Catalyst Project Report

Grower Information	
Grower Name:	Phillip Deguara
Entity Name:	J&F Deguara
Trial Farm No/Name:	MKY-3082A
Mill Area:	Mackay Sugar
Total Farm Area ha:	246
No. Years Farming:	15 years – 3rd generation
Trial Subdistrict:	Mackay – Sandy Creek
Area under Cane ha:	350

Aim:

Provision of low cost, automated Variable rate application maps

Background: (Rationale for why this might work)

A precision agricultural (PA) approach incorporating management zones and variable rate application (VRA) at an intra-block scale provides a potential pathway to refine N inputs according to the yield potential of defined zones. This approach would have a positive influence on water quality and on N use efficiency. However, despite significant advances in VRA technology the adoption of VRA programs at an intra-block scale has been restricted due to a number of knowledge gaps including access to site specific yield and soils data and the ability to interpret this data to produce relevant VRA maps. This trial aims to produce low cost VRA maps made available to growers in an automated or semi-automated system.

Potential Water Quality Benefit:

The application of variable rate nutrients that coincide with yield variability has shown to significantly improve Nitrogen Use Efficiency (NUE) without suffering yield decline. The improved NUE results in the plant taking up and storing Nitrogen (N) therefore reducing the amount of N that is in the soil which is subjected to loss pathways

Expected Outcome of Trial:

Improved water quality leaving the farm.

Service provider contact: Farmacist

Where did this idea come from: Grower/Farmacist

Plan - Project Activities	Date: (mth/year to be undertaken)	Activities :(breakdown of each activity for each stage)
Stage 1	October 2016	Prepare EC and yield variation maps Prepare data from site specific soil analysis data
Stage 2	November 2016	Ground truth maps and data and prepare function specification for software development
Stage 3	April 2017	Develop prototype methodology and software
Stage 4	August 2017	Trial Wi-fi enabled usb drive
Stage 5	June 2018	Review and modify software functional specifications to enable grid based VR maps to be produced within GSM
Stage 6	October 2018	Test the functionality of the grid based VR maps into selected controllers
Stage 7	November 2018	Modify functional specifications to allow grids to be rotated to the direction of the rows
Stage 8	April 2019	Test rotated VR grids in selected controllers
Stage 9	August 2019	Final test for all major rate controller types

Project Trial site details

Trial Crop:	NA
Variety: **Rat/Plt:**	NA
Trial Block **No/Name:**	NA
Trial Block Size Ha:	NA
Trial Block Position **(GPS):**	NA
Soil Type:	NA

Functional Specifications:

Variable Rate Nutrient Plans
- Interface box which allows 6 combinations of Products based on search parameters (P)
    - P1-Sample Data
        - Combined Values for any Element (add +1)
        - Enter min max range
    - P2- Crop Plan
        - Class- Multi tick box
        - Variety- Multi tick box
        - Action- Multi tick box
    - P3- Is this whole of Paddock or Spatial Intersect
        - Select predetermined spatial layer
            - EC soil boundaries
            - High and/or Low Yield Potential
- Display Results by colour in Map window and also show unselected paddocks
- Allow user to add (or Remove) individual polygons to any result window/combination
- Verify Results
- Next step is to display fertiliser product or custom blend selector
- No comments (that's for plant cane recs)
- Output
    - Combine all product selections into single KML as individual layers
    - KML must contain
        - Product
        - Rate
        - Total Volume per paddock
        - Total Volume per Product
    - Shape File generation for Applicator
        - Generate polygons based on Product
            - Export columns
                - Product
                - Rate (kg/ha or L/ha)
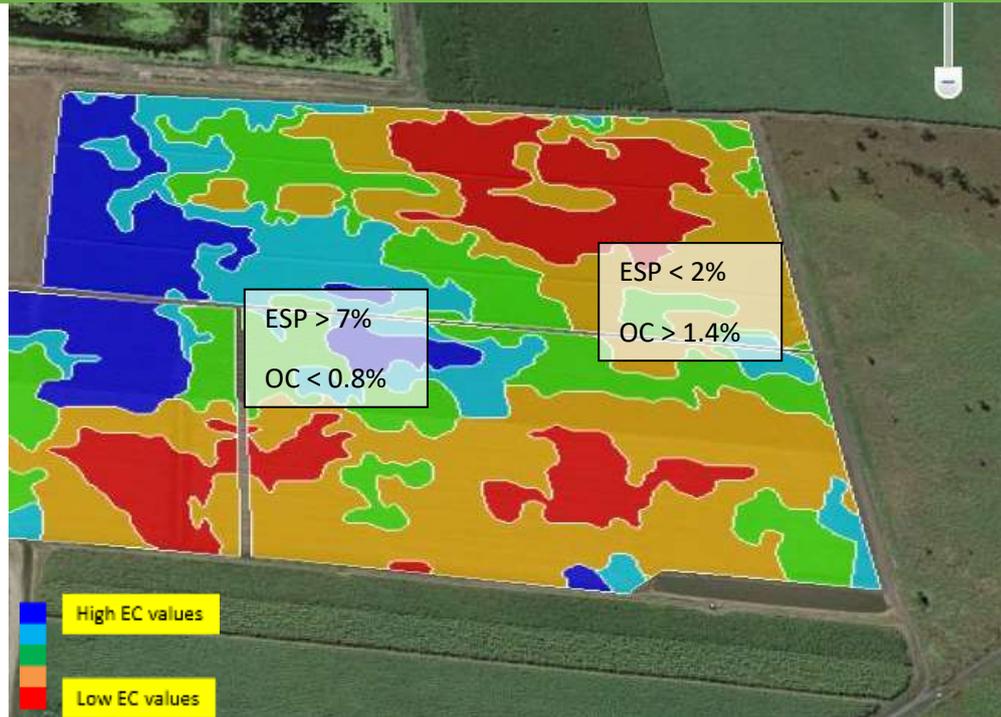   - Choose Directory to save

