevation and crop performance can vary enormously across a paddock, especially if the paddock is large.

Zoning involves splitting areas of a paddock into sections depending on soil type, yield or other performance factors.

By understanding the variation across a paddock, growers can assess whether different parts should be managed differently, e.g. with different rates of fertiliser.

While most growers understand the different soils within a paddock and have a good sense of high and low yielding

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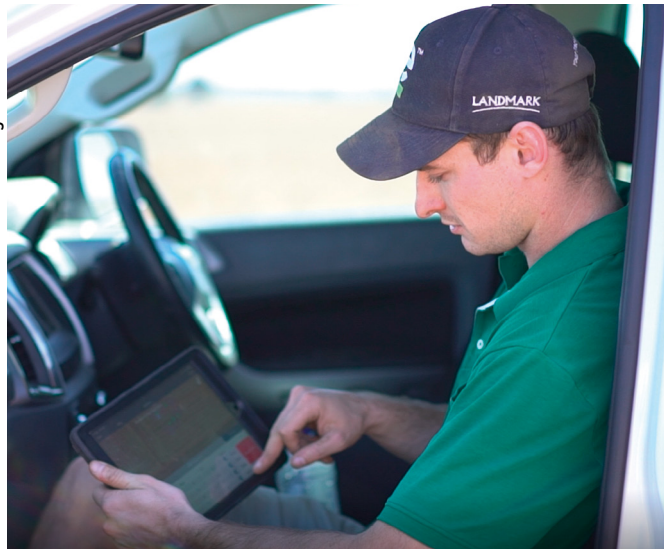
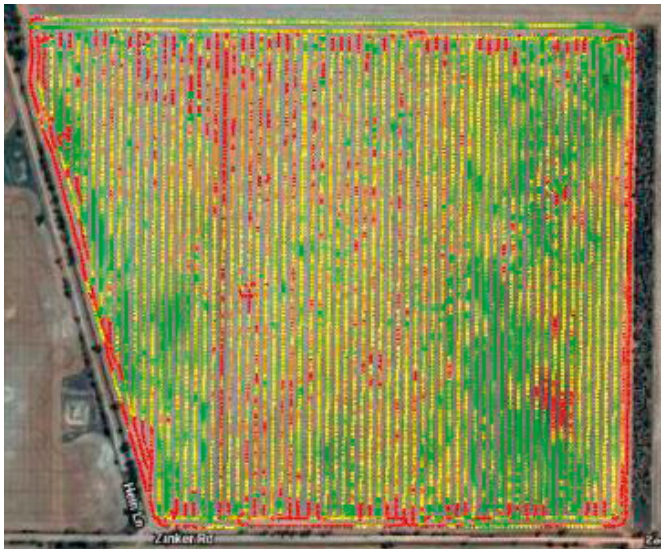
Photo: AgCommunicators



Zoning is completed by collecting raw data which is then processed to create zone maps depending on variables of interest.

Photo: Nutrien Ag Solutions



An example of a yield map.

parts of their paddocks, zoning provides a more scientific approach to identifying and managing areas which might perform differently.

Zoning may be based on a soil characterisation (e.g. soil analysis or EM38 map), or measures of crop performance (e.g. biomass, normalised difference vegetation index (NDVI), or yield maps) or a combination these.

Once the zones have been determined, further testing such as soil and plant testing can be completed to understand why the zones are performing differently and what changes in management practice may be required to improve overall yield and profit.

As nutrient levels are often highly variable within paddocks, investing in zoning technology and other testing options such as soil analysis pays off in the long term.

Why zone paddocks?

Growers who have watched a yield monitor on a harvester know that all paddocks have varying areas of production.

It is important to understand the variability within paddocks and to learn how to treat them accordingly to maximise yield and profit.

Soil testing to depth in different production zones can help identify the causes of variable crop growth and performance.

When deciding where to sample within a paddock, it is advised to target different production zones to ultimately achieve a better paddock overview and a targeted fertiliser application strategy.

Zoning paddocks for high, intermediate and low production enables variable rate application of inputs, rather than a blanket rate across the entire paddock. This can lead to cost savings by placing inputs where they are needed most.

What data sets should be used?

The data set used for zoning depends on the goals that the grower is trying to achieve.

For example, if a grower is mainly interested in increasing yield in poor parts of a paddock, then using historical yield maps will be very useful when dividing areas of the paddock into different zones.

