

Variable Rate Treatments

Getting Started

Precision farming applications are being adopted by producers to varying degrees within western Canada. The adoption of automated guidance has been the most widespread activity at this time. Sectional control of seeding systems and sprayers to prevent overlap is starting to be adopted with development of new equipment.

The practice of variable rate treatments has been around for some time with limited adoption in western Canada. Variable rate treatments (VRT) can apply to fertilizer, seed or pesticides with variable rate nitrogen fertilization being the most common at this time.

There is still some question regarding economics of VRT that has slowed adoption to some degree.

For producers considering variable rate applications there are a number of factors that producers should consider prior to starting.

The first step is to clearly define what you are hoping to achieve with variable rate treatment. There are a number of ways that producers may proceed with this practice that include:

- Increasing yields through variable rate fertilizer applications (note: this may also increase fertilizer costs).
- Increasing profit by reallocating of same fertilizer amounts to more productive portions of the field (this increases revenues without increasing costs).
- Increasing yield and revenues by focusing on increasing yields in less productive portions of the field.
- Reducing fertilizer costs through variable rate fertilizer treatments.
- Increasing the quality of production through variable rate applications.
- Evening out maturity or reducing lodging (this may require varying fertilizer and seeding rates).
- Reducing pesticide costs on practices such as fungicides for disease control.

Producers considering variable rate treatments should start by identifying one or two fields that have significant variability.

Reasons for Variability within a Field

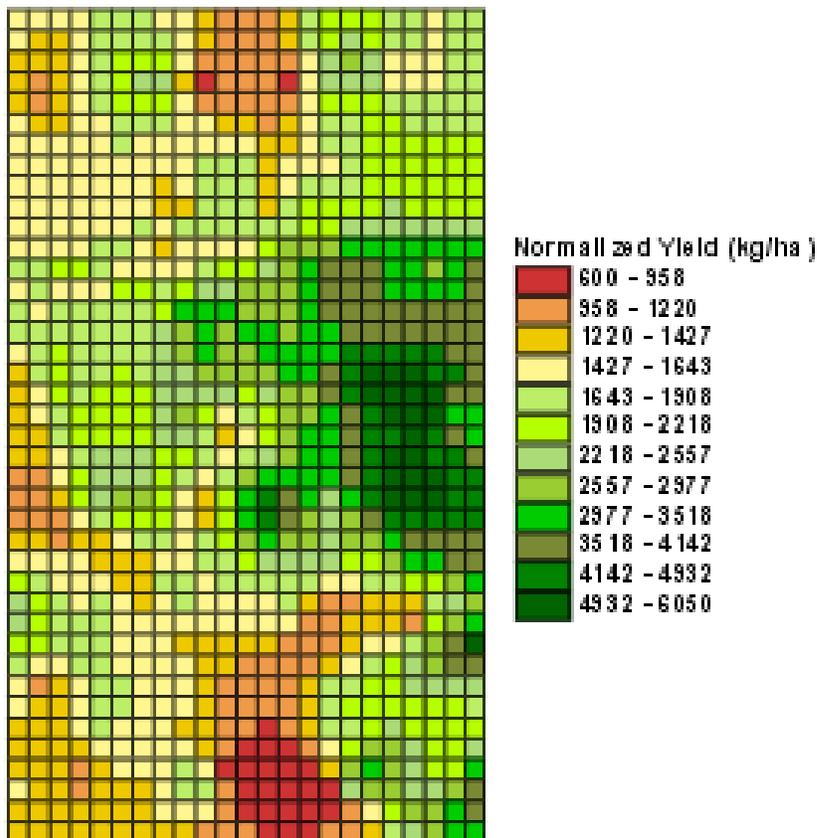
Variability in a field can be due to a number of factors such as soil texture, soil organic matter, soil structure, soil pH, topography, salinity, and water infiltration or accumulation. Three factors that are commonly encountered in western Canadian fields are the ability to supply nitrogen (related to soil organic matter), soil texture and soil water accumulation (related to topography).