Treatments:
Not applicable

Results:

ESP < 2%

OC > 1.4%

ESP > 7%

OC < 0.8%

High EC values

Low EC values

Figure 1 EC Soil map

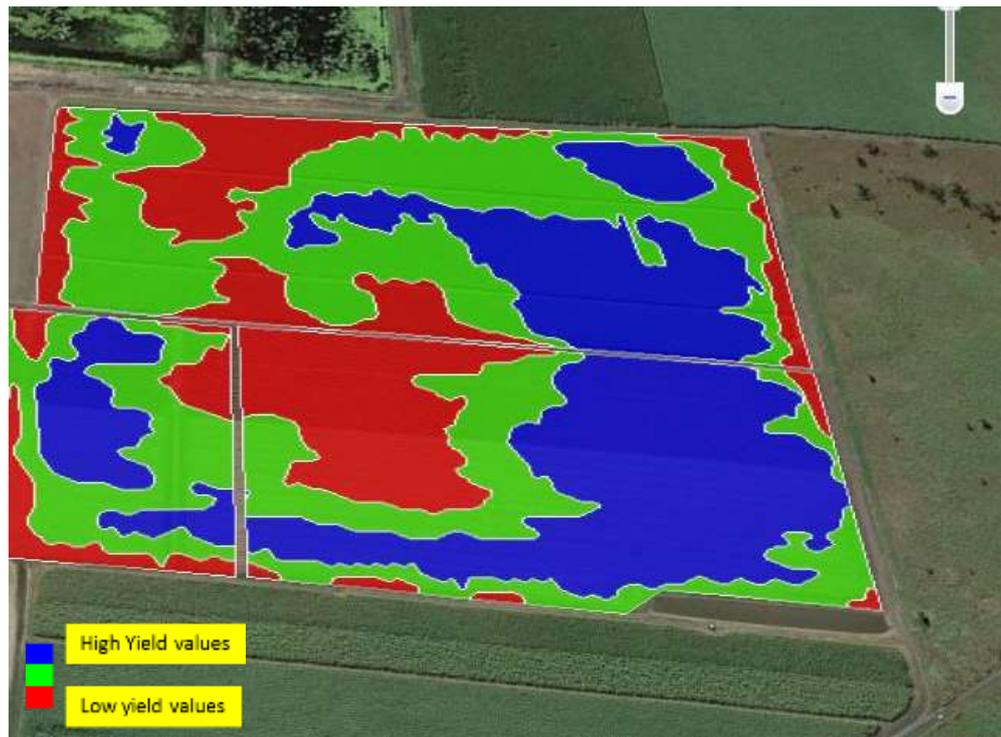High Yield values

Low yield values

Figure 2 - Yield variation map

EC maps (Figure 1) are not soil maps, however;