Often using a combination of data sets will provide the best outline of soil constraints and productivity issues, as one single layer of data may not define the issues and the treatment.

Harvester yield data

- Can identify zones of variable production but will not identify factors which are constraining yield without additional knowledge and/or data
- If protein maps are available, the data can be used to determine nitrogen removal maps
- Highly accurate, relatively low cost
- By analysing multiple years of yield data, crop response in different seasons can be explored

Electromagnetic induction (EM-38 dual dipole)

- Can provide a rapid measure of soil electrical conductivity
- Can be related to soil salinity, texture, soil moisture and water holding capacity at depth
- Soil tests in each paddock are essential to calibrate the EM38 data to specific soil properties

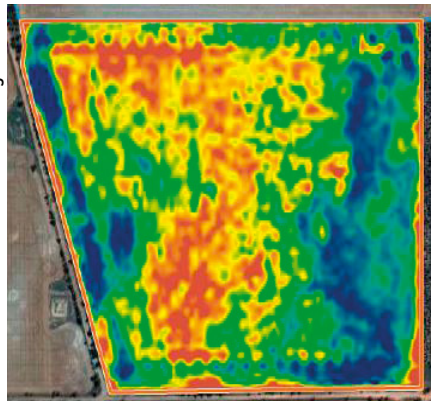
Gamma radiometrics

- Used in combination with EM-38 to identify sand and gravelly soils

In-crop NDVI

- Provides an assessment of canopy density, biomass and plant vigour
- Will not define the underlying factor promoting or limiting plant growth
- Indicates where to investigate further and helps define boundaries

Photo: Nutrien Ag Solutions



An example of an NDVI map.

- Can be taken from a satellite every five to eight days or using drone technology
- Medium accuracy and low cost – a number of commercial companies can provide these maps for multiple years
- High NDVI (biomass) and low grain yield can indicate frost or other issues
- By analysing multiple years of NDVI, crop response in different seasons can be explored

Elevation

- Topography influences the rate of water run-off, soil erosion, and temperatures and can affect soil variability and crop growth
- RTK GPS elevation (collected with most yield maps) is an affordable option and can be used for land forming, erosion control and to determine areas of paddocks which might be more susceptible to frost and waterlogging

Bare soil images

- Aerial imagery of the bare soil (i.e. colour) and vegetation is cheap
- Very basic and depending on the contrast of soil type or the timing of vegetation capture this imagery may not provide enough detail for production zoning

The raw data collected needs to be converted, integrated and processed into maps to be able to help determine production zones.

There are many tools available to complete this, depending on the software available and most familiar to the grower or adviser. Some options include SST Summit or Sirrus, PCT, Trimble Farm Works, AgLeader SMS, Agrian and Google Earth. Several commercial companies offer paddock zoning and variable rate mapping services.

How can the data collected be used?

To fully understand the variability within a paddock, crop data should be collected over several years.

The number of zones within each paddock depends on the size of the paddock, the goals that the grower wants to achieve, along with their variable rate seeding capability. Generally, selecting two or three production zones per paddock is effective, however, it does not have to be restricted to this.

If the paddock is small and the variability is low, the paddock may be treated as one zone. Alternatively, the paddock might be highly variable and the zones might behave differently in different seasons, in which case four or five zones may be required.

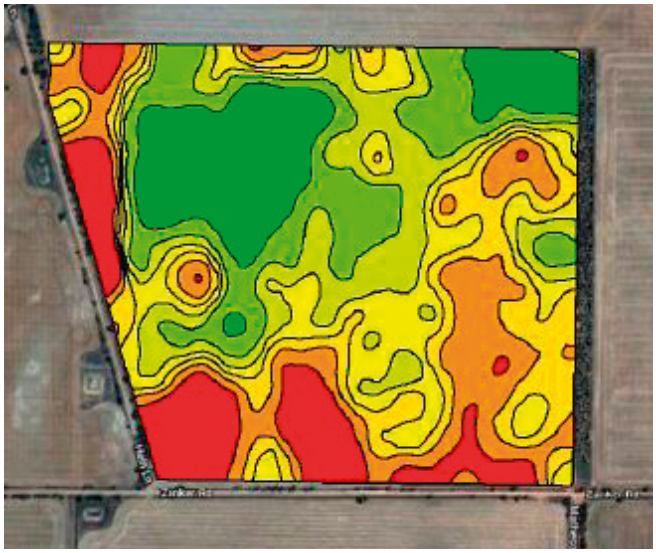
In the GRDC's 'Soil and Plant Testing for Profitable Fertiliser Use' project, producers identified two one-hectare areas representative of each production zone using the data sources available.