Tools for Measuring Variability

A wide variety of tools can be used to document the variability that currently exists within a given field. These tools include:

Harvest yield maps

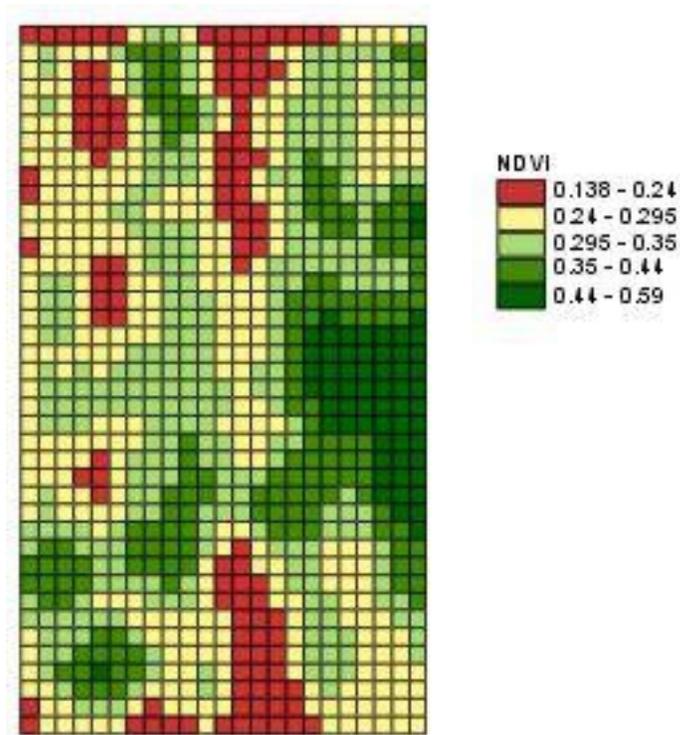
Harvest yield maps are generated by producers or custom harvesters with GPS and yields monitoring capability in their combines. Data cleaning is normally required to remove outliers to get a clear picture. A yield map provides a report of past productivity, but may not provide information on reasons for variability.



Source: B. McConkey et al

Aerial or Satellite Imagery

Satellite imagery can help identify the productive and non-productive areas of a field. The satellite technology can measure and monitor plant growth, vegetative cover and healthy production to create a Normalized Difference Vegetation Index (NDVI). The higher the NDVI value is, the greater the relative biomass production. Archived images from past years can confirm areas of consistently high or low productivity.



Source: B. McConkey et al

Detailed topography maps

Topography maps assist in identifying changes in elevation that may impact other plant growth attributes such as soil organic matter content, water holding capacities and water movement within a field.

Soil maps

Soil maps provide information on soil characteristics such as texture and underlying soil structure issues, such as solonchic soils, that may impact crop productivity.

Soil test results

Soil tests are often carried out as a method to further document reasons for changes in productivity. Characteristics such as soil organic matter, pH, salinity levels and texture, as well as nutrient levels may all be defined in these results.

Electrical conductivity maps (Veris)

Electrical conductivity maps can show variation in a number of soil characteristics including texture and soluble salts.

Producer knowledge

Identify areas of differing productivity that may be due to past management practices, lodging, insect infestations, soil erosion, manure practices, yard sites, weeds or diseases.

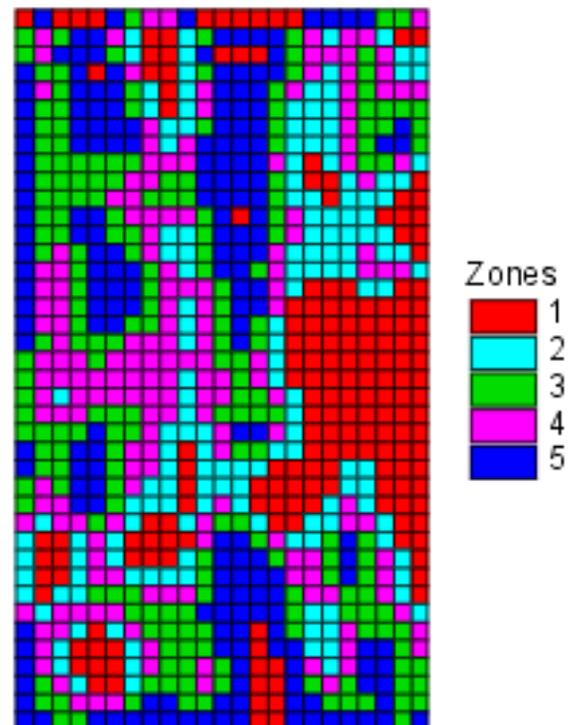
Each of these tools provides useful information. The key is to understand what each provides and how to integrate the information from each into a useful management plan. The best approach is to use a combination of at least a couple of these tools in developing a management plan for your field.