- They show a strong correlation to soil texture
- Identify locations of soil moisture constraints
- Identify locations of sodic soils as shown, areas of low EC values have low ESP and high OC whereas areas of high EC values have high ESP and low OC
- When used in conjunction with site specific soil analysis, they can be used as a surrogate for soil maps

Yield maps (Figure 2) have been developed from the analysis of satellite imagery since 2000

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- One year's data in isolation is not suitable for creating yield variation maps
- Need a minimum of 4 years, preferably 6 years' worth of analysis to be confident of yield trends
- Used in conjunction with EC maps and site-specific soil analysis to identify causes of yield variations
- Data from analysis is used to calculate block and zone yield potential

Output:

The original version of the VR Nutrient map was produced manually. The user had to manually convert the data from the yield or EC maps. The user then used MapInfo add-ons to convert the data into a file that could be edited, add the products required for each polygon of the converted data and manually convert the selected data into a grid. This operation even for a relatively small paddock as shown in Figure 3 took a skilled GIS user in excess of 1 hour to complete. The complex operations required meant the tasks could not be completed for users without the necessary GIS skills.
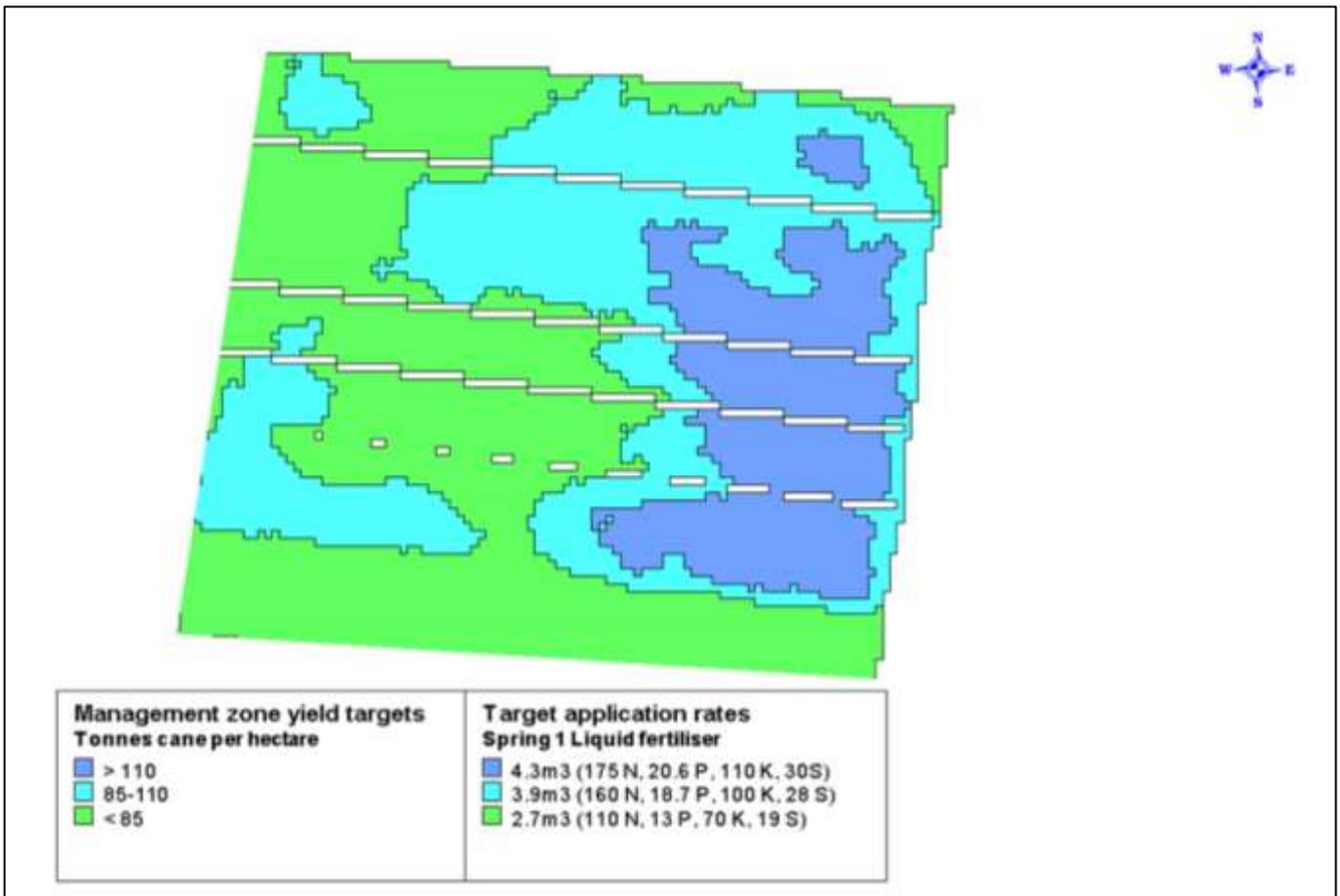