Coordinates for each corner of the test areas were recorded for future reference when completing in-season plant and deep N testing during the year.

Once the production zones and test areas within a paddock were determined, soil testing was completed to help identify the cause of this variability. It is particularly important to understand low-yielding zones as they may be restricted by soil constraints (e.g. acidity or compaction) rather than poor nutrition. These constraints can change the proposed fertiliser program and may point to the need for soil amelioration.

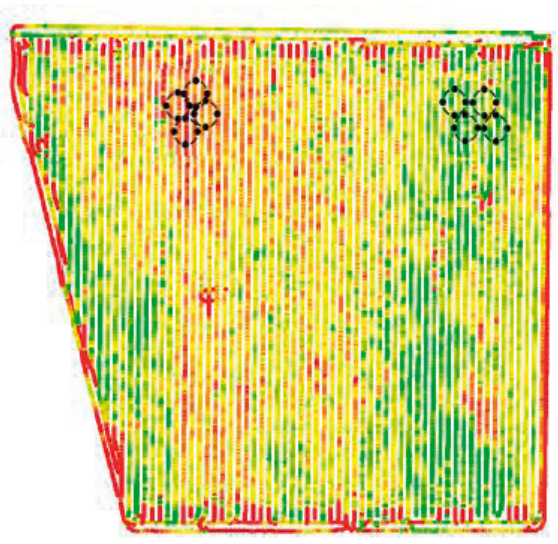
Where soil constraints were not a major issue, fertiliser practices were adjusted to improve crop performance. Mid-season monitoring of crops using plant and deep N soil testing determined the need for in-season fertiliser application.

Photo: Nutrien Ag Solutions



An example of a soil surveying map.

Photo: Nutrien Ag Solutions



Using mapping data, production zones throughout the paddock can be determined. High production = green, mid production = yellow, low production = red.

Variable rate management

Once the zones have been determined within a paddock and the causes of the variability are understood, growers and their agronomists need to determine whether variable rate management might improve profit. This might be achieved by increasing production (e.g. enhanced management on the poor zones) or by reducing costs (e.g. reducing inputs in poor zones that cannot be improved), or through a combination of both.

Soil amelioration (e.g. deep ripping and applications of lime or gypsum) can be costly, but can boost the crop's access to water and nutrients significantly, and thereby provide increases in production. It makes sense to target soil amelioration to the zones in the paddock where the soil constraints exist, and avoid zones where amelioration is not necessary and might actually be detrimental to production.

Where soils do not suffer from serious constraints, nutrients are one of the most costly crop inputs that drive production. Most growers target variable fertiliser applications first, especially nitrogen, which can be easily varied with post-emergent applications using a spreader.

Variable fertiliser application strategies are highly site specific and depend on the soil tests results and seasonal outlook. Growers often start by applying the same amount of fertiliser to the paddock as a whole, but reducing inputs where production potential is low (especially if the soil nutrient levels have accumulated over time), and redistributing this fertiliser to the more productive zones. Consult your agronomist for specific variable rate advice.

USEFUL RESOURCES & REFERENCES

GRDC, Ground Cover, Yield Mapping: Nice maps, how can I use them?
www.grdc.com.au/resources-and-publications/groundcover/ground-cover-issue-26/yield-mapping-nice-maps-how-can-i-use-them

GRDC, Ground Cover, Looking into your soil from on high and on low
www.grdc.com.au/resources-and-publications/groundcover/ground-cover-issue-51/looking-into-your-soil-from-on-high-and-on-low

GRDC, A 'how to' for getting soil water from your EM38 field measurements
www.grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2013/03/a-how-to-for-getting-soil-water-from-your-em38-field-measurements

GRDC, Applying PA: A reference guide for the modern practitioner
https://grdc.com.au/__data/assets/pdf_file/0027/39852/applyingpa-pdf.pdf.pdf

GRDC Tackling Soil Amelioration for Variable Soil Types handbook
https://grdc.com.au/tackling-amelioration-on-variable-soil-types/

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SOIL AND PLANT TESTING STRATEGY