Defining Management Zones

Management Zones are created as a way to define management practices to be carried out in a particular area of the field. This process uses a combination of the tools described earlier (harvest maps, vegetation maps, topography, etc.) to define the zones. Grid soil sampling can also be used but has proven to be expensive on large fields and may not accurately reflect the areas of variability. As a result, it may be better to define the zones and follow-up with soil sampling within those zones.

There is no correct number of zones; to be manageable, you may have as few as 2 or as many as 6. The key is to ensure zones are of similar productivity with similar attributes that are contributing to the productivity. Zones should be sized appropriately for the equipment that you are using for the field operations.

Once management zones have been defined, the next step is to conduct soil sampling in each management zone. These samples would be composites as in past years, but instead of a composite for the field, you now have a soil sample and accompanying soil test result for each management zone. From here, you and your service provider can then prepare application prescriptions for each management zone based on the objectives you had determined at the outset.



Source: B. McConkey et al

Testing Your Management Decisions

One of the important aspects of variable rate treatments is evaluating whether you are achieving your objectives. The most common way of doing this is to use a combine equipped with GPS and a properly calibrated yield monitor to get geo-referenced yields. More accurate measurements can be achieved with smaller equipment and weigh wagons if available.

The test is a comparison of the variable rate treatment to an average or constant rate that normally would have been used. Often this comparison has been done to a strip across the field or a split field comparison. This provides some information on the performance of your prescriptions, but may not provide the best information on the applications for each management zone.

The constant rate strip (or check strip) should cross all management zones defined in the plan. Alternatively, the field locations that get the constant rate (check strip) in each management zone could be written into the prescription. This approach allows for a comparison of the constant rate and the variable rate prescription in each management zone and determines if the desired response is reached in each management zone. This also provides very useful information for fine tuning the prescription in future years. The method described earlier may show a positive or negative response on a field or strip basis, but does not allow you to evaluate whether you have the appropriate prescription for each management zone.

Economic analysis should be part of testing your results. On the expense side of the budget, there will be the change in costs for inputs, but you should also include the cost of your service provider and possibly an amortized cost of specialized equipment that may be required to give you the capability to do variable rate treatments. The income side should reflect the changes in revenue resulting from the changes in application rates.

Working with Service Providers

Precision agriculture and variable rate treatments can be very complex and require a sophisticated understanding of agronomics and technology such as geographic information systems (GIS). A number of the tools discussed can be costly for individuals to acquire; therefore, working with service providers that have the appropriate skills and tools is recommended. There are a number of factors that you should consider when selecting a service provider:

- Do they have the required expertise, tools and time?
- What services will they provide – management zone development and prescriptions, trouble shooting, soil sampling, equipment synchronization?
- Data capture and storage – how you share the data with them, where is it stored and ease of access by you now and in the future, if you were to change service providers.

- Fees – what is included and how are they charged?
- Do you understand the methods and philosophies they use for management zone development?
- References from other producers.

Variable rate treatments have the potential to increase revenues, reduce costs and reduce potential for over application of nutrients. They are an important next step in achieving the 4R's of nutrient stewardship: right source at the right rate, right time and right place.

Further resources for Variable Rate Treatments can be found at:

www.ipni.net/ssmg - International Plant Nutrition Institute Site
Specific Management Guidelines

www.ag.ndsu.edu/pubs/soilfert.html - North Dakota State University Site
Specific Farming: What is Site Specific Farming
Site Specific Farming: Developing Zone Soil Sampling Maps Site
Specific Farming: Yield Mapping and Use of Yield Map Data Site
Specific Farming: Economics and the Environment

www.areca.ab.ca/projects/manuals.html - Agricultural Research and Extension Council of
Alberta Advanced Precision Farming and Variable Rate Technology – A Resource Guide

www.ext.colostate.edu/pubs/crops/00568.html - Colorado State University Field
EC Mapping: A New Tool to Make Better Decisions