Management zone yield targets
Tonnes cane per hectare

- > 110
- 85-110
- < 85

Target application rates
Spring 1 Liquid fertiliser

- 4.3m3 (175 N, 20.6 P, 110 K, 30S)
- 3.9m3 (160 N, 18.7 P, 100 K, 28 S)
- 2.7m3 (110 N, 13 P, 70 K, 19 S)

Figure 3 - manually generated VR application map

Conclusions and comments

This trial has proven more problematic than originally anticipated. The original specification for this trial was to develop a process that would allow a user to transfer and receive the necessary data to produce VR application maps by using a wi-fi enabled usb device that would plug directly into the controller and seamlessly transfer data to and from the device to the user's smart phone via the wi-fi usb device. The data transfer would be controlled by a specialty App on the user's smart phone that would also communicate to a back-end storage and processing system. Task that have been completed to date include:

• Development of the back-end storage database and data processing functionality

• A wi-fi enabled usb device was sourced and trial communications to a smart phone has been established

• Functional specifications designed for the smart phone App.

However, data quality from some controllers on the tractor has caused some processing issues. Mostly, these revolve around lack ok key information being transferred, namely the name of products and the rate at which they have been applied. This information is being entered and stored by the on-board controllers but transferring of this information to outside parties is difficult to access without going through a user pays proprietary service. A solution for this issue continues to be investigated.

In 2018, significant progress has been made in delivering variable rate application maps using the Farmacist designed GSM software program. From this program, the user selects the site from either the EC map or the yield variation map. Once selected, the user chooses the number of production zones that needs to be created in the variable rate map and the selects the product and rate of application to be applied for each zone (Figure 4).
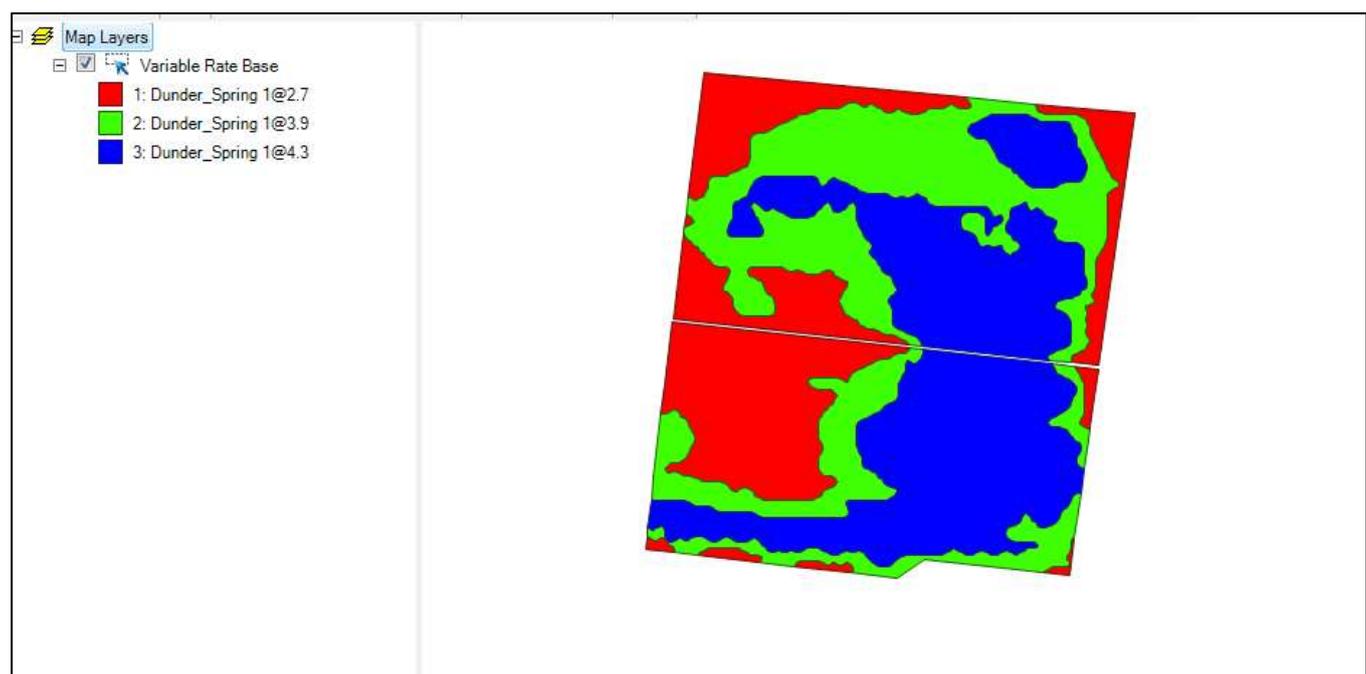

Figure 4 - Variable rate map (GSM shape file base map output)

To allow the importing of this map into a controller, the user selects a suitable grid size and saves this as a grid file to be loaded directly into the tractor controller (Figure 5).
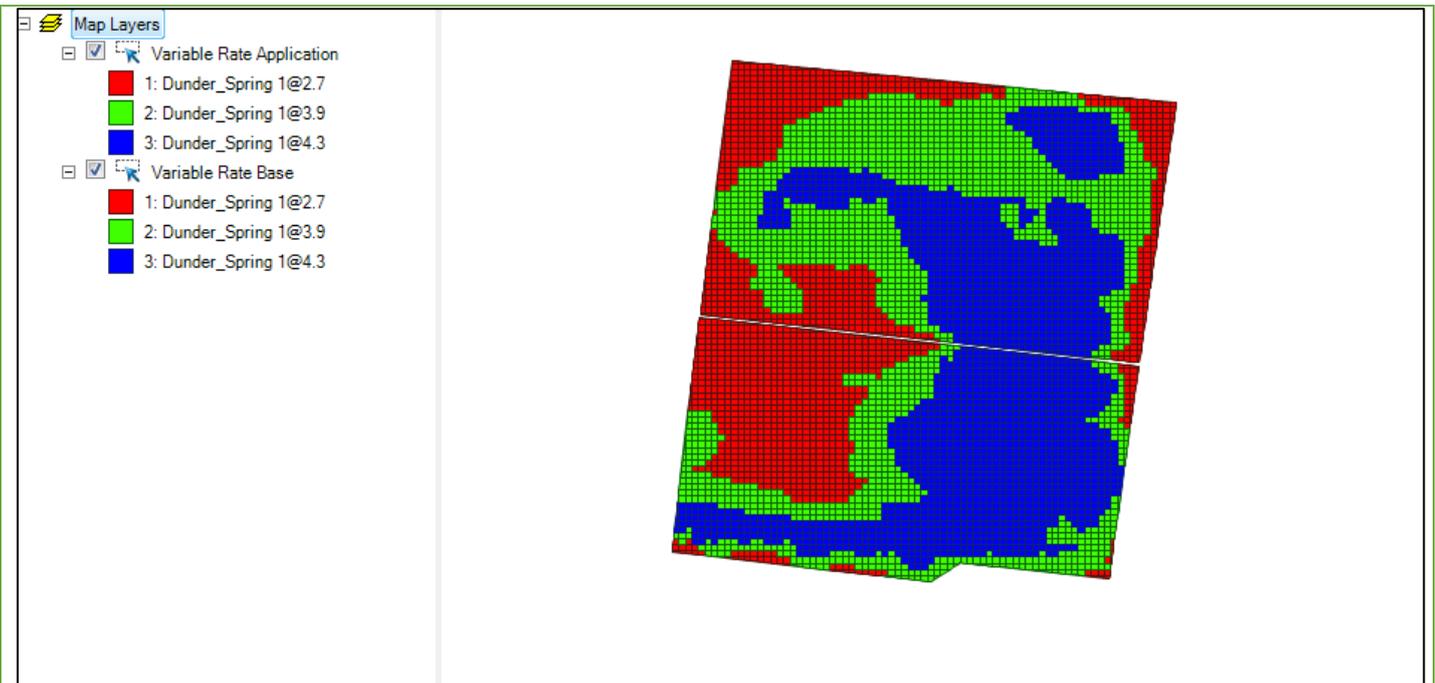
Figure 5 - Variable rate Grid output

The time taken to generate this map using low level GIS skilled operators can now be completed within 60 seconds. Upon completion the user saves the grid to be directly loaded into the tractor controller.

2019 Developments

The grid map shown in Figure 5 has the grid lines running directly North/South and as can be seen in the map, some of the grid lines do not match up with the edge of the paddock (This paddock actually runs in an East/West direction). This can create issues within the rate controller thereby causing inaccuracies in the product delivery, both positionally and with the volume. Changes to the functionality now allows the user to rotate the grid based upon the row direction of the chosen paddock.
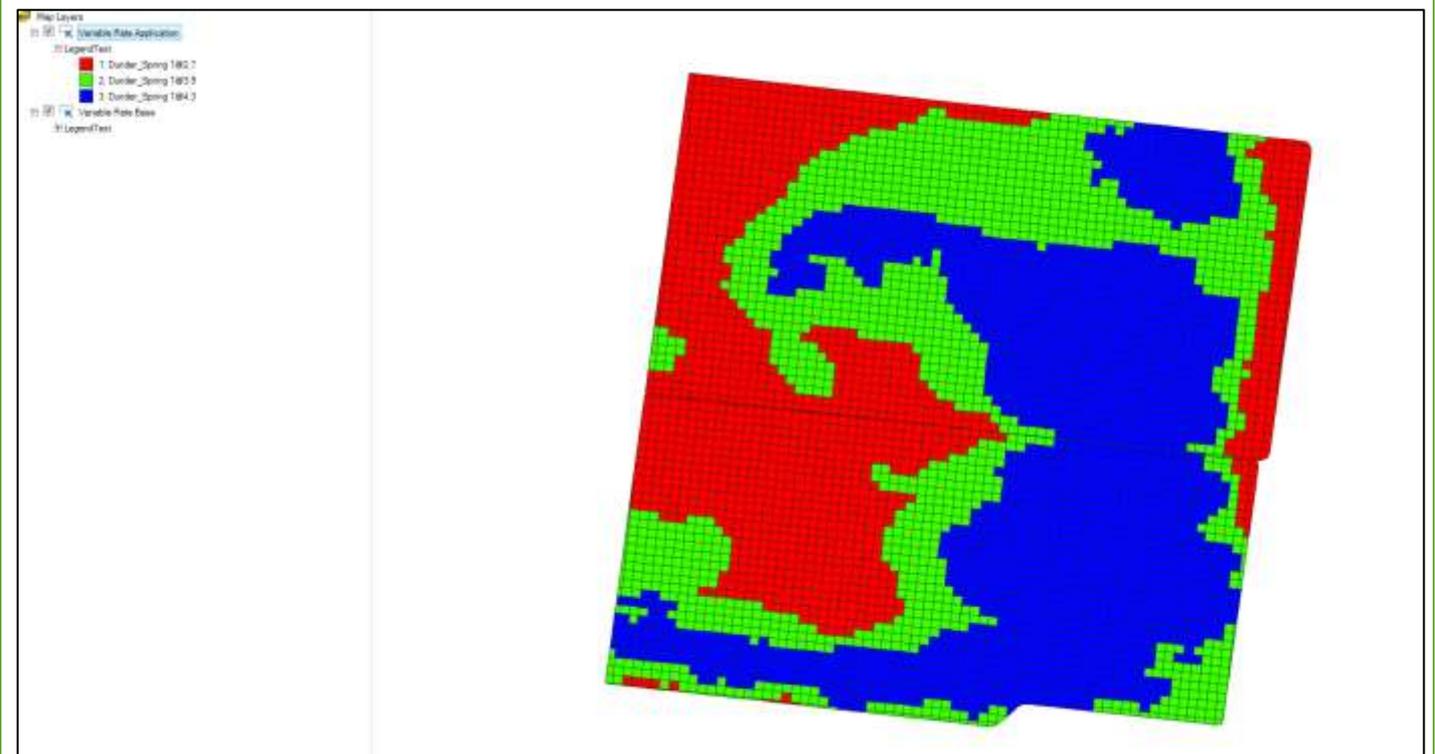

Figure 6 - Grid rotated to the row direction

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Advantages of this Practice Change:
Disadvantages of this Practice Change:
Will you be using this practice in the future:
% of farm you would be confident to use this practice:
Project is continuing 2019